THE POWER OF INDICES

A STUDY OF JOINERS AND LEAVERS TO THE MOST PROMINENT INDICES IN THE NORDICS AND BALTICS

LUKAS SANDELIN

EMILIA ÖSTERBERG

Bachelor Thesis
Stockholm School of Economics
2024

The Power of Indices: A Study of Joiners and Leavers to the Most Prominent Indices in the Nordics and the Baltics

Abstract:

This paper investigates the index effect in the Nordic and Baltic stock markets through an event study on the five major indices: OBX, OMXB10, OMXC20, OMXH25 and OMXS30, covering the period 1996 to 2024. We find positive (negative) abnormal returns for inclusions to (exclusions from) the indices , in line with prior findings. The index effect refers to the abnormal returns and trading volumes observed when stocks are added to or removed from an index. This phenomenon has gained renewed attention with the global shift from actively managed to passively managed funds, which has heightened the role of indices in investment strategies. Utilizing an event study methodology, this research provides evidence consistent with the index effect. The study contributes to the literature by offering a comprehensive analysis of less-explored Nordic and Baltic markets.

Keywords:

Index Effect, Event Study, Abnormal Returns, Abnormal Trading Volume

Authors:

Lukas Sandelin (25820)
Emilia Österberg (25809)

Tutors:

Marieke Bos, Associate Professor, Department of Finance

Examiner:

Ramin Baghai, Associate Professor, Department of Finance

Bachelor Thesis
Bachelor Program in Business and Economics
Stockholm School of Economics

1 Introduction

Passive investing, where investors buy index-based strategies instead of individual stocks, has increased in popularity, and thereafter also size. In February this year, Morningstar reports for the first time that passively managed funds in the U.S. controlled more assets than their actively managed competitors (Morningstar, 2024). A similar trend is evident in the Nordics where the share of passively managed funds in the Swedish fund market has surged from 6% in 2010 to 22% in 2023. This growth shows no signs of losing momentum, as inflows to index funds are nearly 100 times higher than those to actively managed funds, highlighting a strong and sustained preference for passive investing (Fondbolagens Förening, 2024). The underlying driver is partly explained by increased awareness of the difficulties in consistently outperforming the market (Fama and French, 2010). Prior research has primarily focused on the index effect of the S&P 500 list. To our knowledge, we are the first to systematically study the effects on individual stock performance, when a stock is added to or removed from a prominent index in the Nordic and Baltic markets.

Through the research question, this report aims to investigate the effects on performance of joining and leaving prominent indices in the Nordics and the Baltics. Shleifer (1986) documented this effect, and found that as index fund ownership grew, researchers observed that stocks tend to exhibit positive (negative) abnormal returns after being added to (removed from) an index. This phenomenon, known as the *index effect*, has since been extensively studied by scholars. By employing a similar methodology as Beneish and Whaley (1996) and Chen, Noronha and Singal (2004), we aim to quantify whether there is any abnormal trading volume or returns associated with reconstitution events. For our analysis, we use a dataset of index reconstitutions, daily stocks prices and trading volume in the selected markets spanning from the inception date of each index to the present day. By comparing actual returns with expected returns, we examine whether any abnormal returns are present.

Due to the limited prior research on this topic in these regions, this study focuses exclusively on the Nordic and Baltic markets. The constitutional criteria for the indices we study in these markets differ from those in other financial markets studied previously, such as the S&P 500. The OMX indices, maintained by Nasdaq for each of these markets, take a simpler approach compared to S&P 500. For the S&P 500, inclusion requirements are based on a combination of market capitalization, financial viability[1] and liquidity[2]. Additionally, committee discretion is applied to maintain sector balance and ensure representativeness of the U.S. stock market. In contrast, the OMX and OBX indices rely primarily on publicly available data, particularly aggregate turnover over six months, starting seven months before the reconstitution date. This distinction highlights a key difference between the S&P 500 studied previously which is partly based on non-public information, whereas the OMX indices are solely based on publicly transparent data.

The contribution of this paper is to enhance knowledge of the Nordic financial markets, delivering valuable insights into a market with different dynamics than previous studies that can benefit investors, policymakers, and other market stakeholders. This paper also contributes to previous research by applying a larger sample and looking at a

[1] Measured by positive GAAP earnings.

[2] Requiring a minimum float-adjusted market capitalization of $18 billion for new additions.

more recent timeframe for which passive investing has grown considerably in market share. The rationale for including both the Nordics and the Baltics is that they share several characteristics, including market dynamics, political connections, corporate ties, and trade relationships.

We hypothesize that firms joining an index will experience positive abnormal returns, while those leaving an index will experience a negative abnormal return, albeit at a lower magnitude. If our predicted result finds that stocks experience a positive abnormal return upon inclusion to an index and a negative abnormal return upon exclusion, this suggests that the index reconstitution was not priced in among investors. Alternatively, it suggests that the reconstitutions were not a non-information event. Given the methodology of the observed indices, which allows for predictability in their reconstitution, any abnormal returns surrounding index changes could suggest inefficiencies in the market and challenge the validity of the strong-form efficient market hypothesis. If observed, this would contradict the financial theory suggesting that demand curves for stocks are infinitely elastic, since the price at any point in time is assumed to reflect all available information about the stock (Fama, 1970).

Our predicated outcome is derived from empirical evidence on asymmetrical price effects. Chen et al. (2004) demonstrate that companies added to the S&P 500 list experience abnormal returns while stocks being removed show no or a small negative effect. Shleifer (1986) and Ben-Rephael, Kandel and Wohl (2011) provide explanations about price pressure on newly added stocks, arising from an increased demand driven by institutional investors like index funds being forced to rebalance their portfolios as a response to the index reconstitution. Further, Denis, McConnell, Ovtchinnikov and Yu (2003) discuss in their study whether the abnormal performance for newly added stocks to the S&P 500 list is because of the higher attention and expectations of performance or if the index inclusion itself supports greater performance. Additionally, they argue that index reconstitutions thereafter might not be a non-informational event, but a type of signaling of higher quality.

Ideally, to investigate the effects of stocks being added to or removed from the observed indices, the inclusions and exclusion should exhibit truly quasi-randomness as this would allow for isolating causal relationships between the index reconstitution and any observed abnormal returns. The methodology for the index composition is influenced by external, often unpredictable, market dynamics, which introduce variability into the outcomes. These factors might make the process appear quasi-random at times, particularly for securities near the eligibility thresholds. However, the structured rules ensure that the overall process remains systematic and predictable to a significant degree. For example, newly added stocks with high turnover may already exhibit positive abnormal returns before being added to an index, making it harder to attribute the effect to index inclusion.

The methodology for the OMX indices basing the constituents on publicly available information on turnover makes the changes to these predictable. The risk of not accounting for the predictability is underestimating expected returns and consequently overstating the abnormal returns. By aligning our estimation window with the reconstitution window of the indices, the CAPM coefficients should capture any speculation and minimize the risk of overstating the abnormal return.

Since different indices serve as a ranking mechanism for the most actively traded entities in each market, their inclusion or exclusion is not determined solely by individual merits. This introduces a potential risk of endogeneity, as it may lead to estimates that fail to accurately capture the true relationship between the independent and dependent variables. We account for this in two ways. First, we include the traded volumes around the reconstitutions in our study and compare it to the 30-day prior the announcement average. By comparing each stock's traded volumes with its own historical levels, this can to some extent explain the individual performance. This is described further in the appendix under section A.1. Second, we tested the robustness of our findings through the Placebo Permutation test in order to assess the randomness of our findings. The Permutation Test showed that our main findings are robust and are not attributed to randomness in the data.

We have two main sets of findings. First, the result of this study shows that stocks added to a prominent index experience abnormally high trading volume and return. Consistent with the price pressure hypothesis, this study shows that the excess trading volumes can be interpreted as an increased demand leading to a price increase. Moreover, stocks removed from the index experience small to no effect on their performance. Our result, together with previous research, provides us with the insight that index reconstitutions events have similar effects on several different stock markets with different market structures, practicalities and investors.

This paper proceeds as follows: section 2 describes the fundamental concepts. Section 3 outlines the theoretical framework on which our study is based on. Section 4 details the data and methodology used to examine our research question. Section 5 develops and tests our hypotheses, along with presenting our empirical findings. Section 6 evaluates the robustness of our model. Finally, section 7 provides our concluding remarks.

2 Fundamental Concepts

2.1 Efficient Markets Hypothesis

The Efficient Market Hypothesis (EMH) is a foundational financial theory proposing that financial markets are efficient, meaning that asset prices fully incorporate all available information at any given moment (Fama, 1970). Consequently, consistently achieving returns above the market average through strategies such as stock-picking or market timing is deemed impossible, except by chance or by assuming greater risk. EMH offers a framework for understanding investment strategies, market behavior, and the challenges of consistently outperforming the market. It suggests that earning abnormal risk-adjusted returns is unlikely, as price movements are driven by new and inherently unpredictable information. As a result, the hypothesis indicates that actively managed funds are unlikely to consistently outperform passive funds after accounting for fees and expenses. The EMH is divided in three forms, weak-form[3], semi-strong[4] form and strong-form[5], all distinguished by the degree of information available.

2.2 Liquidity and Illiquidity

The liquidity hypothesis persists that investors demand higher returns for investing in illiquid stocks (Beneish and Gardner, 1995). In the context of stocks, liquidity and

[3] Only historical information is accounted for.
[4] Publicly available is also accounted for.
[5] All information is accounted for, including insider information.

illiquidity refer to how easily a stock can be bought or sold in the market without significantly affecting its price. Liquidity in stocks means there is a high level of trading activity, making it easy to buy or sell shares quickly without causing a substantial impact on the stock's price. Liquidity as measured by the size of the bid-ask spread[6] has an inverse relationship to the bid-ask spread, meaning that liquid (illiquid) stocks exhibit smaller (larger) spreads. The larger spread on illiquid stocks implies increased transaction costs, meaning you may pay a premium to buy or sell immediately and vice versa for more liquid stocks.

3 Theoretical Framework

Finance scholars have extensively examined the index effect, where stock returns are impacted by inclusion in or exclusion from specific indices, with a primary focus on the S&P 500 due to its significant prominence and attention. Newly included firms often experience significant positive abnormal returns, sparking investor interest and profitable strategies (Chen et al., 2004; Beneish and Whaley, 1996). The theoretical framework provides a foundation for examining index reconstitution effects on performance and trading volumes, however there are different views regarding the persistence and causes of these price effects. While early studies linked this phenomenon to market inefficiency, evolving research such as those presented below have introduced alternative explanations. Consequently, it is ambiguous whether the index effect violates the efficient market hypothesis or represents an informative event.

Our study is most closely related to Shleifer (1986), Beneish and Whaley (1996) and Chen et al. (2004). Early research noted that prior to 1976, index inclusions or exclusions did not lead to abnormal returns. However, as passive fund ownership of the S&P 500 grew, abnormal returns for the firms included also began to rise, suggesting a correlation between the two (Shleifer, 1986). This relationship underpins the concept of *the index effect*, with Shleifer's research indicating that the magnitude of abnormal returns from index changes is positively associated with the level of index ownership by passive investment vehicles. This is because passive index funds aim to replicate the performance of specific indices and must rebalance their portfolios in response to index revision to minimize tracking errors.

According to Scholes (1972), demand curves for stocks are perfectly elastic, implying that stock prices fully reflect all available information and that changes in demand should not influence prices. However, Shleifer (1986) provided evidence supporting *the downward sloping demand curve hypothesis*, which argues that stock prices are influenced by demand because investors view stocks as unique and imperfect substitutes. Shleifer's study showed a positive relationship between rising stock prices and shifts in demand curves in contexts where no additional information was assumed from inclusion events. In contrast, stock prices decline when a stock is excluded from the index. Notably, these price changes were *persistent*, indicating that short-term arbitrage does not fully correct the demand-driven price adjustments.

Building on this, Chen et al. (2004) presents the *price pressure theory* that claims that stock prices can *temporarily* deviate from their fundamental values due to shifts in

[6] The bid-ask spread refers to the difference between the price at which a buyer is willing to purchase an asset (the bid price) and the price at which a seller is willing to sell that asset (the ask price). It is an important concept in financial markets, as it represents the transaction cost of trading an asset.

supply and demand, even when there is no new fundamental information. We employ a similar model as Chen et al. (2004) to examine if our study finds evidence of the price pressure hypothesis.

Another key framework is the *Information Signaling Theory.* Spence (1973) suggests that actions or events can directly or indirectly signal relevant information to others, influencing their decision. Applied to index compositions, the information signaling theory suggests that inclusion in a major index signals improved quality or reduced risk, which may lower the risk premium for the stock, leading to price increases. Consequently, exclusion may signal higher risk, resulting in price declines. Denis et al. (2003) and Shleifer (1986) argued that while index reconstitutions are often considered as non-informational events, they might carry implicit signals. Their findings indicate that inclusion in the S&P 500 is associated with increased investor expectations of future earnings and actual improvements in earnings relative to comparable companies.

The liquidity hypothesis posits that investors consider transaction costs when buying stocks, which leads them to demand a liquidity premium for holding illiquid stocks, leading to lower prices for such stocks. Applied to indices, this hypothesis suggests that stocks included in an index experience a positive market reaction as measured by reduced bid-ask spreads, while exclusions see the opposite effect. Amihud and Mendelson (1986) found that liquidity characteristics, such as trading volume, shareholder numbers, market maker activity and price continuity, are negatively correlated with bid-ask spreads, and expected asset returns increase with these spreads. Erwin and Miller (1998) observed a significant reduction in bid-ask spreads for stocks added to the S&P 500, which was accompanied by sustained increases in share price and trading volume.

