LUND UNIVERSITY
School of Economics and Management

Investigating the Price and Volume Effects following Changes on OMX Nordic Indices

Master Thesis in Finance
Lund University School of Economics and Management
May 2019
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Abstract

In the last decade, there has been a substantial shift from actively managed funds to funds with passive investment strategies. This shift was also observed by Shleifer (1986), who identified that passive investment funds began to significantly increase their ownership of the S&P 500 in the period between 1975 and 1983. As the ownership of the stock market increased as the number of index funds grew, researchers noticed that stocks experience positive (negative) abnormal returns following inclusions (exclusions) to (from) an index. The phenomenon is denoted the index effect and has been investigated by numerous scholars since the discovery. Different theories have been developed in order to explain the index effect. However, the causes of the effect are still under debate. The purpose of this research is to investigate the index effect on three Nordic stock indices; OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30. There have been few extensive attempts at examining the index effect on Nordic stocks. Therefore, we aim to contribute to the existing field by investigating a longer period, and consequently by including more observations without deviating from the Nordic markets. An event study methodology has been utilized to test whether the stocks included (excluded) in (from) these indices generate positive (negative) abnormal returns. Furthermore, the existence of abnormal volume will be investigated. The sample consisted of 171 firms, over the period 1999 to 2018. Our findings reveal that no significant abnormal returns could be identified. However, large and significant abnormal trading volume was observed the day before the index recomposition. Given that abnormal trading volume possesses some explanatory power when it comes to the index effect, we were able to discover patterns that supported certain existing hypotheses. The results indicate that there is a minor positive (negative) price revision for included (excluded) stocks around the event date, followed by a reversion within five trading days, which supports the price pressure hypothesis. However, over a longer period after the event date, we observed that inclusions (exclusions) had a stable positive (negative) cumulative abnormal return. Over the same period, inclusions (exclusions) had increasing (decreasing) abnormal volume, which suggests that improved liquidity leads to price revisions that stabilize after the event.

Keywords: Index Effect, Abnormal Returns, Abnormal Trading Volume, Event Study.

Acknowledgements

We would like to express our gratitude towards everyone who participated and contributed to the success of this paper.

Firstly, we would like to thank our supervisor, Frederik Lundtofte, for his exceptional advice and expertise. The ideas, recommendations and experience he provided assisted us in fulfilling the purpose of this study to the best of our ability.

Secondly, Hossein Asgharian who participated in our seminar group dedicated time and effort to this thesis and provided valuable feedback, which has helped us improve the paper. For that, we are very grateful.

Finally, thanks to Jens Forssbaeck who provided us with valuable guidelines and instructions that helped us throughout this Master Thesis course.

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Introduction

Background

In the last decade, there has been a substantial shift from actively managed funds to funds with passive investment strategies. Most notably in the United States, where passive index funds have experienced a massive fund inflow since the financial crisis in 2008 (Fichtner, Heemskerk & Garcia-Bernardo, 2017). However, Shleifer (1986) noted that passive index funds began attracting considerable interest as early as 1975. Actively managed funds set out to generate returns in excess of the market return, whereas the passively managed funds' objective is to replicate the return of the market. Because the market return is not observable, it can be proxied by an index. Moreover, active investment strategies are more costly, which consequently leads to higher fees for investors. In contrast to actively managed funds, passive index funds have lower management fees and employ a buy-and-hold strategy which seeks to replicate existing stock indices (Fichtner et al. 2017). These indices do periodically review their composition based on some specific factors, which occasionally leads to the exclusion of stocks that fail to meet the requirements and in turn, the inclusion of new stocks into the index. As the passive investment vehicles replicate the index, they must reallocate their portfolios when the index composition changes, which affects the supply and demand of the included and excluded stocks. Firms included in an index generally enjoys positive abnormal returns while excluded firms suffer negative abnormal returns, and the phenomenon has been denoted the index effect. Numerous scholars have investigated whether the announcement of a firm being included or excluded from an index have any effect on a firm's stock price, and have found evidence supporting this effect. Chen, Noronha, and Singal (2004) states that, for investors, this has been a lucrative trading strategy for many years.

The efficient market hypothesis suggests that stocks prices should remain unaffected by index inclusions or exclusions, due to the implied flat demand curve for stocks. Furthermore, if there exists an anomaly in stock returns following index inclusions, or exclusions, these profit opportunities should be traded away by arbitrageurs. The index effect as a phenomenon has persisted for a long time, despite substantial literature being presented since the early research on the subject. Therefore, one must question whether the index effect violates the notion of efficient markets or if the price changes are a result of rational investor behavior. Amihud and Mendelson (1986) suggest that prices should reflect the liquidity premium, which they measure as the bid-ask spread, and that differences in bid-ask spreads has a greater impact on excess returns in the short term. Furthermore, the bid-ask spread is negatively correlated with liquidity (Amihud & Mendelson, 1986). It is therefore possible that improved liquidity in the form of increased trading volume plays a role in explaining the index effect.

Purpose

The purpose of this research is to investigate the presence of the index effect on prices of stocks listed on three Nordic indices; OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30. The aim is, therefore, to determine if, and to what extent, stock prices are affected by inclusions (exclusions) to (from) the indices.

Many similar studies have been made on the S&P 500 index. However, the criteria of the S&P 500 differs from those of the Nordic indices investigated in this study. The difference is that that the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices do not select their constituents based on firm-specific qualities of the stocks, as it only considers market capitalization and trading volume. Because information about market capitalization and trading volume is publicly available, inclusions or exclusions from these indices should not provide any new information to investors. However, the extant literature on the subject has provided empirical support for abnormal stock returns when these events occur, but mostly on larger indices such as the S&P 500 and FTSE 100. This research will provide new insights into the phenomenon of the index effect, when contrasted to the existing literature that investigated other indices. Because the assumption that a recomposition of the Nordic OMX indices does not convey any new information, it is possible to study the index effect in isolation.

Research Questions

Given the problems identified in the preceding sections, the following questions were formulated in order to investigate the topic:

1. Does there exist an index effect on the stocks included or excluded from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices?
2. If an index effect can be identified, are the abnormal returns temporary, or do they persist over a longer period?

Delimitations

This research will not investigate the stocks' bid-ask spread following inclusions and exclusions from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices. However, abnormal trading volume will be investigated, and we assume that increased (decreased) trading volume will ultimately lead to lower (larger) bid-ask spreads.

This study investigates the index effect on Nordic stocks. However, the Norwegian stock exchange will be excluded from this research. The reason for this exclusion is due to minor differences in how the index constituents are selected. We decided only to include indices that have the same method of selecting constituents.

Due to difficulties with determining the announcement date of the index changes, we decided to only investigate the event date when the index changes are made effective. The OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices do not have a standardized period were the announcement is made, which makes it difficult to isolate the date. The event window, which will be centered around the event day, will instead incorporate the announcement day.

Outline of the Thesis

The outline of the thesis strives to provide a logical flow of information. First, previous literature on the index effect is presented, where the theoretical framework is integrated and developed based on this section. This section will outline the theories underlying the index effect in relation to the previous literature. Second, the methodology is presented, and the assumptions underlying this research will be discussed. Lastly, the analysis and discussion of the empirical evidence are presented.

Previous Literature & Theoretical Framework

Researchers within the finance literature have extensively examined various aspects of the stock market; such as pricing, risk, and market efficiency. The stock market is an area that has experienced considerable attention, providing interesting avenues for further research. One such area is the phenomenon denoted the index effect, where the returns of stocks are affected by the inclusion to, or exclusion from, a specific index. The observation that included firms experience significant positive abnormal returns have attracted attention from investors and has proved to be a lucrative trading strategy (Chen et al. 2004). Several researchers have tried to connect index effects to the efficient market hypothesis, but since the early studies arose, additional explanations have been developed, which will be presented in the subsequent sections.

The Index Effect

The index effect can be described as the price pressure that is experienced when a stock is included or excluded from an index (Kappou, Brooks & Ward, 2010). Because passive index funds track a specific index, they must reallocate their portfolios as the index composition changes, to minimize their tracking error. When stocks are included in an index like the S&P 500, the index funds tracking it must purchase the stock which temporarily affects the demand, and the converse is true for exclusions. Shleifer (1986) observed that, up until 1975, it is estimated that passive index funds owned less than 0,5% of the S&P 500 index, but increased their ownership substantially to 3,1% in 1983. He also noted that, before 1976, no abnormal returns could be identified from index inclusions or exclusions, but it began to increase gradually as the index funds increased their relative ownership of the S&P 500. Because the index ownership by passive investment vehicles steadily increased as the average abnormal return for firms included in an index rose, there seems to exist a relationship between the two. This phenomenon lays the foundation for what is called the index effect. The research by Shleifer (1986) suggests that the size of the abnormal return resulting from an index inclusion or exclusion is positively related to the relative index ownership by passive investment vehicles.

Empirical Evidence on the Index Effect

Lynch and Mendenhall (1997) found that changes to the S&P 500 index composition generated abnormal returns among added firms following the announcement date of the inclusion. Chen et al. (2004) found similar results, claiming that when firms are included in an index, it conveys positive information about the firm. In other words, the authors argue that investors' perception of the longevity and prospects of the firm is enhanced when a firm is included, which then affects the stock price positively. Other researchers (Elliott & Warr, 2003; Kappou et al. 2010) agree that there are increased demand and subsequent price effects due to the reallocation of stocks in the index funds taking place. Passive investment vehicles that track a specific index will buy (sell) the newly included (excluded) stocks, respectively, which increases demand (Elliott & Warr, 2003).

Furthermore, Blume and Edelen (2001) state that most index funds exercise a full replication strategy. The aim of these passive funds is generally to minimize the tracking error, meaning that the performance of the fund should mirror the performance of the index. Blume and Edelen (2001) also found that the demand shock associated with inclusion is not driven by new information. Therefore, these securities seem to experience abnormal returns despite a lack of new information, which opposes the view of the efficient market hypothesis (Fama, 1970). However, another explanation of the index effect was provided by Hedge and McDermott (2003), suggesting that liquidity plays an important role in these price effects. In essence, they argue that increased attention by the public is, to some extent, the result of being included in an index. While it is not a direct relationship, it has been asserted that awareness affects the liquidity through higher trading volume when more attention is directed to the stocks (Chen et al. 2004; Hedge & McDermott, 2003). Also, they argue that there is greater interest in the S&P 500 firms, which generates more information, resulting in reduced information asymmetries and improvements in liquidity. Therefore, when a firm is included, the transaction costs are reduced, and the liquidation of indexed stocks can occur much faster. Conversely, the trading activity on stocks that are excluded from an index will become less liquid. Hence, the inclusion or exclusion seems to suggest that a liquidity premium is incorporated into the price of the security.

A majority of the mentioned studies have been conducted on the S&P 500 index, but similar observations have been made on, e.g., the FTSE 100 and Russell 2000 indices (Chen et al. 2004; Mase 2007). Bechmann (2002) investigated the index effect on stocks in the Danish KFX Index, and the results were in line with previous research. While the index effect seems to be a global phenomenon, the magnitude of the effect might vary between different markets and stock exchanges. Elliott and Warr (2003) investigated the demand shocks as a result of the addition to an index on both Nasdaq and NYSE and found that when firms were added to the S&P 500 index and traded on Nasdaq, they experienced 2,5% higher price reactions than additions of firms that were traded on NYSE. The authors investigated whether Nasdaq's dispersed dealer system is better able to minimize the price impact of additions, in contrast to the specialist system of NYSE. NYSE argues that its centralized specialist system can see the "big picture" and manage the supply more effectively. Also, they have the benefit of investor-supplied liquidity by the limit order book, which means that the specialist can prioritize and tailor the trades better to reduce price effects. On the other hand, Nasdaq argues that their dispersed dealer system implies greater competition for order-flow among investors, and dealers can diversify their positions and, therefore, they are willing to make a market in the newly added stock. Essentially, NYSE is centralized and automated in the way it manages the supply, whereas Nasdaq is market makers and enables a smoother flow of the financial market, thus making it easier to buy and sell securities. Since Nasdaq experience greater price reactions from inclusions, Elliott and Warr (2003) interpret this finding as evidence that NYSE's system is better able to mitigate demand shocks than Nasdaq's. Hence, it is possible that the index effect varies depending on what market or stock exchange the firm is listed on.

In the following sections, related hypotheses will be outlined, and brief arguments on the relevance of each hypothesis for this study will be presented.

Liquidity Hypothesis

Hedge and McDermott (2003) investigated liquidity effects resulting from revisions to the S&P 500 index. They found that if a firm is added to the index, then there is a sustained increase in liquidity, and the increase in liquidity is mostly attributed to a decrease in transaction costs. The authors mainly focus on the bid-ask spreads for measuring the liquidity, yet acknowledges that these spreads aren't always reliable in measuring trading costs. They state that the true cost of transaction is often overstated, since many trades are executed within the quoted spreads. Nevertheless, if a stock is excluded from the index, the liquidity of that stock will subsequently decline. Both the increase and the decrease in liquidity, depending on whether a stock is included or excluded, have been examined over time to enable the authors to see whether these effects were persistent for more than three months. The authors also documented long-term abnormal trading volume for included stocks, as well as abnormal trading volume at the date of the event. This is in accordance with the study made by Harris and Gurel (1986), who found that the trading volume for an included stock had substantially increased and persisted for over a year.

Furthermore, Hedge and McDermott's (2003) findings are in line with that of Shleifer (1986) and Chen et al. (2004), namely that an inclusion to an index leads to more scrutiny of the firm by analysts and investors. They argue that this is because the information provided and the various analyses conducted by different trading firms attract institutional interest, which consequently increases the trading volume. Also, increased visibility of the firms associated with the index addition is likely to increase the flow of public information about the stock, which might induce less informed investors to engage in trading. Hedge and McDermott (2003) found a positive relationship between increased liquidity and positive abnormal returns of newly included stocks. Conversely, stocks that were excluded from the index suffered negative abnormal returns and reduced liquidity. However, Hedge and McDermott (2003) found that only a fraction of the abnormal returns can be attributed to this liquidity measure.

Since the previous literature suggest that increased trading volume of included stocks is accompanied by positive abnormal returns, one may argue that the abnormal returns are a consequence of a reduced liquidity premium. Assuming that the bid-ask spread is an adequate measure of the liquidity premium, tests of abnormal trading volume might provide further insight into the existence of the index effect. This research will therefore investigate the abnormal trading volume of stocks included and excluded from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices.

Awareness Hypothesis

Chen et al. (2004) investigated the price effects of changes to the S&P 500 index and managed to document asymmetric price responses. If investor awareness increases for inclusions, one may argue that investor awareness should decrease for exclusions. In other words, if investors would view inclusions and exclusions in a binary manner, then the perceived benefits from the increased awareness the inclusion brings should be equivalent to the corresponding loss of those benefits for exclusions. Therefore, it is tempting to assume that the effects are symmetrical. To understand the asymmetric effects, they introduced investor awareness as a variable. The authors reiterated the point made by Hedge and McDermott (2003) that when a firm is added to an index, increased monitoring and public scrutiny raise the awareness of the firm among investors. Therefore, if a company is added to an index, the price response should be at least partly explained by increased investor awareness. Conversely, if a firm is excluded from the index, investor awareness should fall. Interestingly, though, the fall in investor awareness for exclusions was of lesser magnitude than the corresponding rise for inclusions. Chen et al. (2004) argue that there are a few reasons why investor awareness and increased monitoring could lead to improved performance. One explanation is that greater interest in the S&P 500 raises the expectations of future cash flows. They believe these expectations force the firms to perform more efficiently and to make more value-enhancing decisions if monitoring has become more effective. Another explanation provided is that membership in the S&P 500 improves the firm's ability to attract capital. The additional capital they manage to attract then enables the firm to grow at a higher rate than before the inclusion. However, because the rise in investor awareness is of greater magnitude for inclusions than the fall for exclusions, these benefits do not disappear entirely for excluded firms. Hence, they argue that the price responses are asymmetric.