Hegde and McDermott (2003) extended these findings by showing that stocks added to the S&P 500 exhibit a persistent increase in liquidity, primarily due to decreased transaction costs and a reduction in asymmetric information. They documented that increased liquidity, often measured by reduced bid-ask spreads, correlates with positive abnormal returns for included stocks, while excluded stocks face decreased liquidity and negative abnormal returns. However, only a portion of these abnormal returns could be directly attributed to changes in liquidity.

Additionally, Hegde and McDermott's study, consistent with earlier research by Shleifer (1986) and Chen et al. (2004), found that index inclusions attract greater attention from analysts and institutional investors, leading to increased trading volume and public information flow. Applying the liquidity hypothesis to this context implies that an index inclusion and the heightened visibility should lead to a permanent increase in trading volume with a decreased bid-ask spread.

Building on these insights, *the investor awareness hypothesis* suggests that firms included in an index gain heightened visibility among investors. Chen et al. (2004) and Denis et al. (2003) documented asymmetric responses and described two main mechanisms driving abnormal returns. First, greater visibility raises expectations, motivating firms to improve efficiency. Second, index membership, like the S&P 500, attracts capital and boosts growth, while reduced information asymmetry lowers bid-ask spreads and improves market access. Deletions have minimal negative effects, as excluded firms retain some benefits and since it is challenging for investors to unlearn information about a firm, explaining weaker impacts of exclusions.

Mase (2007), however, challenged the investor awareness hypothesis, arguing that it primarily applies to first-time inclusions or exclusions rather than repeated changes to index composition. His research on the FTSE100 index suggested that the hypothesis might be less relevant for indices where firms frequently cycle in and out. He posited that firms in the S&P 500 might be more affected by changes in awareness due to differences in index composition and investor behavior

Recent studies have observed that most abnormal returns occur between the announcement day and the opening of the market on the following day (Kappou, Brooks and Ward, 2010; Kim, Li, and Perry, 2017). Kim et al. (2017) findings indicate that stock prices are adjusting more quickly than reported in earlier studies, limiting opportunities for profitable trading based on index inclusions or exclusions. However, Kim et al. (2017) also found evidence of price reversion following the initial spike, suggesting that market participants may initially overreact to the announcement.

Our contribution to previous research is trifold. First, this paper examines a more recent timeframe during which passive investing strategies have grown considerably in market share. Second, we examine the Nordic and the Baltics markets, which have not been previously studied. Following this, our paper enhances knowledge of these financial markets, delivering valuable insights that can benefit investors, policymakers, and other market stakeholders in a market first with different dynamics to those studied previously. Thirdly, a larger sample is studied as compared to most previous work.

In summary, related work has provided valuable insights into the index effect through five main concepts: the Downward Sloping Demand Curve Hypothesis, the Price Pressure Hypothesis, the Information Signaling Theory, the Liquidity Hypothesis, and the Investor Awareness Hypothesis. The composition criteria for the indices examined in this study rely on publicly available information, such as trading volume. Unlike the S&P 500, the Nordic indices studied in this paper should not imply any expectations regarding a firm's continued operation. Consequently, announcements of inclusion or exclusion from these indices should not convey new information to market participants. This implies that some hypotheses from related work may have limited applicability in this context.

4 Data and Methodology

Previous literature provides guidance for our methodology. This section outlines the methodology and the key characteristics of our dataset. We present the initial sample, describe our data processing steps and explain the methodology used in our analysis.

4.1 Index Description

As the objective of this study is to measure the effects on individual stocks' performance upon inclusion to and exclusion from an index limited to the Nordic and the Baltic markets, we identified the most prominent indices in Denmark, Finland, Norway, Sweden and the Baltics. The rationale behind including the Baltics, although it is not an official part of the Nordics, lies in the alignment of market practices, extensive financial integration, and strong economic ties between the Baltics and the Nordic countries. The selected indices are frequently cited in the media to evaluate the state of the stock market, making them influential. Consequently, these prominent indices attract consistent attention from investors, with many funds tracking their performance. Table 1 provides an overview of the selected indices in this study.

Table 1
Index Overview

This table provides an overview of the most prominent indices in the Nordics and the Baltics. The indices are reviewed semiannually and represent the most actively traded stocks. The reconstitution is based on data from seven to one month prior to the effective date.

Ticker	Area	Components	Currency	Reconstitutions	Weight
OBX	Norway	25	NOK	March/September	Market Cap
OMXB10	Baltics	10	EUR	January/July	Market Cap
OMXC20	Denmark	20	DKK	June/December	Market Cap
OMXH25	Finland	25	EUR	February/August	Market Cap
OMXS30	Sweden	30	SEK	January/July	Market Cap

4.2 Data Collection and Processing

The data on index compositions was extracted through Stockholm School of Economics' access to the Refinitiv Eikon data hub (Datastream, 2024), providing detailed information on historical index compositions and dates for each stock's inclusion or exclusion from the index. Additionally, through Eikon and Datastream, we obtained datasets on the daily trading volume and closing price for each affected security. This database is commonly used in both industry and academia and the stock prices used are adjusted for splits and other events. The joiner and leaver data from the Eikon database included only the effective dates of each stock's inclusion or exclusion in the index. However, the announcement date, when market demand typically starts to shift, is of greater interest. The announcement date is at least 5 trading days before the effective date for all indices, except for the OBX Index, where the announcement occurs on the trading day before the effective date.

We filtered the data and excluded irregular events, including but not limited to name changes, merger and acquisition activities, and bankruptcies, to ensure the dataset's relevance to the purpose of this study. To be included in the final dataset, observations needed at least 180 trading days of available data before the event date and 90 days after it. Including observations that did not meet these criteria would result in an insufficient time series and inaccurate estimations. For some observations, the inclusion date was the same as the stock's first trading day, likely reflecting the effects of simultaneous events, such as spin-offs. This makes it challenging to attribute changes solely to index inclusion. Some stocks are added to indices due to mergers or acquisitions, while others leave for the same reasons. For example, Swedish Match left the OMXS30 index in 2022 following its acquisition by Philip Morris, and Astra was excluded in 1999, only to be reintroduced as AstraZeneca after its merger with the British firm Zeneca.

Our data covers the period 1996 to 2024 and the initial sample includes a total of 825 observations of leavers and joiners across all observed indices. Table 2 provides an overview of both our initial and final sample.

Table 2
Number of Observations

This table presents the initial sample and outlines the process leading to the final sample. We excluded irregular events involving, but not limited to, name changes, M&A activity and bankruptcy. Since these events do not represent typical reconstitutions, they were excluded from the sample to ensure the relevance of the dataset to this research. The first stocks to be included in the index at inception have been incorporated into the final data set. This explains the disparity between the number of joiners and leavers overweighting joiners as these initially populated the indices. The data screening process reduced the sample from 825 observation to 582 whereas the number of joiners reduced from 436 to 350 and leavers from 389 to 232. Since irregular events are considered abnormal, removing them from the dataset will not result in a loss of information or accuracy, instead, it is likely to enhance both.

Data	Initial sample	Irregular events	Final sample
OBX	271	95	176
Joiners | Leavers	*136 | 135*	*32 | 63*	*104 | 72*
OMXB10	84	25	59
Joiners | Leavers	*39 | 45*	*5 | 20*	*34 | 25*
OMXC20	158	33	125
Joiners | Leavers	*82 | 76*	*11 | 22*	*71 | 54*
OMXH25	197	56	141
Joiners | Leavers	*107 | 90*	*26 | 30*	*81 | 60*
OMXS30	115	34	81
Joiners | Leavers	*72 | 43*	*12 | 22*	*60 | 21*
Summary	825	243	582
	436 | 389	*86 | 157*	*350 | 232*

The dataset for each index begins with the earliest available data for the respective index, in other words, the date when the index was established. The dataset ends with the most recent reconstitution event as of October 2024, when the data was extracted. Table 3 provides an overview of the time frames for the selected indices.

Table 3
Time Frame for Observations

This table provides an overview of the earliest observed dates and the latest observed dates for additions and deletions to each index. The data sample for each index begins with the first day of trading and ends with the last observed reconstitution event for the respective index.

Index	Earliest observed date	Latest observed date
OBX	1996-06-03	2024-09-23
OMXB10	2006-12-04	2023-06-17
OMXC20	1997-04-23	2024-01-31
OMXH25	1996-08-01	2024-08-01
OMXS30	1996-06-24	2023-01-02

4.3 Justification for Selected Time Periods

Throughout the period examined in our study, major crises and events have influenced the financial markets. To account for their impacts, we divided our data sample into three time periods, defined by key historical events that characterize each interval. Table 4 provides an overview of the selected time periods.

As Hoffman, Post & Pennings (2013) describes, investor behavior changed following the financial crisis of 2008-2009. They found that investors' risk perceptions increased, while return expectations and risk tolerance decreased. Towards the end of the crisis, return expectations, risk tolerance, and risk perceptions began to recover. They demonstrated that investment strategies and risk perceptions are time-varying and significantly related to risk-taking behavior, which, in turn, moves in parallel with market risks. Based on this, we argue that these changes in investor behavior may impact inflows to index funds. Consequently, since the investor behavior changed, our first time period ends the year before the financial crisis to isolate a potential effect in one period.

In recent years, the market experienced a Covid-19 pandemic starting in 2020, followed by the war in Ukraine, which began in 2022, and the conflict in Gaza, which started in 2023. The study by Hoffman et al. (2013) provides a framework for understanding ongoing changes in investor behavior during these periods. Since their findings show that investors' risk-taking behavior is influenced by market risks, it may imply that during times of crisis, investors' risk perceptions have increased. Our third and final time period starts with the beginning of the Covid-19 pandemic in 2020 and ends with the last observed date of our dataset.

Another rationale for the selected time periods is that uncertainty is higher in abnormal environments, such as during crises. This heightened uncertainty makes it more difficult to estimate expected returns, leading to less precise estimations. Consequently, the abnormal returns from such uncertain periods may provide less guidance. Following this, we will test whether the results deviate when the data is segmented into different subperiods.

Table 4

Time Frame for Subperiods

As mentioned in the section above, our data sample is divided into three subperiods based on two major events: the financial crisis in 2008 and Covid-19 in 2020. This table outlines the subperiods as follows: from the first observed date to 2008, from 2009 to 2019, and finally from 2020 to the last observed date for respective index. Each time frame begins on the first trading day of the first year and ends on the last trading day of the final year within the respective subperiod.

Index	Time Frame 1	Time Frame 2	Time Frame 3
OBX	1996 to 2007	2008 to 2019	2020 to 2024
OMXB10	2006 to 2007	2008 to 2019	2020 to 2023
OMXC20	1997 to 2007	2008 to 2019	2020 to 2024
OMXH25	1996 to 2007	2008 to 2019	2020 to 2024
OMXS30	1996 to 2007	2008 to 2019	2020 to 2023

4.4 Our Data Sample in Comparison to Related Work

The data sample in this study differs from the previous literature in three key aspects. First, it focuses on a different geographical area and thereafter different prominent indices than those examined in previous research. Second, our final data sample, consisting of 570 observations, exceeds both the median and average sample size used in prior studies. Finally, the indices selected for this study contain fewer components and represent less total market capitalization compared to those analyzed in related studies. While this will not affect our quantified estimations of the index effect, the underlying drivers, such as investor awareness and the price pressure hypothesis, may provide limited guidance. Table 5 provides an overview of the key characteristics of the samples from previous studies.

Table 5

Comparison to Related Work

This table presents an overview of the selected previous research that provides guidance to our study. As presented in table 2, our final data sample of 582 observations are larger than the median and average of the final data sets for the previous literature.

Research	Index studied	Time period	Total Number of Observations
Beneish & Whaley (1996)	S&P 500	1986 to 1994	103
Chen et al. (2004)	S&P 500	1962 to 2000	995
Mase (2007)	FTSE 100	1992 to 2005	132
Shleifer (1986)	S&P 500	1966 to 1983	297
Our sample	OBX and OMX B10, C20, H25, S30	1996 to 2024	582

Event Study

We use an event study methodology as described by MacKinlay (1997) and Chen et al. (2004) to investigate the price and volume effects of index reconstitution and define an event as an index inclusion or exclusion. We do this to capture abnormal returns, specifically tied to index changes rather than other market factors. We separate the data for the inclusions from the exclusions, creating two datasets. When conducting an event study, two key aspects must be considered, the estimation window and event window. The event date refers to the effective date of the index reconstitution, which must be clearly defined. The event window represents the time frame during which the impact of the event is analyzed. The estimation window is the period used to calculate parameter estimates, which are then applied to compute the normal returns. For indices maintained by Nasdaq, the announcement date (AD) occurs at least five trading days before the effective date (ED), whereas for the OBX index, changes are announced on the first trading day before the ED (Nasdaq, 2024). Table 6 provides an overview of how important events and dates are labelled in our study.

Table 6
Clarification of Labels

In an event study, it is of interest to examine the effect within the set event window. This table provides clarification of how the different intervals are labelled in the results. The announcement date is typically 5 trading days before the effective date for all indices, except for the OBX index, where the announcement occurs on the trading day immediately preceding the effective date. One trading day is defined as *t*.

Dates	Label
Days (*t*) Before the Announcement Date	AD - *t*
Announcement Date	AD
Days (*t*) After AD but Before ED	AD + *t*
Days (*t*) Before the Announcement Date	ED - *t*
Effective Date	ED
Days (*t*) After Effective Date	ED + *t*

4.5 Estimation Window

The estimation window is the period during which the parameters of our application of the Capital Asset Pricing Model (CAPM) are estimated. In line with MacKinlay (1997), this study employs a type of market model to approximate the stock's normal return over the event window. MacKinlay (1997), further suggests that daily closing prices for 120 trading days, approximately six months, are sufficient for estimating the parameters. Based on this guidance, we define our estimation window as [-143, -21] in trading days relative to the ED which is approximately the six months prior to the event window, as shown in Figure 1. Following guidance from MacKinlay (1997), the estimation window should be near the event window since this approach better reflects the current levels of the firm and provides more accurate estimates for the future, as near-term estimations carry less uncertainty compared to long-term outlooks. To avoid overlapping and reduce the risk of the event influencing the parameters, we keep the estimation window, and the event window separate but adjacent.