On another note, Mase (2007) concluded that the investor awareness hypothesis and increased monitoring due to index membership fails to explain these price effects. He argues that this only applies to firms that are completely new to the index, i.e., a first-time inclusion and exclusion. It is quite common that the same firm is both included and excluded more than one time over a set of years. Mase (2007), therefore concludes that this hypothesis does not apply to all changes in the index composition. His study, though, was conducted using data from the FTSE index, whereas Chen et al. (2004) examined the S&P 500. It is, therefore, possible that firms included (excluded) in (from) S&P 500 are more prone to being affected by increased (decreased) awareness than other indices. Specifically, it is possible that there is a larger variety in the number of firms being included or excluded from the index, which might make the investor awareness hypothesis more suitable for the S&P 500.

Many of the companies included in any of the three Nordic indices examined in this report are relatively well-known and is written about extensively in the media. It is possible that inclusions (exclusions) to (from) the indices will not improve investors' awareness of the firms. Hence, one may argue that the investor awareness hypothesis will have limited relevance for this study.

Imperfect Substitutes Hypothesis

If there exist perfect substitutes between stocks, Scholes (1972) argued that their demand curves should be flat, as arbitrage opportunities between perfect substitutes should be possible. In contrast to the perfect substitutes hypothesis, the imperfect substitutes hypothesis argues that stocks have downward sloping demand curves since stocks do not have perfect substitutes. Wurgler and Zhuravskaya (2002) argue that stocks do not have perfect substitutes, which implies that the arbitrage strategy described by Scholes (1972) is not riskless. Arbitrageurs should, therefore, be rewarded for accommodating excess demand caused by index fund portfolio reallocation. The interpretation of their findings is that this risk prevents arbitrageurs from flattening the demand curve of stocks. The imperfect substitutes hypothesis predicts that stock prices will adjust to eliminate excess demand, and abnormal trading volume should persist momentarily until a new equilibrium is reached (Kappou, Brooks & Ward, 2007). Furthermore, the imperfect substitutes hypothesis assumes no long-term stock price reversals after the event.

The imperfect substitutes hypothesis effectively makes the same assumption as the downward-sloping demand curve for stocks hypothesis, as both hypotheses predict downward sloping demand curves. Shleifer (1986) found evidence suggesting that demand curves slope downwards, due to an observed positive relationship between the rise in stocks' prices and shifts in the stocks' demand curves, in a setting where no additional information from the inclusion was assumed.

As we assume that inclusions or exclusions from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices do not provide investors with any new information, the index effect can be examined by investigating abnormal returns and abnormal trading volume of included and excluded stocks. If abnormal returns and abnormal volume are observed, the results could provide support for the imperfect substitutes hypothesis.

Price Pressure Hypothesis

Harris and Gurel (1986) conducted a study on the price pressure hypothesis on the S&P 500 index, when passive index funds reallocate their portfolio. Because the changes to the index composition should, theoretically, not convey any new information about future returns, an investigation into why these stocks experience abnormal returns is necessary. However, notable researchers on the subject have observed indications that there is some qualitative judgment on the new constituents, implying that those who engage in the index reviews have superior (inside) information that is not available to the public (Cai, 2007; Jain 1987). Nevertheless, the authors argue that inclusions and exclusions cause shifts in the demand for the securities. The reason for these shifts is predominantly a result of constituent changes to the indices. Therefore, by studying the effects on price and volume, they investigated whether the price pressure hypothesis could explain these shifts. In Harris' and Gurel's study (1986), they tested what would happen if it was announced that a security was going to be added to the index, and if all index funds purchased that security. They found that the demand should rise by almost 6% at the end of 1983 (Harris & Gurel, 1986). Given that it is unlikely that changes in the composition convey new information, this demand shift led the authors to investigate price pressures in the absence of new information. Over the years 1974-1983, the trading volume increased dramatically, especially in the later half of the sample period. The authors attribute this increase to the substantial growth of index funds during the period, which Schleifer (1986) also commented on in his study. Moreover, this finding was indicative of changes in demand, and by using an event study methodology, Harris and Gurel (1986) found evidence supporting immediate price increases for added securities. The authors described a concept called the "no-information assertion," where they presented three arguments as to why the changes in index composition convey no information. First, if any information about the prospects of the stock is associated with changes in the index composition, information-motivated investors would seek to obtain it as fast as possible. But because of the limited interest in obtaining this information, and that most inquiries were from index fund managers, they concluded that there was no evident information-value effect. Secondly, because of the substantial growth of index funds during this period, if the announcement of an addition conveys new information about the future prices of the stocks, post-announcement prices should increase in both halves of the sample. However, they only observed significant price increases in the second half. Therefore, this result was inconsistent with the information hypothesis. Lastly, any changes to the S&P 500 index should permanently affect prices if new information is disclosed. Under the assumption that inclusions and exclusions contain information, prices would not revert. However, Harris and Gurel (1986) found that the prices did revert. Because the efficient market hypothesis (assuming information) and the imperfect substitutes hypothesis (assuming no information) predicts that there should be no reversal, the argument for a price pressure effect gains more support when the prices do revert. When Harris and Gurel (1986) examined the post-announcement price effect between 1973-1977, the abnormal returns for inclusions were only 0.21%. However, between the years 1978-1983 the abnormal returns for inclusions amounted to 3,13%. Considering only the sheer amount of index funds that arose during the latter period, and given that trading volume per se does not contain new information, their findings did not support an efficient market (Harris & Gurel, 1986). However, significantly positive post-announcement effects on the stock price do support the existence of a price pressure effect. Lastly, though, the question of whether the index effect is temporary or permanent remains enigmatic among scholars.

The price pressure hypothesis serves as the foundation for how to assume that the index effect will impact the stocks included or excluded from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices. Price reversion can be tested by allowing the event window to stretch out over a longer period. If prices tend to revert, it provides support for the assumption that abnormal returns are created due to temporary shocks to the stock's demand. Furthermore, by investigating the existence of abnormal volume following the event, and how it develops over a longer period, one can investigate whether abnormal volume provides support for the price pressure hypothesis.

Information Hypothesis

Shleifer (1986) mentions that inclusion to the S&P 500, and other indices, might have some information value that causes abnormal returns. The theory suggests that inclusions and exclusions hold some information about the quality of the firm. Hence, the information hypothesis might be an additional factor in explaining the index effect. Cai (2007) studied the price and volume reaction of the industry and size matching firms of the added firms. "Matching firms" essentially implies that they are in the same industry as the included (excluded) firm and that they are of approximately the same size. When a firm is added to an index, many argue that there is excess demand which drives up the price of the stock. The benefit, therefore, of using matching firms is that they should not be affected by any excess demand induced by the index addition (Cai, 2007). By this notion, if there are any price effects on the matching firms, then it is likely that the inclusion (exclusion) conveys positive information about the industry and size segment of the firm that was included (excluded) to (from) the index. Like many other studies on the topic of the index effect, it is conducted on the S&P 500 index. As stated in Cai's (2007) article, the S&P 500 does not account for any firm-specific characteristics other than those specified. However, S&P 500 seeks to avoid excessive volume and return from index membership when possible. Additionally, in the "S&P 500 Index Methodology", Cai (2007) cites S&P 500, stating that it "does include the assumption that the company is going to remain in business." Based on this argument, it is also likely that there is information associated with index membership. From the results in his study, Cai (2007) found that the industry and size matching firms of the included stocks also experienced significant positive price reactions. However, he did not find evidence of any increases in the trading volume for the matching stocks. Nevertheless, his evidence suggests that S&P 500 index additions do convey information about the industry and size segment, which, at least partly, explains the price effect. In a study by Denis, McConnell, Ovtchinnikov, and Yu (2003), they point out that there are two relevant lines of thought about the inclusions with respect to the information above. The first one is that S&P has favorable information about a firm and its industry, which then ultimately leads to the addition. The second argument is that the index addition event itself leads to better performance by the added firm. However, Cai (2007) argues that, because he found that the industry and size matching firms also reacted positively to the addition, it is only consistent with the first argument. Taking this into account, he indirectly rejects the explanation provided by Chen et al. (2004), that index inclusions raise the expectations of the included firm's future cash flows and thereby leads to improved future performance. Therefore, Cai (2007) argues that it is more likely that information about the firm's future performance has resulted in an index addition, rather than the firm improving its future performance as a result of the addition.

The selection criteria for including or excluding firms to any of the chosen indices in this study are based on market capitalization and trading volume, which is public information. In contrast to the S&P 500, the Nordic indices give no indication on whether they expect the firm to remain in business. Therefore, it is argued that the information hypothesis should pose little relevance for this study.

The Efficient Market Hypothesis in Relation to the Index Effect

The efficient market hypothesis, developed by Eugene Fama (1970), states that in an efficient market; stock prices always reflect all information available to investors, and only new information should affect stock prices. The efficient market hypothesis essentially suggests that if a security is accurately priced, then trading volume should not affect stock prices because no new information is revealed (Fama, 1970). However, Scholes (1972) notes that stock prices were positively (negatively) affected by large volumes of stock purchases (sales). Whether this effect is attributable to downward sloping demand curves or if the transaction contains information that can alter the stock price is inconclusive (Scholes, 1972; Shleifer, 1986). As mentioned, there are numerous theories which set out to explain the index effect. If these theories are correct in the explanation of the index effect, then it is ambiguous whether the index effect violates the efficient market hypothesis. However, if the stock price reactions to the index effect are rational, then the price adjustment should be realized instantaneously.

Without regards to the appropriate index effect on stocks following an index inclusion or exclusion, the market efficiency can be investigated by studying the speed at which stock prices adjust. Recent studies found evidence suggesting that the abnormal returns generated from the index effect have diminished over time. Kappou et al. (2010) noted that a majority of the abnormal returns were generated between the announcement day and the next day's market opening. Kim, Li, and Perry (2017), also found that the abnormal stock return from index inclusions are generated between the close on the announcement day and the market opening the next day. The authors state that stock prices are adjusting at a faster pace compared to past research, which means that profitable trading possibilities on index inclusions/exclusions are limited. Although Kim et al. (2017) found that stock prices are adjusting to the index change announcement faster, the results also show that prices tend to revert following the initial spike. These results could suggest that market participants overreact to the information initially. Another consideration of market efficiency with regards to the index effect is the investigation of price stability following the index change. Chen et al. (2004) found that the cumulative abnormal returns of index inclusions were relatively stable from the announcement day to 60 days after the announcement, disregarding a minor spike on the effective reallocation day. However, prices of stocks excluded from the index tend to recoup much of the losses made between the announcement day and the effective day, over 60 days after the announcement (Chen et al. 2004).

Because this study investigates the existence of the index effect on stocks listed on the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices, the information value of such an announcement must be discussed in order to predict the appropriate stock price adjustment following the announcement. As mentioned earlier, the member compositions of these indices are based on publicly available information, which means that the information about the new index composition is already attainable by the market participants, ahead of the announcement. Therefore, the index composition announcement should not contain any new information that could influence the stock prices. If, however, abnormal returns are observed for stocks included or excluded from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30, one should investigate the rate at which the prices adjust to the event to determine market efficiency. Furthermore, the existing explanation for the index effect must be considered before suggesting that the index effect violates the notion of efficient markets.

Literature Gap

There is no universally agreed-upon explanation for the index effect, and the evidence brought forward is highly inconclusive as to whether the stock price effects are permanent or temporary (Bechmann, 2002). A majority of the previous literature on the index effect has been conducted on indices tracking U.S stocks, especially the S&P 500 index. Since the S&P 500 index places criteria about operational longevity on its constituents, it might cause an inclusion or exclusion to be seen as an information signal by investors. In contrast, the index composition of OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 is determined by market capitalization and trading volume. As the market capitalization and trading volume are public information, the announcement of inclusion or exclusion from these indices should not reveal new information to market participants. Therefore, by conducting the research on OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices, the index effect can be studied in isolation from new information. There have been some attempts at examining the index effect on specific Nordic markets. However, this research can contribute to the literature by investigating the index effect on Nordic stocks in more recent years.

Method and Data

Data Collection and Structuring

This study investigates the price effect on stocks included or excluded from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices, where each index is reviewed semi-annually. Due to a lack of complete historical price data from Bloomberg, our sample covers the period between 1999 and 2018. Data on the index compositions were retrieved from Bloomberg, and the differences in the member composition between the review periods constitute the inclusions and exclusion for that period. Furthermore, the results were then compared to Thomson Reuters' "Leaver - Joiner"-list to verify the sample. Daily price data for each stock in the sample and the reference indices were collected from Bloomberg, for both the estimation period and the event window.

The initial sample of inclusions and exclusions amounted to 251 firms. However, 80 of these observations were deleted due to lack of price data, M&A activity, or spin-offs. The final sample consisted of 171 firms, of which 91 were inclusions, and 80 were exclusions. Table 1 shows the distribution of the index inclusions and exclusions over the period investigated.

Table 1. *Number of Observation*

	OMX Helsinki 25		OMX Copenhagen 20		OMX Stockholm 30	
	Inclusions	Exclusions	Inclusions	Exclusions	Inclusions	Exclusions
1999 - 2018	**40**	**35**	**35**	**32**	**16**	**13**
1999 - 2008	33	28	18	14	11	8
2009 - 2018	7	7	17	18	5	5

OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30

The OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices are tradable indices representing the largest and most liquid stocks in Finland, Denmark, and Sweden respectively. The OMX Copenhagen 20 index portfolio constituents are selected based on rankings of two main criteria; market capitalization and trading volume. The OMX Helsinki 25 and OMX Stockholm 30 index constituents are based on trading volume. The indices are reviewed semi-annually, which may lead to a recomposition of the firm constituents.

Event Study

Schleifer (1986) was an early academic who observed significant abnormal returns at the announcement of an inclusion to the S&P 500 and recommended that an event study methodology should be applied when investigating the index effect. This research will also utilize an event study, as it has been the standard method used in the literature concerning the index effect. Specifically, this study will draw upon the event study methodology developed by MacKinlay (1997). There are three key aspects to consider when conducting an event study, namely: Event Date, Event Window, and Estimation Window. First, the Event Date, which is the effective date of the index recomposition, must be determined. Secondly, the Event Window represents the time frame in which the impact of the event is examined. Finally, the Estimation Window is where the parameter estimates are calculated, which are then used to compute the normal returns.

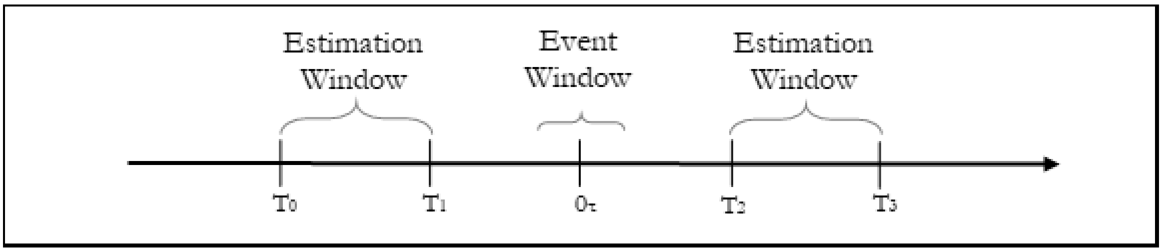

Figure 1. *Estimation Windows and Event Window*

Event Window

Because the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices select member constituents based on publicly available information, there is a possibility for investors to anticipate changes to the index composition ahead of the announcement. Therefore, the event window will be designed to account for this possibility. Furthermore, as the announcement day of the first information about the new index composition is ambiguous, the event window should be chosen such that it encompasses this date as well.

An event window from -20 days to +40 days was selected to investigate the long term index effect on stock prices, as Chen et al. (2004) found that stock prices revert following the event. The longer post-event window will allow for an investigation into the ambiguous discussion on temporary versus permanent price effects. The 20 trading days leading up to the event date, was deemed sufficient to capture both the first announcement date and possible early trading from investors who predicted the new index composition ahead of the announcement. From the initial event window, several different sub-windows will be investigated to gain further insight into the characteristics of the index effect on the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices.