The six months leading up to the event window align with Nasdaq's evaluation period for determining the upcoming reconstitution of the index. For stocks newly added or removed, this period may partially reflect abnormal activity compared to their historical levels. Added stocks typically exhibit higher trading volumes and meet criteria they had previously failed to satisfy, while removed stocks show decreased volumes, reflecting their exclusion. Since the indices are determined through a ranking system, these reconstitution events could also result from shifts in the performance of competing stocks. To assess whether a stock's inclusion or exclusion is based on its individual merits, we compare its performance (trading volume and returns) during the period when it failed to meet the inclusion criteria with the evaluation period when it did. This analysis is detailed in Figure A.1 in the Appendix.

4.6 Event Window

The event window is defined as the period spanning 20 trading days prior to the effective date (ED) to 60 trading days following the ED. This is in line with previous research who investigate similar effects on the S&P 500, KFX and FTSE100 indices

(Beneish and Whaley, 1996; Bechmann, 2002; Chen et al., 2004; Mase, 2007). This time frame is designed to capture both short-term and long-term effects of index reconstitution on stock prices. The 20 trading days before the announcement date allow for the inclusion of potential early trading activity by investors anticipating changes in the index composition prior to the official announcement. The 20 trading days preceding the event are considered sufficient to capture both the initial announcement and any early trading activity by investors who anticipated the index changes before the official announcement.

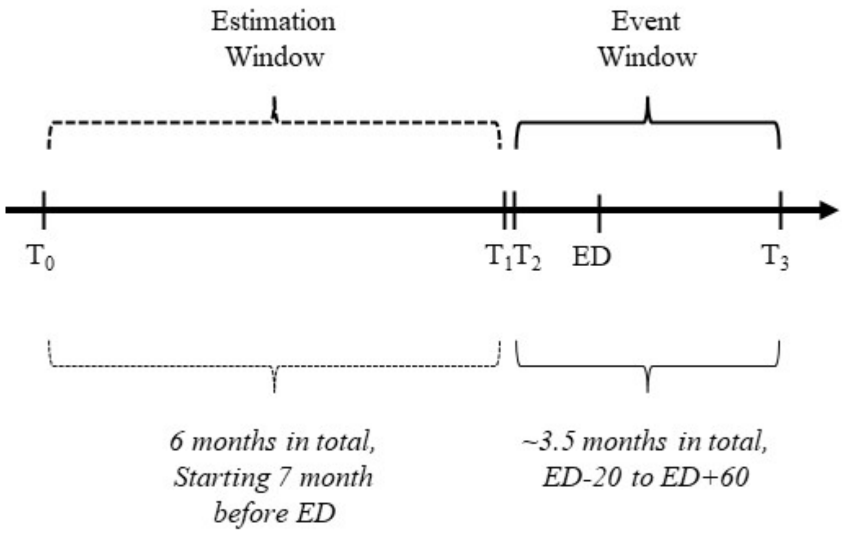
Chen et al. (2004), suggests that stock prices may revert after the event, and extending the post-event window provides an opportunity to examine whether the observed price effects are temporary or permanent. Beneish and Whaley (1996) found decreasing significance of the effects of stock index inclusion up to 60 days post the ED. Their results were still statistically significant at the 5% level 60 days post ED. Extending the event window to 60 days post ED allows for testing if any eventual effects persist over a longer term or capturing delayed market reactions that shorter windows might miss. This approach enables a comprehensive analysis of the dynamics surrounding index reconstitution, capturing investor behavior surrounding the announcement, immediate market reactions to the effective date, and longer-term price adjustments after the event.

The announcement date (AD) varies across indices. For the OBX10, OMX20, OMXH25 and OMXS30 indices, reconstitution decisions are announced five trading days before the effective date. In contrast, for the OBX index, the announcement is made just one trading day prior to the effective date.

The effective date (ED) is the date when the changes to the index officially take effect, either through the inclusion or exclusion of stocks. For the OMX Copenhagen 20 index, the effective date occurs on the nearest trading day after the third Friday in December and June. The OMX Helsinki 25 index implements changes on the nearest trading day following the last trading day of January and July. For the OMX Stockholm 30 index, reconstitution takes effect on the nearest trading day after the last trading day of June and December.

Figure 1
Estimation Window and Event Window

This figure provides an overview of the selected estimation window and event window. The expected returns are estimated using data from the estimation window, spanning from T_0 to T_1 in the figure. The estimation window spans a total of six calendar months, beginning seven months prior to the effective date and ending one month (~22 trading days) prior ED. The event window covers the period from 20 trading days before the effective date to 60 trading days after the effective date, noted T_2 and T_3 in the figure. The event window is in total 81 trading days, which is approximately three and a half months. The two windows are adjacent to each other but do not overlap to separate potential spill-over effects.



4.7 Estimating Expected Return

Our analysis uses an estimation window of six months that ends before the event window to estimate each stock's expected return. This is explained in depth under the previous section *Event Study.* The expected return or "normal" return is the return that would be expected without the index reconstitution taking place. From the estimation window we derive each stock's expected return under the Capital Asset Pricing Model (CAPM). Abnormal return (AR) on day t is the difference between the actual return of the stock and its expected return based on the market model. We then calculate the cumulative abnormal return (CAR) as the sum of the daily abnormal return over a specified period. Lastly, we use a two-tailed student t's test to determine if the observed AR and CAR is significantly different from zero. A more thorough explanation is provided below.

First, we define the daily stock return as the arithmetic change in closing price on day τ from day τ-1 (equation 1).

$$R_{i,\tau} = \frac{P_{i,\tau} - P_{i,\tau-1}}{P_{i,\tau-1}} \tag{1}$$

Secondly, we specify the CAPM as the model characterizing "normal" returns. MacKinlay (1997) argues that the improvements with a multiple factor model are limited for an event study. The CAPM predicts $R_{i,\tau}$, the return of company i on day τ based on its correlation with $R_{MKT,t}$, the market return on day τ, where $E[\epsilon_{i,\tau}] = 0$.

$$R_{i,\tau} - r_{f,\tau} = \alpha_i + \beta_i(R_{MKT,t} - R_{f,\tau}) + \epsilon_{i,\tau} \tag{2}$$

$$E[R_{i,\tau}] - r_{f,\tau} = \alpha_i + \beta_i(R_{MKT,t} - r_{f,\tau}) \tag{3}$$

To estimate the coefficients α_i and β_i of stock i to the market, we run the ordinary least squared (OLS) regression expressed in equation 2 for each individual security during the estimation window. We use a dummy variable indicating whether an event is an inclusion or an exclusion event. The proxy for the market is the market return in the daily European Fama French Factors derived from Kenneth R. French's data library. As previously discussed, the estimation window spans 120 trading days (six months) [-143, -23] relative to the ED. Since the announcement date (AD) is ordinarily 5 days prior to the ED, it is reasonable to assume that no effect is leaking to our estimation window and should not affect the parameter estimates of the CAPM. The expected return is then calculated under CAPM as described in equation 3.

A shortcoming of our application of CAPM is the choice of market proxy. Since this study focuses on the Nordic markets, a reasonable market proxy would be the broader all-share indices for each country. This could potentially raise questions about endogeneity as the studied indices make up the majority of the market capitalization for these markets. We opted to use another proxy for the market which also had more historical data available which increased the sample size.

We then calculate the daily abnormal return (AR) during the event window [-20, 60] relative to the ED. The abnormal return is calculated as the difference between $R_{i,\tau}$, the realized return of stock i on day τ and $E(R_{i,\tau})$, the expected return of stock i (equation 4). We also calculate the average abnormal return (AAR) across all stocks i on day τ (equation 5).

$$AR_{i,\tau} = R_{i,\tau} - E(R_{i,\tau}) \tag{4}$$

$$AAR_\tau = \frac{1}{N}\sum_{i=1}^{N} AR_\tau \tag{5}$$

To aggregate the daily abnormal return through time, we calculate the cumulative abnormal return (CAR) as the sum of abnormal returns for stock i between T_1 and T_2 (equation 6).

$$CAR_{i,T_1,T_2} = \sum_{t=T_1}^{T_2} AR_{i,\tau} \tag{6}$$

The subperiods from our event window for which we calculate CAR is expressed in Table 7. The chosen subperiods are determined based on the findings from previous research (Chen et al., 2004; Beneish and Whaley, 1996).

Table 7
Clarification of Labels and Sub-Event Windows

Table 7 provides a detailed breakdown of the sub-event windows used in this study, explaining the labels and their respective intervals in trading days. Anticipation Period captures market activity and potential speculative behavior before any official announcements. Investors might anticipate changes to index compositions based on prior trends or turnover data, which can influence prices and trading volumes even before public announcements are made. The inclusion period represents the time from the announcement date leading up to the effective date. Institutional investors, particularly index funds, begin rebalancing their portfolios by buying stocks being added to the index or selling those being excluded. Prior research has shown that this period often exhibits significant price and volume changes. After the effective date, the market undergoes a short-term adjustment phase. This period is used to assess how quickly prices stabilize and whether any short-term overreaction occurs. The event effect sub-windows captures both pre- and post-effective date activity to measure the overall impact of the event. It provides insights into whether the observed effects persist beyond the immediate reconstitution.

Sub-Event Window	Labels	Interval (trading days)
Anticipation Period	ED-20 to ED-5	16 days
Inclusion Period	ED-5 to ED	6 days
Adjustment Period	ED+1 to ED+60	60 days
Event Effect	ED-5 to ED+20	26 days
Event Effect Longer Term	ED-5 to ED+60	66 days
Event Period in Total	ED-20 to ED+60	81 days

To calculate the mean effect across the observed stocks in our sample we calculate the average cumulative abnormal return $\overline{CAR}_{T_1,T_2}$ across all stocks for each subperiod from our event window (equation 7).

$$\overline{CAR}_{T_1,T_2} = \frac{1}{N}\sum_{i=1}^{N} CAR_{T_1,T_2} \tag{7}$$

We use the cross section of CAR_{i,T_1,T_2} to estimate the variance $Var[\overline{CAR}_{T_1,T_2}]$ (equation 8).

$$Var[\overline{CAR}_{T_1,T_2}] = \frac{1}{N^2}\sum_{i=1}^{N}(CAR_{T_1,T_2} - \overline{CAR}_{T_1,T_2})^2 \tag{8}$$

An important assumption when calculating the variance is that the abnormal returns in the cross-section are uncorrelated (Campbell, Andrew, and MacKinlay, 1997). This assumption is valid when the event day is not common to the stocks observed. For our sample, some stocks are likely to share the same event date but if they are from different industries, the CAPM reduces the inter-correlation to zero (Brown and Warner, 1982). In our sample, most of the stocks that share the same event date also have opposite dummy variables, being included or excluded. We therefore assume that the abnormal returns are uncorrelated in the cross-section.

Lastly, we perform a hypothesis test and interpret the results to assess the significance of the observed effect. We use a two-tailed t-test to account for both positive and negative effects as the predictability of the composition of the observed indices suggests that eventual price effects could potentially be priced in and reversed around the ED and AD. The null hypothesis is that the average CAR and AR are zero. With our sample being large, since N > 30, the $\overline{CAR}_{T_1,T_2}$ and $AAR_{i,\tau}$ follow the normal distribution (equation 9). The two-tailed t-test statistic is defined in equation (10).

$$\overline{CAR}_{T_1,T_2} \sim N[0, var(\overline{CAR}_{T_1,T_2})] \tag{9}$$

$$\theta_1 = \frac{\overline{CAR}_{T_1,T_2}}{\sqrt{Var[\overline{CAR}_{T_1,T_2}]}} \tag{10}$$

4.8 Methodology to Examine Trading Activity

To isolate abnormal trading volume related to the index reconstitution we use the constant mean model (MacKinlay, 1997), we calculate a volume ratio (equation 11) based on a benchmark trading volume as the average volume for stock i in the estimation window [-143, -23] (equation 12). This allows us to assess whether the reconstitution has any impact on the trading volume.

$$VR_{i,\tau} = \frac{V_{i,\tau}}{\overline{V}_{\tau-143:\tau-23,i}} \tag{11}$$

$$\overline{V}_{\tau-143:\tau-23,i} = \frac{1}{N}\sum_{\tau-143}^{\tau-23} V_{i,\tau} \tag{12}$$

Whereas:

$$VR_{i,\tau} = \ Volume\ Ratio\ for\ stock\ i\ on\ day\ \tau$$

$$V = \ Volume\ for\ stock\ i\ at\ time\ \tau$$

$$\overline{V}_{\tau-143:\tau-23,i} = \ Average\ Volume\ of\ stock\ i\ in\ the\ estimation\ window$$

$$N = Number\ of\ observations$$

Similar to how we tested the significance of the $\overline{CAR}_{T_1,T_2}$, we applied the two-tailed student t's test at the 5% significance level to test if there are any abnormal trading volumes surrounding the ED. The drawback of the methodology for the constant mean model is that it does not account for changes in the market which could generate biased results. An additional consideration is that the timing of the index reconstitutions (January/July) imply that the stock returns might experience seasonality (January Effect).