Announcement Date (AD)

The announcement date is the day when the first information about the new index composition is released. As mentioned, the first announcement of the new index composition proved to be difficult to determine. Despite contact with Nasdaq Nordic, the exact dates of each announcement remain unclear for many of the indices, since the release of the indices' semi-annual reviews differs. Furthermore, the announcement is not made uniformly about the effective reallocation date but can change depending on the review period. This would make the event window of each review period different from one another and would complicate the investigation. Therefore, it was decided to not include the announcement day specifically, but indirectly through the event window centered around the effective reallocation date.

Event Date (ED)

The nature of index effects has been examined vastly in previous literature, and scholars have documented stock price effects at the time of announcement and the effective date. The effective date is the date when the inclusion (exclusion) into (from) the index occurs, following the index recomposition.

The changes to the OMX Helsinki 25 index are made effective on the closest trading day, following the last trading day of January and July. The changes to the OMX Copenhagen 20 index are made effective on the closest trading day, following the third Friday in December and June. The OMX Stockholm 30 index recomposition is made effective on the closest trading day, following the last trading day of June and December.

Estimation Window

The estimation window is the period during which the parameters of the market model are estimated. Following the research by MacKinlay (1997), this study employs the market model to approximate the stock's normal return over the event window. MacKinlay (1997) further suggests that 120 observations of daily price data are sufficient for estimating the parameters. Jain (1987) argues that the parameters in the market model are non-stationary in the period after the event, compared to the period leading up to the event. Therefore, this study will also utilize two different estimation periods, 120 days before the event window, and 120 days after the event window, as seen in figure 1. The first collection of the market model parameters were estimated from day -140 to day -31 to determine normal returns from day -20 to day 0. The second collection of the market model parameters were estimated from day +41 to +160 to determine normal returns from day +1 to +40. The estimation window and event window are separated, to avoid overlapping and consequently reduce the risk that the parameters are influenced by the event.

Normal Returns

The normal return represents the stock's theoretical return in the absence of the event. This paper will use the market model to estimate the normal return, as the gain from more complicated multifactor models tend to be limited in event studies (MacKinlay, 1997). The market model is a statistical model, and it is constructed in such a way that the return for any given security is conditional on the return of the market portfolio. As with many statistical models, the assumption that asset returns are jointly multivariate normal, and identically and independently distributed (IID) must be imposed. This assumption implies that the model can be specified linearly, which is necessary in order to utilize the model (MacKinlay, 1997). Following the market model, each stock's normal return can be determined with the following formula:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

$$E[\varepsilon_{it}] = 0 \qquad var(\varepsilon_{it}) = \sigma_\varepsilon^2$$

Where R_{it} and R_{mt} are the returns of security i and the market portfolio at time t, respectively. ε_i is an idiosyncratic, zero mean, disturbance term for security i. *a_i and β_i* are the estimated parameters in the market model. The market return proxies for the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 stocks were OMX Helsinki PI, OMX Copenhagen PI, and OMX Stockholm PI respectively. The OMX Helsinki PI, OMX Copenhagen PI, and OMX Stockholm PI indices are value-weighted indices of all listed shares in each respective country.

Abnormal Return (AR) and Average Abnormal Return (AAR)

Abnormal returns are calculated by subtracting the expected return from the actual return. Following the market model, the formula for estimating abnormal returns is:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt})$$

Where AR_{it} represent the abnormal return of security i at time t. Theoretically, in the absence of any new event, a stock's abnormal return should be zero. We assume that the abnormal return is characterized by the following distribution:

$$AR_{it} \sim N(0, \sigma^2(AR_{it}))$$

MacKinlay (1997) states that the variance of the abnormal return is derived from two components; the market model disturbance term parameter $\sigma^2_{\varepsilon_i}$ and an additional variance term representing the sampling error in α_i and β_i. The variance of the disturbance term is given by the following formula:

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{T-2}\sum_{t=T_0+1}^{T_1}(R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt})^2$$

Where T_0+1 to T_1 represents the estimation period and estimates the disturbance term for day -30 to 0. The same formula is applied to calculate the disturbance term for day 1 to 40, however, it is then based on the estimation window T_2+1 to T_3. The conditional variance of the abnormal return, including the variance of the sampling error, is given by:

$$\sigma^2(AR_{it}) = \hat{\sigma}^2_{\varepsilon_i} + \frac{1}{T}\left[1 + \frac{(R_{mt} - \hat{u}_m)^2}{\hat{\sigma}^2_m}\right]$$

The aim of this study is to determine if index inclusions or exclusions from the OMX Stockholm 30, OMX Helsinki 25, and OMX Copenhagen 20 indices affects stock prices. We are therefore interested in the firm-average abnormal return for each day in the event window. The formula for calculating AAR is stated below:

$$A\hat{A}R_t = \frac{1}{N}\sum_{i=1}^{N}\widehat{AR}_{it}$$

The variance of the firm-average abnormal return is given by the following formula:

$$\hat{\sigma}^2(AAR_i) = \frac{1}{N^2}\sum_{i=1}^{N}\hat{\sigma}^2(AR_{it})$$

We are interested in testing if the firm-average abnormal return of each day is significantly different from zero, in order to draw any conclusions about the effect of the event. With a null hypothesis that states that the firm-average abnormal return is zero, the t-statistic is given by:

$$S\widehat{AA}R_t = \frac{A\hat{A}R_t}{[\hat{\sigma}^2(AAR_t]^{1/2}} \sim \mathrm{N}(0,1)$$

Cumulative Average Abnormal Return (CAAR)

Once the firm-average abnormal return was calculated for each day throughout the event window, it can be summed to compute the cumulative average abnormal return (CAAR). Aggregating the abnormal returns across securities and through time will provide us with the overall impact on stock prices. The calculation of CAR through T1 to T2 is as follows:

$$C\widehat{AAR}(T_1,T_2) = \sum_{t=T_1}^{T_2} A\hat{A}R_t$$

The variance of the cumulative abnormal return, over any specified period, is given by the following formula:

$$\hat{\sigma}^2(CAAR(T_1,T_2) = \sum_{t=T_1}^{T_2} \hat{\sigma}^2(A\hat{A}R_t)$$

The ambition with computing the cumulative abnormal return, over some specified period, is to test whether it is significantly different from zero. We apply the following t-statistic to verify the existence of cumulative abnormal returns following inclusions and exclusions from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices:

$$SC\hat{A}AR = \frac{C\widehat{AAR}(T_1,T_2)}{[\hat{\sigma}^2(CAAR(T_1,T_2)]^{1/2}} \sim \mathrm{N}(0,1)$$

Abnormal Volume (AV) and Average Abnormal Volume (AAV)

The calculation of abnormal volume follows the method provided by Campbell and Wasley (1996), where the individual stocks' abnormal volume is calculated from a mean-adjusted approach. They define a stock's daily trading volume as the percentage of shares traded, in relation to the total number of outstanding shares. Ajinkya and Jain (1989) found that trading volume of NYSE stocks were non-normally distributed, however, the log-transformed trading volume generated an approximately normal distribution. Furthermore, to account for days with zero trading, a constant of 0,000255 is added to avoid taking the log of zero. The formula for individual, daily, trading volume is therefore expressed as:

$$V_{it} = log\left(\frac{n_{it} + 0{,}000225}{S_{it}} * 100\right)$$

Where S_{it} is the stock's number of outstanding shares at time t, and n_{it} is the observed trading volume for stock i at time t. This research will determine abnormal trading volume, using a mean-adjusted approach:

$$AV_{it} = V_{it} - \bar{V}_i$$

Where the average trading volume for stock i is given by:

$$\bar{V}_{it} = \frac{1}{T}\left(\sum_{t=T_0+1}^{T_1} V_{it} + \sum_{t=T_2+1}^{T_3} V_{it}\right)$$

For the abnormal volume, half of the estimation period is drawn from the period before the event window and other half after the event window (Campbell & Wasley, 1996). The estimation period will be 120 trading days before and 120 trading days after the event window. Similar to the average abnormal return, the average abnormal trading volume is given by the following formula:

$$AAV_t = \frac{1}{N}\sum_{i=1}^{N} AV_{it}$$

The standard deviation of the abnormal trading volume is calculated over the estimation window, and is given by the following formula:

$$s(AAV_t) = \sqrt{\frac{1}{T}\left(\sum_{t=T_0+1}^{T_1}(AAV_t - \overline{AAV})^2 + \sum_{t=T_2+1}^{T_3}(AAV_t - \overline{AAV})^2\right)}$$

Where $\overline{AAV}$ is the mean of the daily average abnormal trading volume over the estimation period:

$$\overline{AAV} = \frac{1}{T}\left(\sum_{t=T_0+1}^{T_1} AAV_t + \sum_{t=T_2+1}^{T_3} AAV_t\right)$$

Subsequently, one can construct a parametric test of the daily average abnormal volume:

$$\frac{AAV_t}{s(AAV_t)}$$

Limitations and Quality of Data

A problem with event studies is overlapping events that can impact the stock price and lead to incorrect conclusions. We removed observations where the firms had received acquisition bids or been acquired, and spin-offs. However, it is still possible that we failed to account for all such events. Other possible events, such as earnings reports, has not been accounted for and could therefore affect stock prices during our event window.

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. Due to this problem, we decided not to investigate the announcement date directly, but rather encompass it in the event window. As the announcement date has been an important date for abnormal return creation in previous research, it is a limitation not to be able to isolate the date in our investigation. Also, since we investigate the index effect between 1999 and 2018, our period covers two stock market crashes. These events alone seem to have a significant impact 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. Some of these subgroups contained only a small number of observations which limits 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.

This research employed the market model to estimate the stocks' normal returns, and one could argue that complicated models might have yielded a better estimation of the normal return. However, MacKinlay (1997) argues that the gain from using more complicated models is limited in an event study setting.

Another possible factor that could have yielded different results is if the reference indices used for estimating the model parameters were different. For instance, using the MSCI World Index would have given us different betas that could then alter the market model returns, and consequently, the abnormal returns. In addition, there has been some arguments in the literature on whether you should use a domestic all-share index or a broad index, such as the MSCI World Index. Hence, changing the index that is used for estimation might also have altered the results.

Empirical Findings and Discussion

The evidence uncovered in this research, regarding the abnormal return generated from inclusions and exclusions from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices, is rather puzzling. While there is some evidence in line with previous research, there is also a considerable difference between the results for the period 1999-2008 and the period 2009-2018. In the following paragraphs, the results will be examined in greater detail.

The average abnormal returns and cumulative abnormal returns were not statistically significant, for neither inclusions nor exclusions, as seen in table 2 and 3. We suspect that the lack of significant results is mostly due to the additional variance representing the sampling error. As the estimation period of the market model parameters was 120 trading days, the additional variance becomes rather large. It is, therefore, possible that a longer estimation period would generate significant values.

Table 2. *Average Abnormal Return and Cumulative Average Abnormal Return*

		Inclusions								
	Periods	AAR (%)			CAAR (%)					
		ED -1	ED	ED +1	-20 to ED	-5 to ED	ED to +5	ED to +40	-5 to +5	-20 to +40
	1999 - 2018	0,33%	-0,05%	-0,40%	-0,51%	0,60%	-1,88%	1,12%	-1,22%	0,66%
Full Sample	1999 - 2008	0,34%	-0,06%	-0,69%	-0,16%	1,25%	-2,72%	1,18%	-1,40%	1,09%
	2009 - 2018	0,29%	-0,01%	0,18%	-1,25%	-0,60%	0,08%	1,43%	-0,50%	0,19%
OMX Helsinki 25	1999 - 2018	0,64%	-0,19%	-0,72%	0,30%	2,71%	-2,96%	1,64%	-0,05%	2,86%
OMX Copenhagen 20	1999 - 2018	0,11%	0,12%	-0,30%	-1,01%	-1,15%	-0,43%	0,91%	-1,71%	-0,22%
OMX Stockholm 30	1999 - 2018	0,01%	-0,02%	0,11%	-2,05%	0,10%	-2,04%	0,36%	-1,92%	-1,67%

10%=*, 5%=**, and 1%=*** **Bold figures imply significance**

Table 3. *Average Abnormal Return and Cumulative Average Abnormal Return*

		Exclusions								
	Periods	AAR (%)			CAAR (%)					
		ED -1	ED	ED +1	-20 to ED	-5 to ED	ED to +5	ED to +40	-5 to +5	-20 to +40
	1999 - 2018	-0,83%	0,36%	0,21%	-0,43%	-1,06%	-0,04%	-0,42%	-1,46%	-1,20%
Full Sample	1999 - 2008	-1,64%	0,53%	0,41%	-2,56%	-2,50%	0,41%	-2,35%	-2,63%	-5,45%
	2009 - 2018	0,63%	-0,09%	0,02%	3,27%	1,30%	-0,61%	2,74%	0,78%	6,10%
OMX Helsinki 25	1999 - 2018	-1,55%	1,09%	0,89%	0,39%	-2,11%	1,17%	-1,89%	-2,03%	-2,59%
OMX Copenhagen 20	1999 - 2018	0,20%	-0,50%	-0,22%	-0,79%	0,38%	-1,90%	2,25%	-1,02%	1,95%
OMX Stockholm 30	1999 - 2018	-0,60%	0,47%	-0,46%	-2,51%	-1,10%	0,25%	-3,10%	-1,33%	-6,08%

10%=*, 5%=**, and 1%=*** **Bold figures imply significance**

In this study, the announcement day is not directly investigated, which limits the comparability with previous research. The research conducted by Kappou et al. (2010) suggests that all abnormal returns are essentially generated on the day after the announcement. In contrast, Bechmann (2002) found that the abnormal returns, of inclusions and exclusions from the Danish KFX index, were much smaller on the day after the announcement. He also found that the abnormal return on the day after the announcement and the day before the event were of equal magnitude. As the results of this research find no evidence for a positive (negative) price effect of inclusions (exclusions) between day -20 and ED, it might suggest that the index effect has a lesser impact on prices for stocks listed on Nordic exchanges. Because our results show negative cumulative average abnormal returns for included firms between day -20 and ED, one could argue that the price effect on the announcement day is negligible.

The results of this research do, however, find evidence for a price effect around the event date. As seen in figure 2, prices increase (decrease) for inclusions (exclusions) between day -5 and ED, and then reverts within the next five trading days. The finding that prices revert following the event date is supported by the previous literature (Kappou et al. 2007; Mase, 2007).

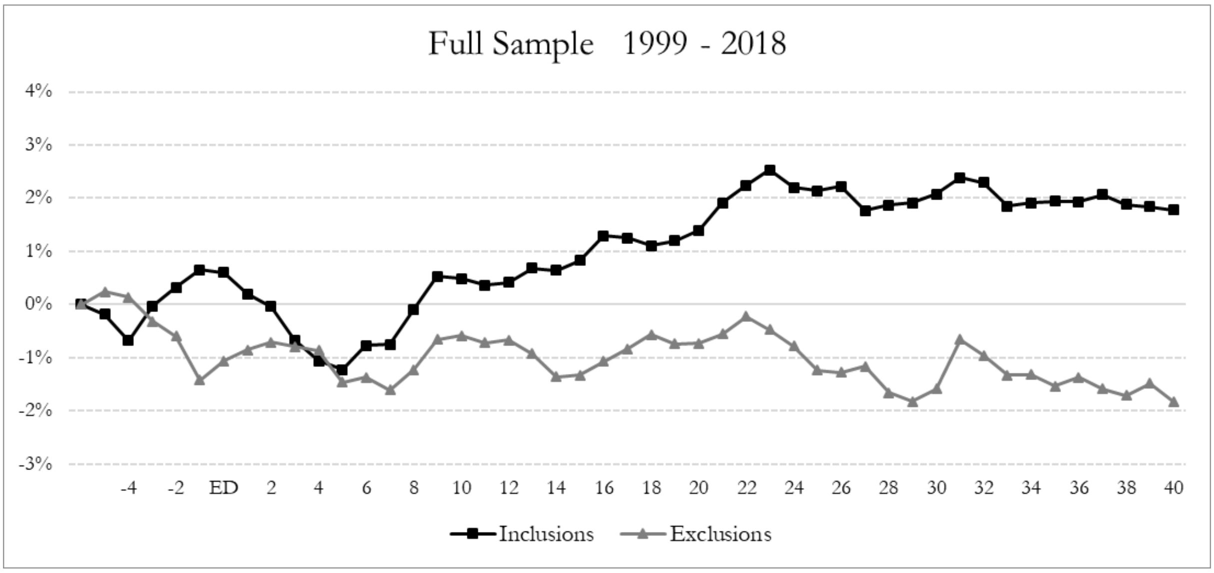

Figure 2. *Full Sample-Display of the Cumulative Average Abnormal Returns between 1999 - 2018*