4.9 Data Limitations

A general concern with event studies is other overlapping events that can impact the studied outcome and lead to incorrect conclusions. In the setting of this thesis, this relates to other idiosyncratic events such as but not limited to M&A activity, earnings announcements, changes in capital structure or changes in management. We accounted for name changes and M&A activity and removed these observations as it would skew the results. This was done both manually and through the coding process, but the risk of human error that we failed to account for all such events still prevails. This paper does not account for earnings announcements during the event or estimation windows which could have an impact on the stock price.

Determining the announcement date caused another limitation, because the announcements are not always made on the same date in relation to the effective event date. Despite extensive effort, we were not able to access the exact announcement date for each observation. Due to this problem, we decided not to investigate the announcement date directly, but rather encompass it in the event window. Previous research in other financial markets has found the AD to be of high importance for abnormal returns and not accurately determining this date across all stocks studied in this paper highlights a limitation. A more extensive study could utilize web scraping to extract the announcement dates from financial newspapers.

The timeframe of this study encompasses two events that affected the stock market broadly, namely the financial crisis and Covid-19. These events alone could have a significant impact on investor behavior and consequently on the overall cumulative abnormal return over the entire period. We divided our initial sample into subgroups, both across indices and over different time periods to account for these changes. Some of these subgroups contained only a small number of observations which limit the conclusions that can be drawn from the sample. With smaller samples, it is possible that outliers will have a greater impact on the overall results of the subgroup.

The market model is applied to estimate each stocks' normal return. In general, scholars suggest that models incorporating additional factors can yield a better estimation (Fama, French, 1992) Meanwhile MacKinlay (1997) argues that the improvements from more complicated models are limited when applied to an event study.

Using another market proxy, such as the MSCI Nordic Index or the OMX All-Share indices for each country, could yield different conclusions. The small size of these markets raises concerns about endogeneity with the stocks studied in this paper, particularly if the OMX All-Share indices were used as the market proxy. Additionally, historical daily closing prices for these broader indices are limited, restricting the observation for our sample. Following this, another potential risk of using local and broader indices as market proxies is the difficulty in maintaining a sufficient sample size. In this study, the current sample size is larger than most similar studies, which is something we want to strengthen in the research.

As previously discussed, the timing of reconstitution of the studied indices raises the concern of seasonality such as the January effect.

5 Results

Ideally, to test the effects on individual stocks being added to or removed from the selected indices in this study, the inclusion and exclusion should exhibit quasi-randomness as it would allow for isolating a causal relationship between the index reconstitution and any observed abnormal returns. Additionally, by analyzing quasi-random inclusion and exclusion, investors, researchers and policymakers gain a better understanding of market mechanics, behavioral tendencies and the interplay between indices and securities. This analysis does not only help to optimize trading and portfolio management strategies but also enhances market transparency and efficiency. The inclusion and exclusions to the selected indices in this study are quasi random, since rules exist but the outcome (membership to the index) are influenced by external variables.

We find robust results showing that, for both inclusions and exclusions, trading volume increases on the days before the effective date of the reconstitution, with a larger magnitude observed for excluded stocks. We find positive $\overline{CAR}$ for included stocks in the five days preceding the inclusion date. In line with previous studies (Schleifer, 1986; Benish and Whaley, 1996) we find this effect to be permanent with no signs of reversal observed during the event window. This is not in line with the findings of Chen et al. (2004) which found the effects were reversed after 60 days post ED. For excluded stocks, we find negative abnormal returns preceding the exclusion date with the largest magnitude occurring 20 to 5 days preceding the exclusion event. We see a short reversal of the $\overline{CAR}$ for the excluded stocks until almost 30 days post the ED, before the $\overline{CAR}$ turns negative again.

5.1 Abnormal Trading Volume

In this section we document the changes in volumes traded as a result of index reconstitution events. This study does not directly investigate the announcement day, which limits its comparability to previous research. Kappou et al. (2010) suggest that the observed positive abnormal return and trading volume are significant both at the close of the announcement day and during the opening of the market on the following day, reflecting the market's reaction to newly released information. Additionally, Bechmann (2002) observed that abnormal returns and trading volume were most significant and of similar magnitude on the day after the announcement and the day before the effective date.

Table 8 presents the results for the abnormal trading volumes surrounding the effective date (ED). The table is split between Panel A for inclusions and Panel B for exclusions. The observations are also split among the observed indices and for the full sample.

We observe an increased trading volume on the day immediately preceding the effective date (ED-1) across all indices for both the inclusions and exclusions. The increase in trading volume is notably larger for excluded stocks and appears to persist in the days immediately following the ED. For the full sample, the abnormal trading volume for exclusions is more than double that observed for included stocks on day ED-1. The positive abnormal trading volume observed for the inclusions on day ED-1 appears to be temporary when observing Figure 2. We see that the cumulative abnormal trading volume is negative for inclusions over the event window but gradually reverts toward zero by the end of the event window. Overall, the standard errors are small for all observations. We find similar results in our regression analysis on the abnormal trading volume in Appendix A.2.

For the stock being included in the indices, we see that there are significant decreases in trading volume on days ED-5 to ED-3 (Table 8). This is interesting since previous research has found the most significant increases in trading volume around the announcement date (AD) (Kappou et al., 2010). Given the set methodology of the OMX index compositions, ED-5 should be the AD by praxis. However, since we did not have accurate data on the individual announcement date, we cannot confirm that there have been no deviations from the general praxis regarding the announcement date. Assuming that day ED-5 is the announcement date, these findings go against our expectations and contradict previous research which has found increased trading volume on the AD and the trading day immediately following. Potential explanations to this might be that passive index funds that will include the stock may delay significant buying activity until the official inclusion date to align with the index. This restraint could lower overall trading volumes temporarily.

As shown in Table 8, the volume ratio for deletions increases in the days leading up to the effective date (ED) and decreases in the days following the ED. Our findings indicate significantly higher volumes on the day or days immediately preceding the ED. Since the volume ratio reflects both selling and buying activity, the observed increase in volume ratio for deletions can be attributed to heightened selling pressure from index funds rebalancing their portfolios. This rebalancing involves selling the deleted stock while simultaneously purchasing newly added stocks, consistent with the index effect theory.

Table 8
Average Abnormal Trading Volume

Table 8 presents the average daily abnormal trading volume surrounding the effective date (ED) across all stocks in each subset. A more thorough table is provided in the appendix (section A.4). Day 0 represents the ED of the reconstitution. The abnormal volume is defined as the difference between the actual daily volume and the normal daily volume where the normal volume is defined as the average trading volume over the estimation window. The standard error for each observation is presented in parentheses. The significance level is tested with a student t's test. All data is retrieved from Datastream. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level respectively. Standard errors are presented in parentheses below each observation.

Day	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
Panel A: Inclusion						
-5	-22.27% ***	-7.52%	-18.42%	-32.37% ***	-36.24% ***	-21.83% **
	(0.042)	(0.081)	(0.239)	(0.066)	(0.068)	(0.079)
-4	-24.03% ***	-17.80% **	3.10%	-8.61%	-45.77% ***	-35.83% ***
	(0.045)	(0.060)	(0.176)	(0.155)	(0.073)	(0.088)
-3	-17.78% ***	5.33%	-12.09%	-14.78%	-38.96% ***	-33.55% ***
	(0.044)	(0.091)	(0.158)	(0.117)	(0.073)	(0.071)
-2	6.36%	10.80%	86.53% **	-11.65%	-17.71%	2.59%
	(0.065)	(0.128)	(0.309)	(0.126)	(0.109)	(0.112)
-1	62.92% ***	115.75% ***	85.74%	1.33%	31.97%	61.46%
	(0.141)	(0.290)	(0.667)	(0.118)	(0.203)	(0.354)
0	2.46%	18.86%	31.23%	-7.89%	-12.33%	-10.46%
	(0.082)	(0.188)	(0.490)	(0.101)	(0.097)	(0.098)
1	-8.92%	-4.51%	68.50%	-18.99%	-25.62%	-25.80% ***
	(0.092)	(0.098)	(0.803)	(0.107)	(0.129)	(0.061)
2	-9.12%	-8.54%	58.92%	-22.46%	-41.30% ***	2.94%
	(0.092)	(0.098)	(0.803)	(0.107)	(0.129)	(0.061)
Panel B: Exclusion						
-2	50.37% *	25.76%	407.86%	25.01%	-9.64%	-4.97%
	(0.242)	(0.132)	(2.308)	(0.149)	(0.152)	(0.103)
-1	139.76% ***	176.03% **	111.99%	27.67%	193.15% ***	126.47% **
	(0.262)	(0.623)	(0.784)	(0.138)	(0.393)	(0.374)
0	15.99%	42.18%	2.37%	4.80%	-8.15%	9.10%
	(0.161)	(0.421)	(0.238)	(0.173)	(0.101)	(0.137)
1	23.28%	-15.56%	10.63%	-9.06%	3.97%	209.05%
	(0.292)	(0.094)	(0.223)	(0.119)	(0.192)	(2.065)
2	27.19%	-3.28%	35.07%	-25.85% *	1.25%	215.44%
	(0.292)	(0.094)	(0.223)	(0.119)	(0.192)	(2.065)

Studies by Bechmann (2002), Hedge and McDermott (2003), and Kappou, Brooks and Ward (2007) indicate that index funds tend to avoid making significant reallocations prior to the effective date (ED), irrespective of any price fluctuations leading up to the event. They attribute regulations and policies to force portfolio managers to hold their positions as long as possible to reduce tracking errors. This could explain why we observe increased trading activity on the day immediately preceding the ED instead of those surrounding the AD. Bechmann (2002), Hedge & McDermott (2003) and Kappou et al. (2007) argue that in the closing hours on ED-1, index funds start executing large block trades to buy (sell) the stocks being included (excluded) in the indices. This could be an explanation to why we observe increased trading activity on the day preceding the ED. We find no statistical support for this in the cross-sectional regression in the appendix (Section A.3).

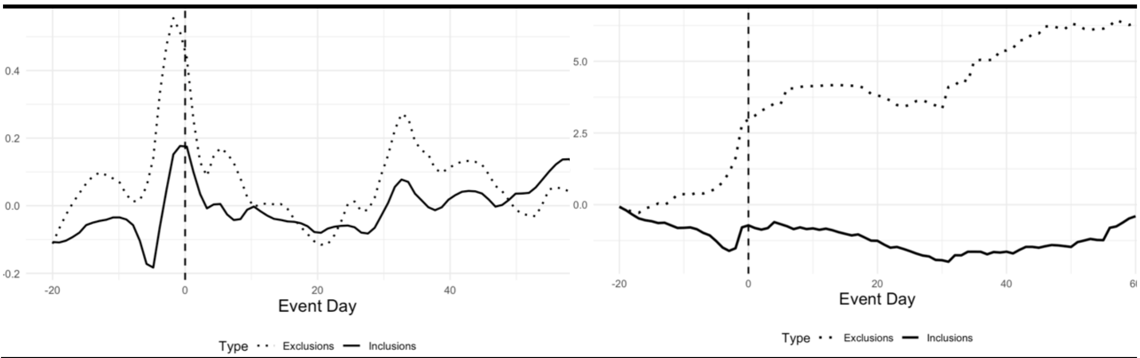
Finance scholars are divided as to whether changes to indices have temporary or permanent effects. When observing Figure 2, we see that most of the abnormal trading activity is surrounding the ED, depicted as event day 0 in the plots. When observing the plot to the right for the cumulative abnormal volume ratio (CAVR) we see that for the exclusions, the increased trading activity seems to be permanent whilst for the inclusions, the decrease in trading looks to revert to zero towards the end of the event window.

The temporary decrease in trading volume for the included firms could be explained by them having higher trading volumes during our estimation window which coincides with the index reconstitution window and is the cause for them being included in the index. This results in a higher benchmark of which the added stocks revert to towards the end of our event window.

Figure 2
Abnormal Trading Volume Plot

Figure 2 plots the average abnormal volume ratio (AVR) and average cumulative abnormal volume ratio (CAVR) over the event window. The x-axis is the event day in the event window and the y-axis is the observed volume ratio. The vertical dashed line depicts day zero which is the effective date (ED) of the index reconstitution. The dotted line is the observed values for the exclusions dataset and the solid line is the observed values for the inclusion dataset. A value of zero on the y-axis indicates no abnormal trading volume and values above (below) indicate positive (negative) abnormal trading volume.

AVR | **CAVR**



5.2 Price Effect

In this section we document the price effects following the changes to the observed indices. We report results based on abnormal and cumulative abnormal returns. In table 9 and 10 along with figure 3 and 4 the price effects surrounding the effective date (ED) are presented. Average Abnormal Return is denoted as AAR and Average Cumulative Abnormal Return is denoted as $\overline{CAR}$.

Overall we find the presence of the index effect in the Nordic markets supporting research by Chen et al. (2004) and Shleifer (1986) but do not find support for any reversals of the effects such as Mase (2007) and Beneish and Whaley (1996). Our findings support the awareness hypothesis as proposed by Chen et al. (2004). There is some support for the observed abnormal returns being attributed to increased demand which could stem from inflows from index funds.

For the full sample, we observe the most prominent price movement to be the positive $\overline{CAR}$of 5.67% for the timeframe -5:ED. Meanwhile excluded stocks have negative abnormal returns of 0.13% over this period, although not statistically significant. Since the indices maintained by Nasdaq announce the reconstitutions at least 5 days prior to the effective date, this supports the hypothesis that markets react positively (negatively) to index inclusion (exclusion). These findings are in line with previous research that suggests that all abnormal returns are essentially generated on the day after the announcement (Kappou et al., 2010).