The results seen figure 2 also imply that inclusions (exclusions) experience a positive (negative) price drift after initial reversion from the event date, which culminates in rather stable price levels. Although a window of 40 days following the event day prevents us from drawing conclusions about the price stability over even longer periods, the results do seem to support the observation that price increases (decreases) from inclusions (exclusions) are persistent over longer periods (Shleifer, 1986; Bechman, 2002). Kappou et al. (2007), however, noted that only the large firms in their sample experienced a positive price drift following the index inclusion, which lasted more than 150 days after the reversion from the event date. Given that the index constituents investigated in this research are selected partly based on market capitalization, our findings could stand in contrast to the findings of Kappou et al. (2007). However, it is possible that grouping inclusions and exclusions based on size from the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices could yield similar results.

Figure 3 and 4 show the cumulative average abnormal returns of inclusions and exclusions over two different periods; 1999-2008 and 2009-2018. The early period display similar characteristics as the full period results, which is likely due to larger sample size in this period. In the later period, however, the results suggest that there is essentially no price effect on stocks following an index inclusion or exclusion. Despite significant abnormal volume around the event date, the prices remain stable. This finding provides some support for the efficient market hypothesis since prices seem relatively unaffected by abnormal trading volume. However, the results might also be attributable to changes in the market microstructure, but as this research did not investigate market microstructure, it provides opportunities for future research.

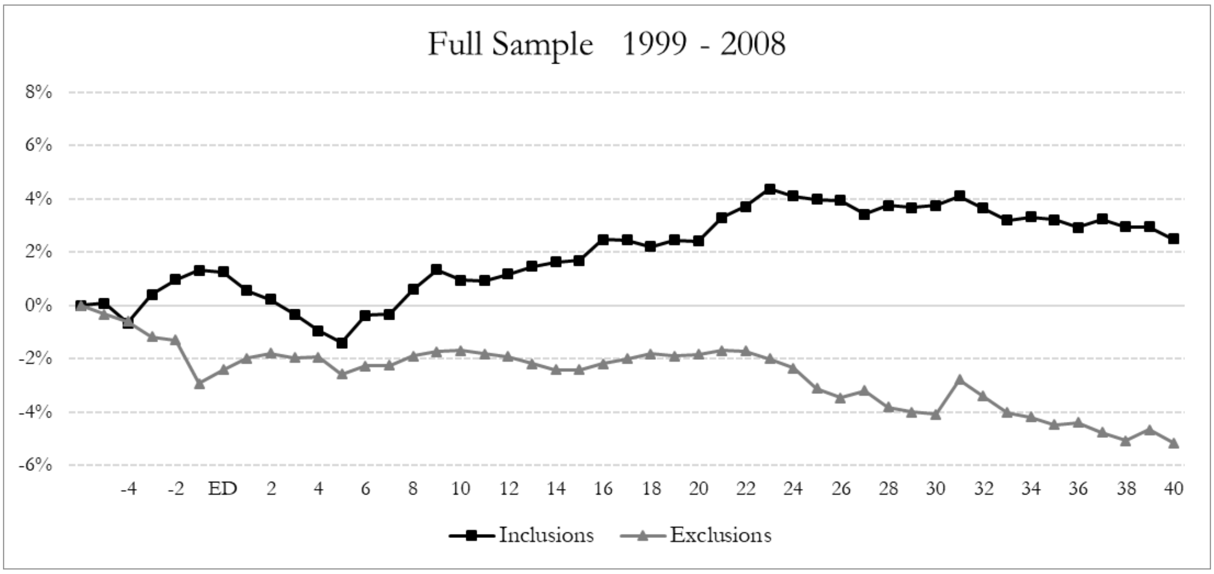

Figure 3. *Full Sample-Display of the Cumulative Average Abnormal Returns between 1999 - 2008*

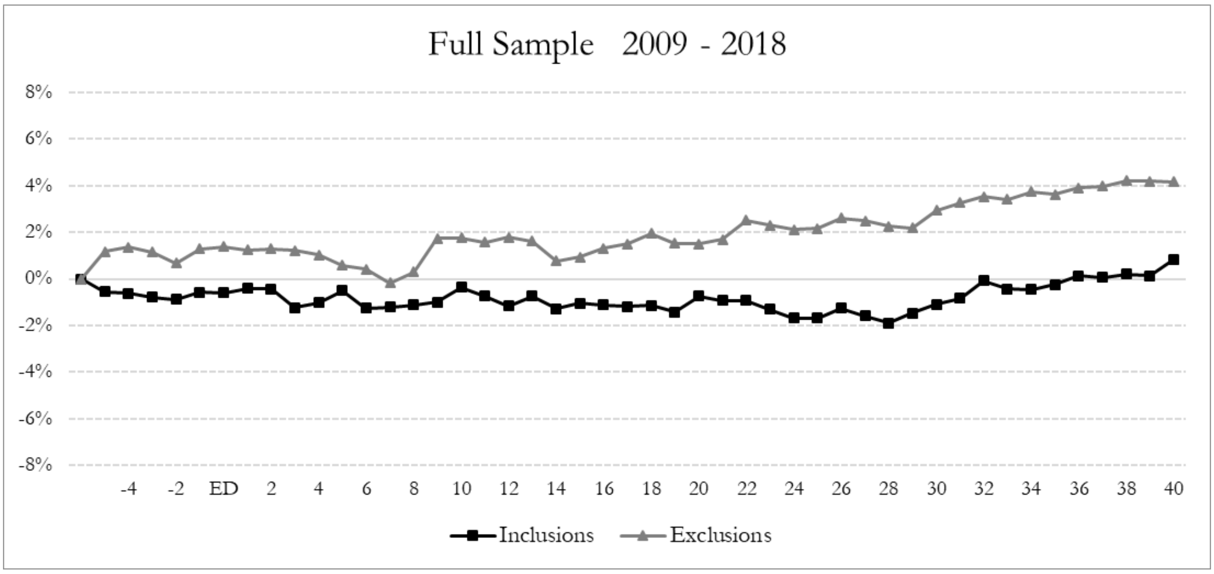

Figure 4. *Full Sample-Display of the Cumulative Average Abnormal Returns between 2009 - 2018*

The OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices selects their constituents in a similar manner. Therefore, one could argue that the Nordic exchanges, which are owned by Nasdaq, should share similar characteristics. In that sense, the price effects following index inclusions and exclusions should, arguably, be similar. However, figure 5 and 6 show that the price effects differ between the indices, where inclusions from the OMX Helsinki 25 display the strongest price effects. It should be noted that a considerable share of the observations for the OMX Helsinki 25 were made in the early period, which could explain this difference. While Elliot and Warr (2003) found differences in abnormal returns between firms included to the S&P 500 based on whether the firm was listed on Nasdaq or NYSE, this observation should not have a significant impact the results of this research, as all firms in the sample are listed on Nasdaq's Nordic exchanges.