Across the indices the OBX index exhibits the largest positive abnormal return of 14.57% during the inclusion period (-5:ED). Notably, the OMXC20 index records a negative abnormal return of -16.82%, for the period -20:ED which may significantly contribute to lowering the overall return for the full sample. All indices exhibit positive abnormal returns on ED-1 for inclusions, with statistically significant results observed for the full sample, OMXC20, and OMXS30. The magnitude ranges from 0.17% to 1.44% on ED-1. As previously discussed, we also find statistically significant increases in trading activity on ED-1. This could be interpreted as the abnormal returns being linked to increased demand on ED-1 supporting the downward sloping demand curve and price pressure hypothesis. Other explanations could be that the information asymmetry as measured by the bid-ask spread is reduced (increased) when stocks are included (excluded). This would mean that the liquidity premium is priced in. An extension on this study would thus be to investigate the bid-ask spread and assess whether the information asymmetry is affected by the index reconstitution.

We observe significant and positive average abnormal return ($\overline{CAR}$) for the full sample of inclusions across all event windows except ED+5. The magnitude of this effect is likely affected by the AAR on ED-2 of 4.85%. The AAR for the full sample on ED-2 is not statistically significant and could simply be an outlier in the dataset so the interpretation of the $\overline{CAR}$ over periods which encapsulate this day should take this into consideration. For the full sample, the AAR on the ED and subsequent days are negative, although not statistically significant.

Comparing the AAR for exclusions on the ED, we observe only negative abnormal return for OBX10 whilst all other indices and the full sample have positive abnormal returns. In contrast, we observe negative abnormal returns for OMXH25, OBX and OMXC20 for the inclusions. This could be explained by the anticipation effect, where investors have already acted on the event in advance.

Table 9

Daily Average Abnormal Return

Table 9 presents our main findings on the average daily abnormal return surrounding the effective date (ED) across all stocks in each subset. These show the largest effect on the $\overline{CAR}$ over the event windows presented later in Table 10. A more thorough table is provided in the appendix (section A.5). Day 0 represents the ED of the reconstitution. The abnormal return is defined as the actual return minus the expected return as determined by the CAPM. The significance level is tested with a student t's test. All data on daily stock prices is retrieved from Datastream and daily market return is retrieved from Kenneth R. French's' data library. The values given in parentheses is the standard error of each observation. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level respectively. Standard errors are presented in parentheses below each observation.

Panel A: Inclusions						
Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-3	-0.49%**	-0.72%*	0.64%	0.03%	-0.50%	-2.65%***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
-2	4.85%	14.74%	0.43%**	0.49%	-0.33%	0.04%
	(0.033)	(0.106)	(0.002)	(0.01)	(0.005)	(0.004)
-1	0.47%***	0.43%	0.17%	0.39%***	0.40%	1.44%***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.005)	(0.003)
0	-0.03%	0.61%**	0.43%	-0.06%	-1.21%***	0.25%
	(0.002)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
1	-0.06%	0.24%	0.29%	-0.24%	-0.01%	-0.62%**
	(0.001)	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)
2	-0.24%	-0.17%	0.07%	0.24%	-0.50%	-0.73%***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.009)	(0.003)

Panel B: Exclusion						
Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-3	-0.49%**	-0.72%*	0.64%	0.03%	-0.50%	-2.65%***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
-2	-0.01%	1.72%***	1.36%***	-14.78%***	-0.98%	1.60%***
	(0.005)	(0.005)	(0.005)	(0.022)	(0.011)	(0.006)
-1	0.56%	-0.38%	0.50%*	0.05%	1.47%	0.49%
	(0.005)	(0.003)	(0.003)	(0.002)	(0.013)	(0.005)
0	0.55%**	1.11%***	-0.31%	0.00%	0.26%	1.65%*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.008)	(0.009)
1	-0.08%	0.03%	-0.28%	0.11%	0.00%	-0.94%
	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.006)
2	0.06%	0.24%	0.09%	-0.73%*	0.43%	0.40%
	(0.002)	(0.005)	(0.002)	(0.004)	(0.005)	(0.005)

Table 10

Average Cumulative Abnormal Return ($\overline{CAR}$)

Table 10 presents the cumulative average abnormal return ($\overline{CAR}$) for both the inclusion and exclusion datasets over 6 periods. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level. Standard errors are presented in parentheses below each observation.

Panel A: Inclusions

Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-20:ED	4.94%***	13.42%***	6.41%***	1.66%***	-1.47%**	1.41%**
	(0.011)	(0.032)	(0.005)	(0.006)	(0.007)	(0.007)
-5:ED	5.67%***	14.57%**	2.12%***	0.92%**	0.82%	2.62%***
	(0.020)	(0.060)	(0.004)	(0.004)	(0.009)	(0.008)
ED:5	-0.10%	0.25%	-0.23%	0.20%	0.25%	-1.48%***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.004)
ED:60	-0.61%***	-3.31%***	-5.26%***	5.74%***	-1.95%***	1.03%***
	(0.002)	(0.004)	(0.004)	(0.006)	(0.006)	(0.003)
-5:20	6.17%***	13.78%***	2.60%***	2.61%***	4.43%***	-0.29%
	(0.010)	(0.029)	(0.003)	(0.005)	(0.006)	(0.005)
-5:60	5.10%***	10.65%***	-3.58%***	6.73%***	0.08%	3.40%***
	(0.006)	(0.019)	(0.004)	(0.006)	(0.006)	(0.004)

Panel B: Exclusion

Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-20:ED	-4.66%***	-2.35%***	-3.59%***	-16.82%***	-5.55%***	-10.04%***
	(0.004)	(0.007)	(0.008)	(0.033)	(0.007)	(0.012)
-5:ED	-0.13%	-0.24%	2.19%***	-14.58%**	0.02%	-0.26%
	(0.005)	(0.011)	(0.007)	(0.060)	(0.008)	(0.018)
ED:5	3.08%**	0.88%*	0.40%	-0.88%**	11.37%**	0.16%
	(0.014)	(0.005)	(0.003)	(0.004)	(0.054)	(0.009)
ED:60	0.51%	-7.13%***	-3.40%***	-3.07%***	15.11%***	-1.33%**
	(0.006)	(0.005)	(0.004)	(0.005)	(0.021)	(0.007)
-5:20	5.47%***	0.24%	4.05%***	-12.99%***	19.10%***	-0.93%
	(0.009)	(0.007)	(0.004)	(0.029)	(0.031)	(0.010)
-5:60	-0.16%	-8.48%***	-0.90%**	-17.66%***	14.87%***	-3.24%***
	(0.006)	(0.006)	(0.004)	(0.019)	(0.020)	(0.008)

For the inclusions, the most noticeable period of $\overline{\text{CAR}}$ is -5:ED which suggests that the most significant effects occur between the announcement date and the effective date. Given the limited data we have on announcement dates we cannot fully determine this but as described in the data limitations, most reconstitutions are announced at least 5 trading days before the ED.

We observe positive average cumulative abnormal returns ($\overline{CAR}$) for stock inclusions for the full sample and across all indices during the five days preceding the effective date (-5:ED), with all values statistically significant except for OMXH25. Over the extended window of 20 trading days prior to the effective date (-20:ED), all $\overline{CAR}$ values are statistically significant. with positive $\overline{CAR}$ for all indices except OMXH25. The OBX index exhibits the highest $\overline{CAR}$ for both the -5:ED and -20:ED windows, measuring 14.57% and 13.42%, respectively, compared to the $\overline{CAR}$ of 5.67% and 4.94% for the full sample. This outperformance is largely attributable to an exceptionally high abnormal return (AAR) of 14.74% for OBX on ED-2. (Table 9, Panel A).

Following this, it is evident that as previously mentioned, the period -5:ED is considered the most impactful, suggesting that the most significant effects are concentrated the days succeeding the announcement date. This is under the assumption that ED-5 is the announcement date. These findings are in line with previous research such as Kappou et al. (2007).

For the exclusions, there seem to be an opposite effect where we observe negative $\overline{CAR}$ for the full sample and across all indices for the period -20:ED. The most negative $\overline{CAR}$ over this period is for the OMXC20 index with a $\overline{CAR}$ of -16.82% and for the entire sample this is -4.66%. The $\overline{CAR}$ for OMXC20 over this period is in large because of the AAR on day ED–2 where the OMXC20 index has an AAR of -14.78%. For the exclusions, it seems like most of the negative effects are captured in the period before the announcement date.

Comparing the $\overline{CAR}$ for the inclusion and exclusion dataset over the same periods, we find support for the asymmetric price effects observed by Chen et al. (2004). We observe positive abnormal return for the included stocks and negative abnormal returns for excluded stocks. Only looking at the period -20:ED, the effect seems to be symmetric with included stocks having a similar price increase as excluded stocks have a decrease. Looking at the period, -5:ED, this symmetry diminishes as included stocks show a larger positive effect than excluded stocks show a negative one.

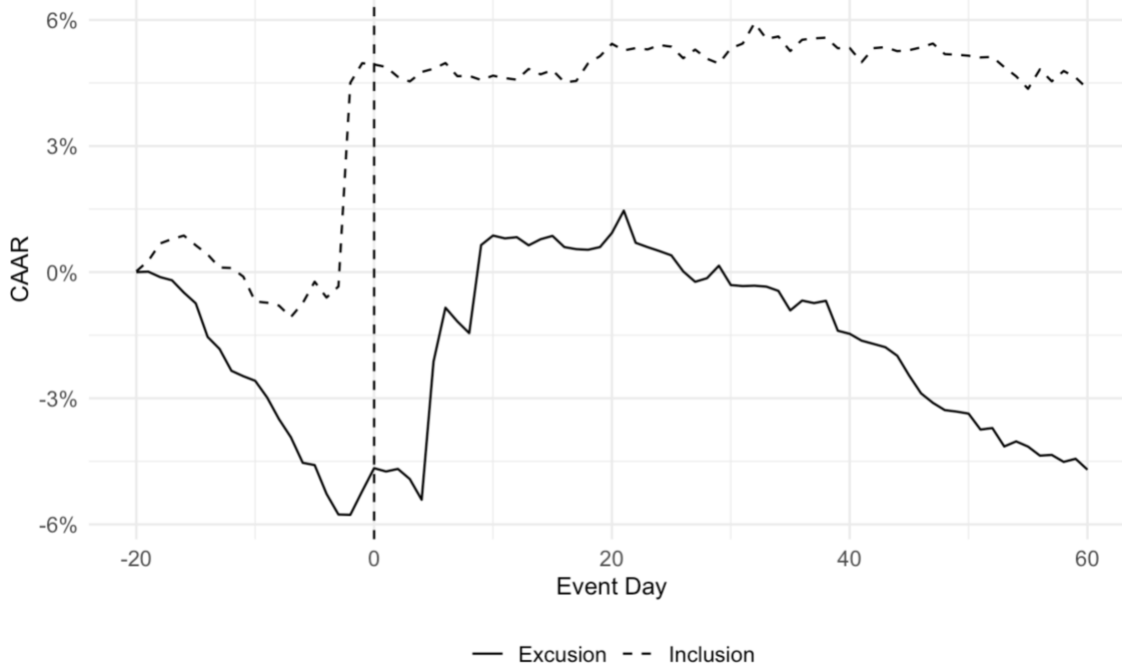
Our findings on the difference in where in the event window most of the effects for the inclusions and exclusions are captured are in line with the awareness hypothesis (Chen et al., 2004). The excluded stocks, which are already tracked by many investors capture their effect earlier in the event window as compared to the inclusions. Moreover, the permanent price increase observed for included stocks can also be supported by the awareness hypotheses as they receive more monitoring from analysts.

This permanent price increase presents strong evidence for the imperfect substitute hypotheses (ISH) as proposed by Schleifer (1986). The ISH explains that stocks are not perfect substitutes since they have different underlying assets and investors have heterogenous preferences. In the context of the index effect, the ISH persist that included stocks receive permanent price increases from demand pressure. We observe this for included stocks having abnormal trading volume and experience a permanent price increase.

We also find there to be a gradual price shift preceding the ED challenge the semi-strong form of the efficient market hypothesis, that all publicly available information should be priced in the stock price. Under the EMH, we would expect all relevant information to be quickly reflected in the stock price instead of gradually.

Figure 3
Average Cumulative Abnormal Return

Figure 3 plots the Average Cumulative Abnormal Return ($\overline{CAR}$) for the full sample over the entire event window. The dashed line represents the exclusion dataset, the solid line represents the inclusion dataset. Day 0 is shown as the vertical dashed line and denotes the effective date (ED) of the reconstitution.



When observing the plots for the $\overline{CAR}$, an interesting observation is the movements on the days leading up to the effective date. Just from the observation, it is in line with our hypothesis that included (excluded) stocks experience positive (negative) price effects. For the exclusion dataset, the downtrend leading up to the ED is reverted until approximately 10 days post the ED and then continues the downward sloping trend. The positive effect on included stocks looks to be permanent as the effect does not revert towards zero during the event window. We do not find for either of the inclusions and exclusions that the price effect is temporary and revert towards zero. The excluded stocks start to revert and the $\overline{CAR}$ turns positive before turning negative again succeeding 20 trading days post the ED. This supports the findings of Chen et al. (2004) whilst Mase (2007) found the similar effects in the FTSE100 index to be reversed and Beneish and Whaley (1996) also found the effects to start to reverse following the ED.

In figure 4, we can observe the differences over different time periods. We see that the effects during the period 2020-2024 which is depicted as the dotted line in figure 4 are more stable and do not deviate as much from 0 as the other time frames. This is in line with more recent research that shows that the abnormal returns associated with the index effect have diminished over time, suggesting that the market has become more efficient. Findings by Kappou et al. (2010) and Kim et al. (2017) show that stock prices adjust more quickly than reported in earlier studies, limiting arbitrage opportunities for profitable trading based on index inclusions or exclusions. However, since the observed indices in this study are smaller in size and less liquid, the index effect may have larger implications for these markets compared to more established ones, such as the S&P 500.

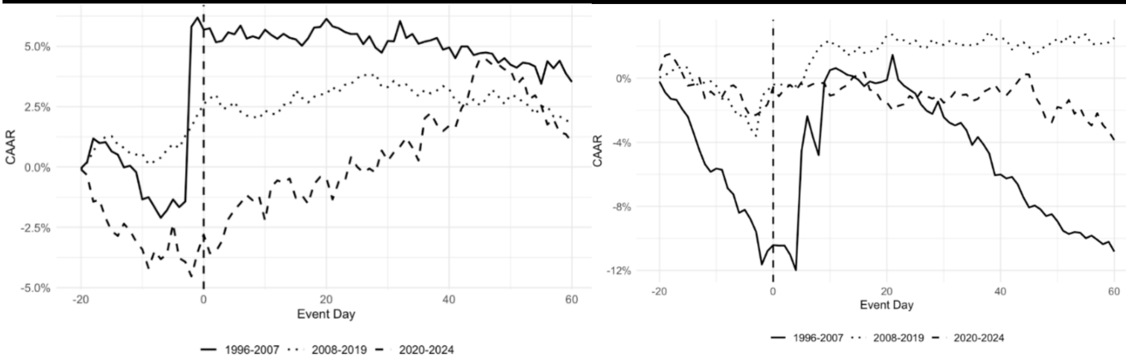
Worth considering is also the fact that the timeframe for which we observe the smaller magnitude is also shorter and has a smaller sample size.

Figure 4

Average Cumulative Abnormal Returns ($\overline{CAR}$) for Inclusions in Different Time Frames

Figure 4 plots the Cumulative Average Abnormal Return for both the inclusion and exclusion datasets over three different time frames. The solid line represents the period 1996-2007, the dotted line represents 2008-2019 and the dashed line represents 2020-2024.

Inclusions	Exclusions



6 Additional Robustness Tests

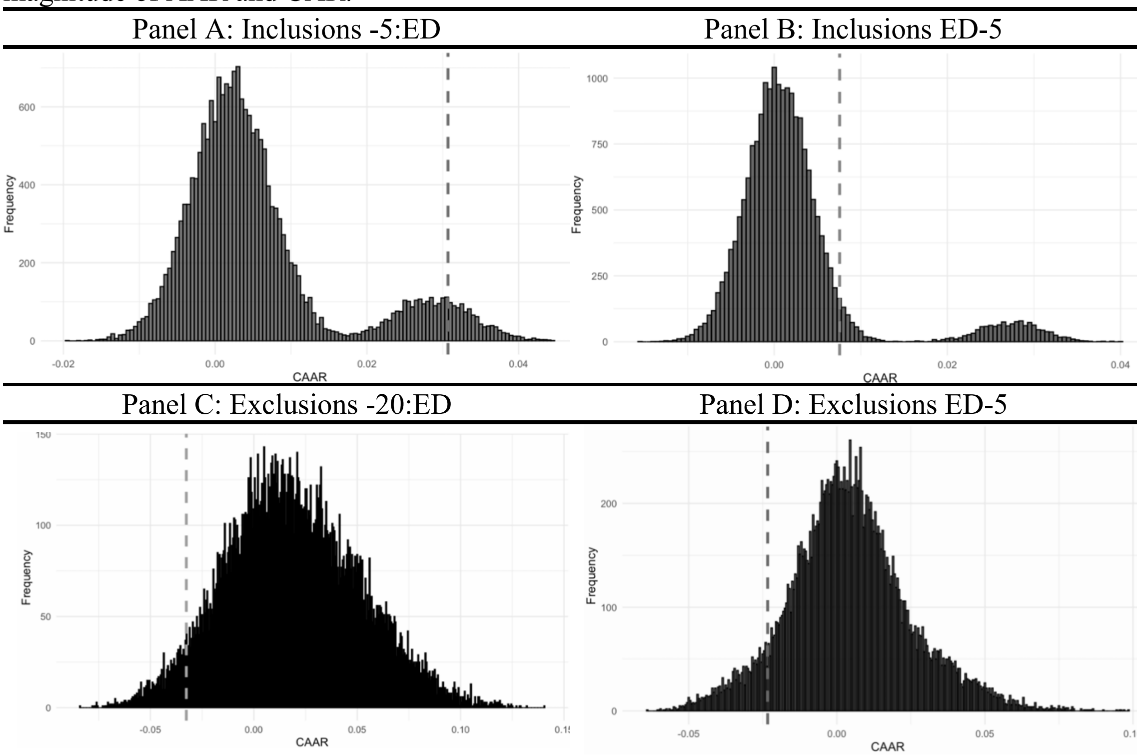
Next, we examine the robustness of the key findings from the previous section. Specifically, we consider the vulnerability of the results to issues related to randomness and data structure. To test this, we apply a placebo permutation test, in which random stocks are randomly assigned inclusion or exclusion dates. By reshuffling the dummy variables in the dataset over 20 000 iterations, the test breaks the relationship between the reconstitution event and trading volume and returns. This allows us to assess whether the observed abnormal returns and volume are associated with the reconstitution events or whether they are random. The test should create a normal distribution of the test statistic from random reshuffling. If our result lies in either tail of this distribution, it suggests that our findings are unlikely due to randomness. While this provides evidence against randomness, additional analysis is required to argue for a causal relationship with the reconstitution event. We apply the same analysis used in the main results, and exclude stocks with insufficient data, thus, the test does not suffer from biases as stocks being assigned dates for which they were not public will not be included in that iteration. Because of computing limitations, we only apply the permutation test to the main findings for the full sample set across all indices.

Panel A and B in Figure 5 plots the permutation test for the $\overline{CAR}$ of the inclusion dataset over the period -5:ED and we find that our findings are robust. The vertically dashed line in Figure 5 plots our findings, suggesting that our findings exhibit randomness to some degree. The dashed line clearly does not lie in the main body of the null distribution, but it lies somewhat in the middle of the smaller tail to the right. The observed results are unlikely due to random chance. The main body of the distribution looks to be normally distributed centered around zero with few outliers. The shape of the distributions suggests the validity of the permutation test. One concern is that a second cluster is formed to the right of the main body, which could indicate non-random patterns in the data. The dashed line for our findings lies close to the center of the second smaller body of the distribution. Panel B in Figure 5 plots the permutation test for ED-5 (5 days before the addition date). Again, the distribution seems to be normally distributed centered around zero with a smaller cluster to the right. Our observation on day ED–5 lies in the right tail of the main body of the distribution centered around 0, suggesting that this finding is robust as well.

Figure 5

Permutation test on $\overline{CAR}$ and AAR for inclusions

Figure 5 plots the permutation test for the Average Abnormal Returns (AAR) and Average Cumulative Abnormal Returns (CAR) for the main findings of our results. The test was performed by running the same analysis as the main findings and randomly reshuffling the event dates 20 000 times until a normal distribution was formed. The histogram plots the randomized observations. The vertical dashed lines plot our observed result for the entire sample. The x-axis is the magnitude of return, and the y-axis is the frequency of the number of observations for each magnitude of AAR and CAR.



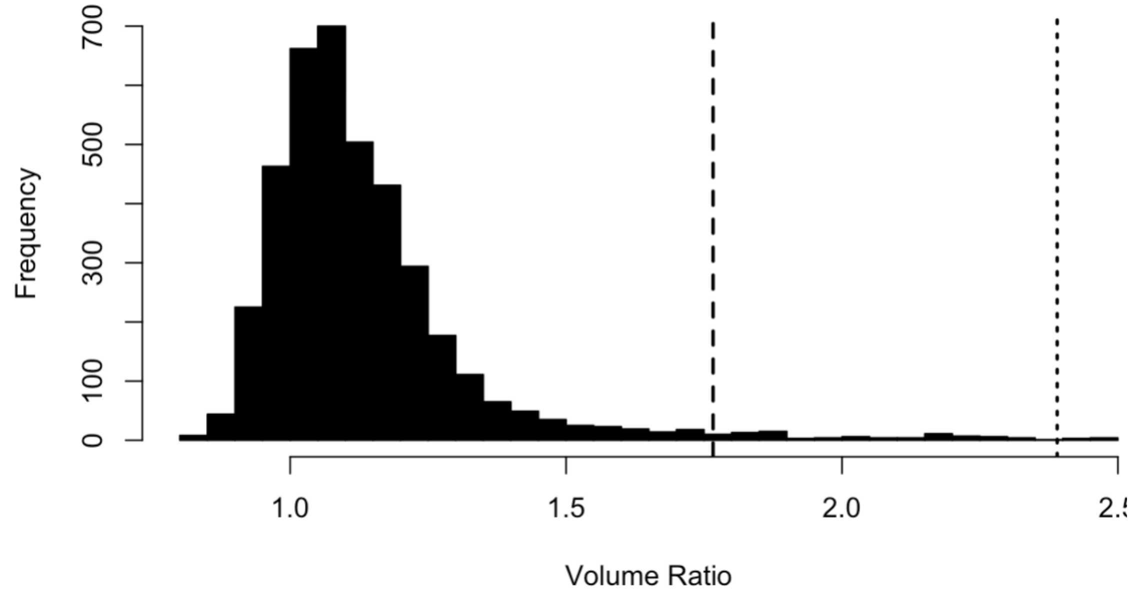
In figure 5 Panel C and D, the plots of the permutation test for the dataset on exclusions are presented. We chose the period -20:ED which is where we found that most of the effect took place for the deletions dataset and event day ED-5 to act as a means of comparison to the inclusion dataset. We see that for both of these, the distribution seems to exhibit normality with ED-5 being centered around zero and -20:ED centered just to the right of zero. The shape of the distributions suggests the validity of the permutation test. We see that for both plots, our observation lies in the left tail of the distribution suggesting that the results are unlikely to be observed at random. While these observations lie in the tail of the distributions, they do not lie in the extreme, which suggests that the findings are only moderately significant, indicating some level of robustness but also warrants cautious interpretation.

Figure 6 plots the permutation test for the volume ratio. The test was performed on event day ED-1 since this is where we found the most effect on trading volume appearing. The distribution looks to approximately exhibit normality centered just above one. We would expect the distribution to be centered around one under the null hypothesis as a volume ratio of 1 indicates that there is no difference to the benchmark volume. The slight shift to the right does not affect our conclusion on the robustness of our findings as the overall shape of the distribution looks to approximately exhibit normality and our observations lie so far to the right. The permutation test for the volume ratio is performed with the same methodology as for the abnormal return by randomly reshuffling the event dates but only 4 000 times because of limitation on computing power. We deem 4 000 permutations as sufficient as we obtain a normal distribution. The vertical line plots the findings in our main results for day ED-1. We see that our observed statistic lies in the very far right tail of the distribution. We conclude that our findings are robust and not due to randomness.

Figure 6
Permutation test on Abnormal Volume

Figure 6 plots the permutation test for the Average abnormal trading volume. The selected event day is the day for which we found the most effect on abnormal volume in our main results. The test was performed by running the same analysis as the main findings and randomly reshuffling the event dates 4 000 times until a normal distribution was formed. Limitations on computing power restricted our number of randomized permutations. The histogram plots the randomized observations. The vertical lines plot our observed result for the full sample. The dashed left line represents the inclusion and the vertical dotted line to the right plots our observation on the exclusion dataset. The x axis is the magnitude of the volume ratio, and the y-axis is the frequency of the number of observations for each magnitude of the volume ratio.

ED-1



7 Conclusion

This study provides a comprehensive examination of the index effect in the Nordic and Baltic stock markets, specifically focusing on the prominent indices OMXS30, OMXH25, OMXC20, OMXB10, and the OBX Benchmark Index. By employing an event study methodology, similar to previous research (Shleifer, 1986; Beneish and Whaley, 1996; Chen et al., 2004), we analyzed the short-term and long-term abnormal returns and trading volumes associated with stock inclusions and exclusions.

Our most prominent findings confirm the presence of significant short-term and long-term abnormal returns and trading volume spikes for both inclusions and exclusions. Notably, stocks added to indices experience a persistent price increase which does not appear to revert towards zero during the event window. Rather it finds a new steady level. Similar to Chen et al. (2004) we attribute this to the awareness hypotheses but do not rule out the signaling hypothesis. We also attribute these effects to the Imperfect Substitutes Hypothesis as presented by Schleifer (1986). We attribute the effects on the day before the reconstitution date to heightened demand and reduced liquidity constraints, supporting to some degree the downward sloping demand curve hypothesis. However, we cannot strongly conclude that the observed index effect is a result of capital inflows from passive index funds, rather we provide it as a possible explanation. In contrast, exclusions show a more complex dynamic, with initial price drops followed by partial reversals and subsequent declines, reflecting the asymmetric impact of index reconstitutions. These results are consistent with the related work (Shleifer, 1986; Beneish and Whaley, 1996).

Building on the extensive research conducted on the S&P 500, this study aims to enhance the field by offering a more detailed and comprehensive analysis of the index effect on Nordic stocks, filling a notable gap in the existing literature and providing insights for investors and policymakers. Our result, together with previous research, provides us with the insight that index reconstitution has similar effects on several different stock markets with different market structures, practicalities and investors.

Our findings on the gradual price shift preceding the ED challenge the semi-strong form of the efficient market hypothesis, that all publicly available information should be priced in the stock price. Under the EMH, we would expect all relevant information to be quickly reflected in the stock price instead of gradually. Notably, the magnitude of the findings has smoothed over the years, suggesting that markets are becoming increasingly efficient.

As for the results of any model which simplifies complex phenomenon in the real-world economy, these results can be questioned. The limitations of our study was discussed extensively under data limitations, expressing issues such as absence of available announcement dates. Particularly, the methodology for the OMX indices, which relies on publicly available turnover data, makes these changes more predictable. Notably, our robustness tests further validated our observed findings as we conclude that they are unlikely to occur at random. Overall, we believe this event study provides valuable insights into the effects of index inclusion and exclusion on individual stocks in the Nordic and Baltic markets.

References

Amihud, Y. and Mendelson, H. (1986). Liquidity and Stock Returns, Financial Analysts Journal, 42(3), pp.43-48

Bechmann, K. (2002). Price and Volume Effects Associated with Changes in the Danish BlueChip Index: The KFX Index. Multinational Finance Journal, 8(1-2). 3-34.

Beneish, M. & Gardner, J. (1995). Information Costs and Liquidity Effects from Changes in the Dow Jones Industrial Average List. The Journal of Financial and Quantitative Analysis. 30(1), 135-157.

Beneish, M. and Whaley, R. (1996). An Anatomy of the "S&P Game": The Effects of Changing the Rules. The Journal of Finance, 51(5). 1909-1930.

Ben-Rephael, A., Kandel, S. and Wohl, A. (2011). The Price Pressure of Aggregate Mutual Fund Flows. The Journal of Financial and Quantitative Analysis, 46(2). 585-603.

Brown, S. and Warner, J. (1985). Using Daily Stock Returns: The Case of Event Studies, Journal of Financial Economics, 14(1), pp. 3-31.

Campbell, J. Andrew, L. MacKinlay, A. (1997) The Econometrics of Financial Markets.

Chen, H., Noronha, G., and Singal, V. (2004). The price response to S&P 500 index additions and deletions: Evidence of asymmetry and a new explanation. The Journal of Finance, 59(4), 1901–1930.

Denis, D. K., McConnell, J. J., Ovtchinnikov, A. V. and Yu, Y. (2003). S&P 500 index additions and earnings expectations. The Journal of Finance, 58(5), 1821–1840

Erwin, G. and Miller, J. (1998). The liquidity effect associated with addition of a stock to the S&P 500 index: evidence from bid/ask spreads. The Financial Review, 33(1).131-146.

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

Fama, E. and French, K.R. (1992). The Cross-Section of Expected Stock Returns. The Journal of Finance, 47(2). 427-465.

Fama, E. F. and French, K. R. (2010). Luck versus skill in the cross-section of mutual fund returns. The Journal of Finance, 65(5). 1915-1947.

Fondbolagens Förening. Årsrapport: Fondsparandet 2023. Published 2024-01-16. https://www.fondbolagen.se/globalassets/faktaindex/manadsstatistik/arsrapport_2023.pdf.

Hegde, S. P. and McDermott, J. B. (2003). The liquidity effects of revisions to the S&P 500 index: An empirical analysis. Journal of Financial Markets, 6(3). 413–459.

Hoffmann, A., Post, T. and Pennings J. (2013). Individual investor perceptions and behavior during the financial crisis. Journal of Banking & Finance, 37(1). 60-74.

Kappou, K., Brooks, C., & Ward, C. (2007). A Re-examination of the Index Effect: Gambling on Additions to and Deletions from the S&P 500's 'gold seal', Research in International Business and Finance, 22(3), pp.325–350

Kappou, K., Brooks, C., & Ward, C. (2010). The S&P 500 Index Effect Reconsidered: Evidence from Overnight and Intraday Stock Price Performance and Volume. Journal Of Banking & Finance, 34(1).116-126

Kim, C., Li, X., & Perry, T. (2017). Adaptation of the S&P 500 Index Effect, The Journal of Index Investing, 8(1).29-36

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

Mase, B. (2007). The Impact of Changes in the FTSE 100 Index, The Financial Review, 42(3). 461-484

Nasdaq, Inc. (2024). OBX Benchmark 25® Index Methodology. Accessed October 11, 2024. https://indexes.nasdaq.com.

Nasdaq, Inc. (2024). Nasdaq OMX Baltic 10® Index Methodology. Accessed October 11, 2024. https://indexes.nasdaq.com.

Nasdaq, Inc. (2024). Nasdaq OMX Copenhagen 20® Index Methodology. Accessed October 11, 2024. https://indexes.nasdaq.com.

Nasdaq, Inc. (2024). Nasdaq OMX Helsinki 25® Index Methodology. Accessed October 11, 2024. https://indexes.nasdaq.com.

Nasdaq, Inc. (2024). Nasdaq OMX Stockholm 30® Index Methodology. Accessed October 11, 2024. https://indexes.nasdaq.com.

Rekenthaler, J. Morningstar, Index Funds Have Officially Won, Published 2024-02-14. https://www.morningstar.com/columns/rekenthaler-report/index-funds-have-officially-won. Retrieved 2024-11-12.

Scholes, M. (1972). The Market for Securities: Substitution Versus Price Pressure and the Effects of Information on Share Prices, The Journal Of Business, 45(2). 179-211

Shleifer, A. (1986). Do demand curves for stocks slope down? The Journal of Finance, 41(3), 579–590.

Spence, M. (1973). Job Market Signaling. The Quarterly Journal of Economics. 87(3), 355-374.

S&P Dow Jones Indices. S&P U.S. Indices Methodology. Published November 2024.

Thomas Reuters Datastream Economics (2024). Eikon Datastream. Datastream International. Retrieved October 17, 2024, from SSE Library, OBX/OMXB10/OMXC20/OMXH25/OMXS30, Constituents, Leavers and Joiners.

AI-Appendix

AI tools have been used to improve the quality of our writing by providing advanced grammar checking. Additionally, AI tools have offered guidance for debugging problems encountered in the coding process.

Appendix

Appendix A.1: Assessing Whether Index Reconstitution Events are Driven by Individual Merits or Relative Competition

The six months period Nasdaq uses to evaluate performance for the upcoming reconstitution decision spans from seven to one month prior to the effective day. For newly added or deleted stocks, this period may partially indicate an abnormal period in relation to their historical levels. During this period, added stocks showed higher trading volumes and met requirements they previously did not meet, while removed stocks experienced lower volumes, reflecting their exclusion from the index. The seven months before the effective date likely capture trading volumes above (for included stocks) or below (for excluded stocks) their historical averages. However, since the indices are a ranking, the reconstitution events could be caused by changes in the performance of the competing stocks. To investigate whether inclusion or exclusion of a stock is based on individual merits or not, we examine the performance (trading volume and return) of the affected stocks in the period where they meet (or not met) the requirements for the inclusion of the index to a period where they did not meet (or met) the requirements for the index. If the average performance increases (decreases), the reconstitution event is based on individual merits. If the average performance has not changed, the reconstitution event is caused by changes in other firms. Figure A.1 shows the new estimation window, the reconstitution window and how they are in relation to the event window. The student t-test below shows that the average volume in the reconstitution window is significantly larger than the average over the 6 month period preceding across all stocks. We hence conclude that stocks are included as a response to their own increase in trading volume rather than others decrease.

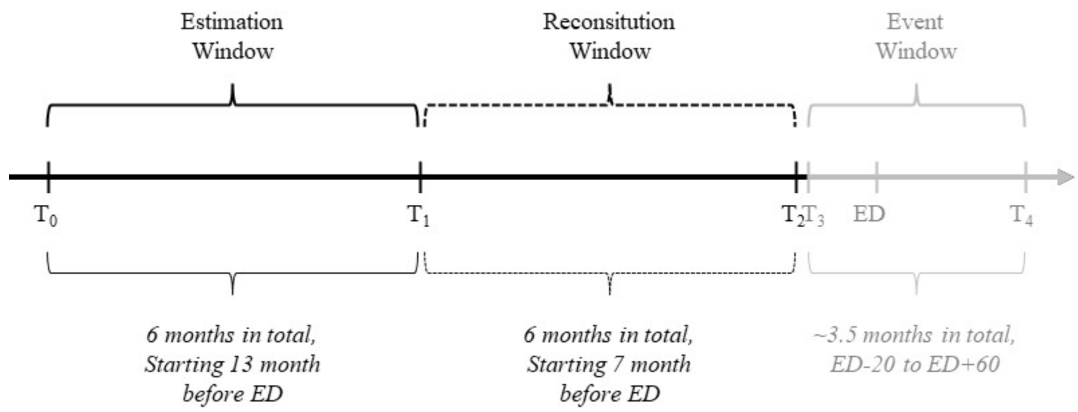
Table A.1

Individual Performance: Output

	Mean	T-stat	CI lower bound	CI upper bound
$\frac{\overline{V}_{\tau-143:\tau-23,i}}{\overline{V}_{\tau-265:\tau-142,i}}$	1.417	6.459	1.291	1.545

Figure A.1
Examining Individual Performance

This table provides an overview of the selected windows used to estimate individual performance leading up to the event window. The purpose is to examine if the firm was included or excluded from the index based on individual merits or relative competition. If individual performance remains unchanged from the estimation period to the reconstitution period (T_0 to T_2 in figure 2), this suggests that the reconstitution event was likely driven by relative competition among other stocks in the ranking. In contrast, if there is a change in performance between the estimation window and the reconstitution window (T_0 to T_2 in figure 2), this supports that the firm was included or excluded based on individual merits. However, ambiguity remains, as it is not possible to reject one hypothesis in favor of the other. The reconstitution event may have been influenced by both individual merits and changes in relative performance. The figure illustrates the event window, primarily to show the relationship between the estimation window and the reconstitution window. Note that the event window itself is not used in this estimation.



Appendix A.2: Volume ratio with dummy variables for event days

Table A.2 presents the regression results used to analyze increases in trading volume on the days surrounding the reconstitution date. The variables represent Recon at different time points (t) and are dummy variables indicating the day relative to the event date (ED), where t = 0 corresponds to the ED. The dependent variable is the volume ratio for each stock, calculated as specified in Equation 10. A positive coefficient indicates an increase in trading volume, while a negative coefficient indicates a decrease, both benchmarked against the average.

The results in table indicate no significant increases in trading volume on the ED. In fact, insignificant decreases are observed for both the OMXH25 and OMXC20 indices on this day. However, on the day preceding the ED (t = -1), significant increases in trading volume are observed across all indices except the OMXC20, which shows an insignificant decrease. The most substantial increase is observed for the OBX Index, with a rise of 118.5% on day t = -1.

Table A.2

Regression Output: Volume Ratio

A positive coefficient indicates an increase in trading volume, while a negative coefficient indicates a decrease, both benchmarked against the average. The independent variables indicate dummy variables for each day relative to the effective date. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level.

Panel A: Inclusions

Variable	All stocks	OBX	OMXB10	OMXC20	OMXH25	OMXS30
Recon t-3	-0.167	-0.018	0.013	-0.204	-0.383	-0.215
Recon t-2	0.115	0.021	1.437***	-0.215	-0.151	0.157
Recon t-1	0.707***	1.185***	1.051***	-0.038	0.513*	0.697**
Recon t	0.044	0.078	0.377	-0.109	-0.017	0.026
Recon t+1	-0.092	-0.131	0.492	-0.237	-0.173	-0.104
Recon t+2	-0.105	-0.188	0.506	-0.304	-0.344	0.144
Recon t+3	-0.013	-0.102	0.129	-0.237	-0.173	0.653*

Panel B: Exclusions

Variable	All stocks	OBX	OMXB10	OMXC20	OMXH25	OMXS30
Recon t-3	0.091	-0.119	0.668	0.755*	-0.278	-0.084
Recon t-2	1.559***	0.163	7.292***	4.511***	-0.226	-0.084
Recon t-1	1.031***	1.064**	0.975	0.294	1.864***	0.823**
Recon t	0.052	0.244	0.007	-0.083	-0.173	0.083
Recon t+1	0.277	-0.319	-0.165	-0.178	1.262***	1.343***
Recon t+2	-0.041	-0.237	-0.665	-0.358	-0.053	1.354***
Recon t+3	-0.144	-0.154	-0.978	-0.213	-0.208	0.666*

Appendix A.3: Regression Output

Table A.3

Regression output: CAR as dependent on Cumulative volume ratio

The price-volume relationship is interesting in testing the price pressure hypothesis. Consistent with Shleifer (1997) we test the association between abnormal trading volume (AV) and abnormal return (AR) by treating the AR as a dependent variable and AV as the independent variable to examine if the abnormal return is dependent on the abnormal volume. In line with Shleifer, we apply the following cross-sectional regression $AR_{i,\tau} = \alpha_i + \beta_1 VR_{i,\tau} + \epsilon_{i,t}$ to test this. If the volume ratio has a positive relationship to the abnormal return, this supports the downward sloping demand curve and price pressure hypothesis. Table 8 presents a cross-sectional regression. The dependent variable is the CAR over different intervals. The independent variable is the cumulative VR over the same period. A positive coefficient suggests a positive relationship between trading volume and CAR. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level respectively.

Panel A: Inclusions						
	Dependent variable (CAR)					
	-20:0	-5:0	-5:5	0:10	0:60	0:20
Cum. VR	-0.001	-0.005	-0.003	0.000	0.000	0.001
S.E.	(0.002)	(0.004)	(0.002)	(0.001)	(0.000)	(0.001)
Constant	-0.524	-1.141	-1.325	0.696	0.849	1.153
R^2	0.001	0.003	0.001	0.001	0.002	0.002

Panel B: Exclusions						
	Dependent variable (CAR)					
	-20:0	-5:0	-5:5	0:10	0:60	0:20
Cum. VR	0.000	0.001	0.000	-0.001	0.001	-0.001
S.E.	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)
Constant	-0.609	1.123	-0.150	-0.170	0.630	-0.403
R^2	0.002	0.001	0.002	0.001	0.002	0.001

Appendix A.4: Extended Abnormal Trading Volume

Table A.4

Average Abnormal Trading Volume

Table A.4 presents an extended version of the average daily abnormal trading volume surrounding the effective date (ED) across all stocks in each subset. Day 0 represents the ED of the reconstitution. The abnormal volume is defined as the difference between the actual daily volume and the normal daily volume where the normal volume is defined as the average trading volume over the estimation window. The standard error for each observation is presented in parentheses. The significance level is tested with a student t's test. All data is retrieved from Datastream. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level respectively. Standard errors are presented in parentheses below each observation.

Panel A: Inclusion						
Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-10	-6.06%	9.38%	-2.60%	9.97%	-38.28% ***	-9.21%
	(0.060)	(0.099)	(0.219)	(0.216)	(0.091)	(0.091)
-9	0.87%	43.72%	-15.33%	-17.55%	-17.73%	-17.24% *
	(0.167)	(0.544)	(0.175)	(0.141)	(0.104)	(0.076)
-8	-7.90%	0.75%	23.23%	-9.97%	-34.49%	-5.20%
	(0.066)	(0.073)	(0.298)	(0.117)	(0.181)	(0.146)
-7	-14.98% **	3.60%	-23.57%	-19.42%	-35.58% ***	-11.89%
	(0.046)	(0.100)	(0.145)	(0.101)	(0.089)	(0.086)
-6	-7.61%	19.54%	-33.96% *	-22.65% **	-6.62%	-22.08% *
	(0.088)	(0.269)	(0.125)	(0.074)	(0.110)	(0.085)
-5	-22.27% ***	-7.52%	-18.42%	-32.37% ***	-36.24% ***	-21.83% **
	(0.042)	(0.081)	(0.239)	(0.066)	(0.068)	(0.079)
-4	-24.03% ***	-17.80% **	3.10%	-8.61%	-45.77% ***	-35.83% ***
	(0.045)	(0.060)	(0.176)	(0.155)	(0.073)	(0.088)
-3	-17.78% ***	5.33%	-12.09%	-14.78%	-38.96% ***	-33.55% ***
	(0.044)	(0.091)	(0.158)	(0.117)	(0.073)	(0.071)
-2	6.36%	10.80%	86.53% **	-11.65%	-17.71%	2.59%
	(0.065)	(0.128)	(0.309)	(0.126)	(0.109)	(0.112)
-1	62.92% ***	115.75% ***	85.74%	1.33%	31.97%	61.46%
	(0.141)	(0.290)	(0.667)	(0.118)	(0.203)	(0.354)
0	2.46%	18.86%	31.23%	-7.89%	-12.33%	-10.46%
	(0.082)	(0.188)	(0.490)	(0.101)	(0.097)	(0.098)
1	-8.92%	-4.51%	68.50%	-18.99%	-25.62%	-25.80% ***
	(0.092)	(0.098)	(0.803)	(0.107)	(0.129)	(0.061)
2	-9.12%	-8.54%	58.92%	-22.46%	-41.30% ***	2.94%
	(0.092)	(0.098)	(0.803)	(0.107)	(0.129)	(0.061)
3	5.62%	0.97%	21.53%	-33.15% ***	-32.27% **	77.20%
	(0.082)	(0.092)	(0.649)	(0.114)	(0.090)	(0.142)
4	6.26%	12.57%	-4.63%	-17.52%	8.97%	19.59%
	(0.159)	(0.124)	(0.277)	(0.094)	(0.096)	(0.713)
5	-9.31%	-3.37%	-5.27%	-22.64%	3.80%	-22.22%
	(0.110)	(0.163)	(0.159)	(0.106)	(0.349)	(0.281)
6	-10.96% *	3.36%	-7.11%	-27.34% *	-10.73%	-19.58% *
	(0.082)	(0.105)	(0.216)	(0.158)	(0.286)	(0.113)
7	-14.43% *	-1.66%	9.70%	-30.39% **	-19.32%	-25.41% **
	(0.055)	(0.122)	(0.211)	(0.120)	(0.100)	(0.094)

8	4.45%	-1.13%	4.50%	0.71%	40.85%	-22.84% *
	(0.071)	(0.141)	(0.254)	(0.106)	(0.204)	(0.081)
9	-13.10%	-4.52%	-10.08%	-29.43% **	-6.39%	-20.04%
	(0.105)	(0.087)	(0.231)	(0.159)	(0.423)	(0.107)
10	-3.36%	13.37%	-8.23%	-1.41%	-5.47%	-24.25% *
	(0.068)	(0.113)	(0.206)	(0.097)	(0.216)	(0.119)

Panel B: Exclusion

Period	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-10	8.54%	3.87%	30.61%	18.76%	0.09%	5.41%
	(0.096)	(0.117)	(0.533)	(0.274)	(0.203)	(0.150)
-9	-2.23%	-5.17%	-38.72% **	-11.06%	9.51%	23.70%
	(0.102)	(0.100)	(0.125)	(0.112)	(0.405)	(0.180)
-8	5.69%	39.07%	-8.38%	-24.83% **	-6.90%	-12.13%
	(0.109)	(0.256)	(0.269)	(0.076)	(0.189)	(0.138)
-7	-15.70% *	7.67%	-58.14% ***	-29.38% **	-18.52%	-25.09% **
	(0.062)	(0.134)	(0.114)	(0.091)	(0.131)	(0.075)
-6	7.35%	28.56%	17.40%	-18.05%	1.06%	-11.93%
	(0.079)	(0.152)	(0.36)	(0.125)	(0.156)	(0.110)
-5	15.94%	12.40%	77.40%	2.36%	18.86%	-4.19%
	(0.156)	(0.161)	(1.135)	(0.237)	(0.372)	(0.236)
-4	30.30%	42.93%	180.74%	30.17%	-28.33% **	-14.21%
	(0.183)	(0.335)	(1.267)	(0.245)	(0.102)	(0.15)
-3	31.36%	4.01%	116.40%	140.23%	-20.11%	-17.17%
	(0.271)	(0.101)	(0.664)	(1.419)	(0.136)	(0.088)
-2	50.37% *	25.76%	407.86%	25.01%	-9.64%	-4.97%
	(0.242)	(0.132)	(2.308)	(0.149)	(0.152)	(0.103)
-1	139.76% ***	176.03% **	111.99%	27.67%	193.15% ***	126.47% **
	(0.262)	(0.623)	(0.784)	(0.138)	(0.393)	(0.374)
0	15.99%	42.18%	2.37%	4.80%	-8.15%	9.10%
	(0.161)	(0.421)	(0.238)	(0.173)	(0.101)	(0.137)
1	23.28%	-15.56%	10.63%	-9.06%	3.97%	209.05%
	(0.292)	(0.094)	(0.223)	(0.119)	(0.192)	(2.065)
2	27.19%	-3.28%	35.07%	-25.85% *	1.25%	215.44%
	(0.292)	(0.094)	(0.223)	(0.119)	(0.192)	(2.065)
3	22.70%	31.42%	-6.88%	-12.62%	-1.48%	109.02%
	(0.302)	(0.096)	(0.516)	(0.110)	(0.190)	(2.122)
4	29.02%	2.77%	-27.66%	-7.80%	11.92%	216.20%
	(0.224)	(0.320)	(0.223)	(0.129)	(0.148)	(1.368)
5	3.31%	-2.42%	8.12%	-29.84% **	-10.91%	83.13%
	(0.320)	(0.141)	(0.193)	(0.160)	(0.206)	(2.260)
6	96.34%	-0.31%	-24.08%	14.32%	395.62%	55.08%
	(0.146)	(0.115)	(0.330)	(0.108)	(0.179)	(0.939)
7	0.69%	-21.92% **	0.98%	26.21%	-0.93%	27.19%
	(0.866)	(0.128)	(0.198)	(0.343)	(3.862)	(0.794)
8	8.66%	-0.11%	4.46%	10.80%	6.41%	35.24%
	(0.104)	(0.077)	(0.295)	(0.344)	(0.156)	(0.460)
9	7.49%	3.07%	48.81%	28.89%	-19.83%	4.95%
	(0.100)	(0.105)	(0.245)	(0.233)	(0.221)	(0.396)
10	0.77%	17.92%	-5.20%	-4.02%	-9.51%	-16.14%

Appendix A.5: Extended Abnormal Trading Volume

Table A.5

Daily Abnormal Returns

Table A.5 presents an extended version output of our findings on the average daily abnormal return surrounding the effective date (ED) across all stocks in each subset. These show the largest effect on the $\overline{CAR}$ over the event windows presented later in table 10. Day 0 represents the ED of the reconstitution. The abnormal return is defined as the actual return minus the expected return as determined by the CAPM. The significance level is tested with a student t's test. All data on daily stock prices is retrieved from Datastream and daily market return is retrieved from Kenneth R. French's' data library. The values given in parentheses is the standard error of each observation. The symbols *, **, and *** denote significance at the 10 %, 5 %, and 1 % level respectively. Standard errors are presented in parentheses below each observation.

	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
Panel A: Inclusions						
-5	-0.05%	-0.89%***	0.19%	0.76%	0.47%	-2.26%***
	(0.003)	(0.003)	(0.005)	(0.011)	(0.008)	(0.008)
-4	-0.69%***	-1.09%***	-0.19%	-0.65%***	-0.70%**	0.91%
	(0.004)	(0.004)	(0.004)	(0.002)	(0.003)	(0.007)
-3	-0.49%**	-0.72%*	0.64%	0.03%	-0.50%	-2.65%***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
-2	-0.01%	1.72%***	1.36%***	-14.78%***	-0.98%	1.60%***
	(0.002)	(0.005)	(0.005)	(0.022)	(0.011)	(0.006)
-1	0.56%	-0.38%	0.50%*	0.05%	1.47%	0.49%
	(0.004)	(0.003)	(0.003)	(0.002)	(0.013)	(0.005)
0	0.55%**	1.11%***	-0.31%	0.00%	0.26%	1.65%*
	(0.004)	(0.003)	(0.003)	(0.003)	(0.008)	(0.009)
1	-0.08%	0.03%	-0.28%	0.11%	0.00%	-0.94%
	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.006)
2	0.06%	0.24%	0.09%	-0.73%*	0.43%	0.40%
	(0.005)	(0.005)	(0.002)	(0.004)	(0.005)	(0.005)
3	-0.24%	0.04%	0.29%	-0.28%	-0.64%**	-0.58%
	(0.005)	(0.005)	(0.002)	(0.004)	(0.003)	(0.004)
4	-0.49%	-0.09%	0.08%	-0.28%	-1.65%	0.21%
	(0.004)	(0.004)	(0.003)	(0.003)	(0.016)	(0.008)
5	3.29%	-0.45%	0.53%**	0.30%	12.98%	-0.59%
	(0.004)	(0.003)	(0.003)	(0.003)	(0.125)	(0.006)
Panel B: Exclusions						
-5	-1.05%***	-1.05%***	-1.05%***	-1.05%***	-1.05%***	-1.05%***
	(0.003)	(0.003)	(0.005)	(0.011)	(0.008)	(0.008)
-4	-0.60%	-1.09%***	-0.19%	-0.65%***	-0.70%**	0.91%
	(0.004)	(0.004)	(0.004)	(0.002)	(0.003)	(0.007)
-3	0.09%	-0.72%*	0.64%	0.03%	-0.50%	-2.65%***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)
-2	0.23%	1.72%***	1.36%***	-14.78%***	-0.98%	1.60%***
	(0.002)	(0.005)	(0.005)	(0.022)	(0.011)	(0.006)
-1	0.44%	-0.38%	0.50%*	0.05%	1.47%	0.49%
	(0.004)	(0.003)	(0.003)	(0.002)	(0.013)	(0.005)

0	1.04%***	1.11%***	-0.31%	0.00%	0.26%	1.65%*
	(0.004)	(0.003)	(0.003)	(0.003)	(0.008)	(0.009)
1	-0.55%	0.03%	-0.28%	0.11%	0.00%	-0.94%
	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.006)
2	0.45%	0.24%	0.09%	-0.73%*	0.43%	0.40%
	(0.005)	(0.005)	(0.002)	(0.004)	(0.005)	(0.005)
3	0.26%	0.04%	0.29%	-0.28%	-0.64%**	-0.58%
	(0.005)	(0.005)	(0.002)	(0.004)	(0.003)	(0.004)
4	-0.33%	-0.09%	0.08%	-0.28%	-1.65%	0.21%
	(0.004)	(0.004)	(0.003)	(0.003)	(0.016)	(0.008)
5	0.50%	-0.45%	0.53%**	0.30%	12.98%	-0.59%
	(0.004)	(0.003)	(0.003)	(0.003)	(0.125)	(0.006)

			Panel A: Inclusions			
	Full Sample	OBX	OMXB10	OMXC20	OMXH25	OMXS30
-1	0.56%	-0.38%	0.50%*	0.05%	1.47%	0.49%
	(0.004)	(0.003)	(0.003)	(0.002)	(0.013)	(0.005)
0	0.55%**	1.11%***	-0.31%	0.00%	0.26%	1.65%*
	(0.004)	(0.003)	(0.003)	(0.003)	(0.008)	(0.009)
			Panel B: Exclusions			
-2	0.23%	1.72%***	1.36%***	-14.78%***	-0.98%	1.60%***
	(0.002)	(0.005)	(0.005)	(0.022)	(0.011)	(0.006)
-1	0.44%	-0.38%	0.50%*	0.05%	1.47%	0.49%
	(0.004)	(0.003)	(0.003)	(0.002)	(0.013)	(0.005)
0	1.04%***	1.11%***	-0.31%	0.00%	0.26%	1.65%*
	(0.004)	(0.003)	(0.003)	(0.003)	(0.008)	(0.009)