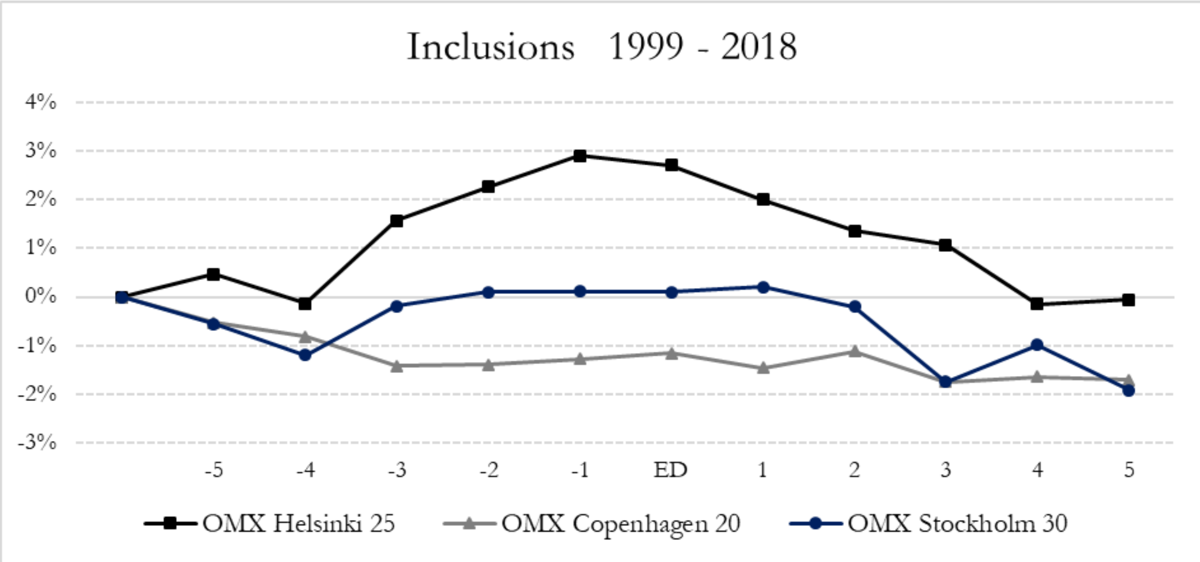

Figure 5. *Display of the Cumulative Average Abnormal Returns for each Index Separately between 1999 – 2018*

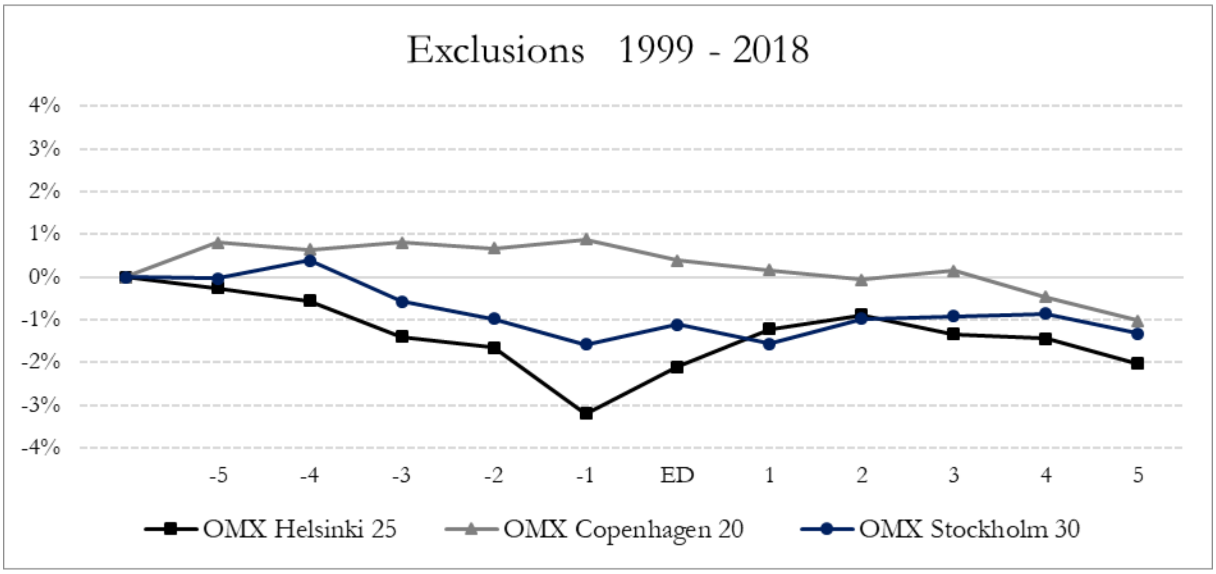

Figure 6. *Display of the Cumulative Average Abnormal Returns for each Index Separately between 1999 – 2018*

The average abnormal volume is split into two tables, table 4 and 5, where they represent inclusions and exclusions, respectively. The full sample of inclusions in the entire period and the split periods are presented. Furthermore, the abnormal volume for each index is separated and presented for the total period. In accordance with prior theories (Bechmann, 2002; Hedge & McDermott, 2003), we observe significant abnormal volume for inclusions on the event date for all periods. This is in line with our expectations, since the effective date is when the constituent changes to the indices are implemented. When examining the indices separately, significant abnormal volume is only observed for OMX Helsinki 25.

Table 4. *Average Abnormal Trading Volume*

	Exclusions											
	Periods	Average Abnormal Volume										
		-5	-4	-3	-2	-1	ED	1	2	3	4	5
	1999 - 2018	-1,8%	0,0%	3,0%	**9,1%***	**38,9%*****	**17,4%*****	7,0%	2,4%	2,4%	-2,4%	-5,2%
Full Sample	1999 - 2008	-6,9%	-1,0%	0,8%	8,1%	**41,6%*****	**24,5%*****	9,9%	7,0%	9,0%	1,7%	-3,1%
	2009 - 2018	6,1%	1,5%	6,3%	**10,8%***	**34,7%*****	6,5%	2,4%	-4,5%	-7,8%	-8,7%	-8,5%
OMX Helsinki 25	1999 - 2018	-8,0%	-9,0%	-5,7%	5,1%	**45,8%*****	**25,0%*****	7,9%	4,4%	11,5%	4,2%	5,5%
OMX Copenhagen 20	1999 - 2018	1,9%	**13,5%***	**20,7%****	**19,7%****	**32,1%*****	**13,0%***	7,1%	0,4%	1,1%	-6,6%	**-13,3%***
OMX Stockholm 30	1999 - 2018	9,6%	-9,1%	**-16,5%****	-6,9%	**36,3%*****	**11,9%***	6,3%	3,1%	**-18,7%****	**-12,2%***	-9,7%

10%=*, 5%=**, and 1%=*** **Bold figures imply significance**

Table 5. *Average Abnormal Trading Volume*

	Inclusions											
	Periods	Average Abnormal Volume										
		-5	-4	-3	-2	-1	ED	1	2	3	4	5
	1999 - 2018	-5,4%	**-8,3%****	-3,1%	-0,3%	**32,4%*****	**11,2%****	6,2%	3,7%	**10,7%****	**6,7%***	3,4%
Full Sample	1999 - 2008	-7,1%	**-9,0%***	-1,5%	0,1%	**32,7%*****	**9,4%***	6,0%	4,8%	**12,6%****	**10,1%***	7,1%
	2009 - 2018	-2,0%	**-6,9%***	-6,5%	-0,9%	**31,7%*****	**14,6%*****	6,5%	1,5%	**6,8%***	-0,2%	-4,0%
OMX Helsinki 25	1999 - 2018	-7,4%	**-13,7%***	-4,8%	-3,4%	**45,5%*****	**17,7%****	3,5%	3,2%	7,1%	9,8%	0,5%
OMX Copenhagen 20	1999 - 2018	**-9,6%***	-7,4%	4,7%	5,7%	**13,1%****	0,8%	**8,0%***	-0,7%	7,2%	-0,5%	0,1%
OMX Stockholm 30	1999 - 2018	8,3%	3,0%	**-14,9%***	-3,7%	**41,0%*****	15,1%	7,4%	**14,5%***	**24,8%*****	**17,2%****	12,4%

10%=*, 5%=**, and 1%=*** **Bold figures imply significance**

Bechmann (2002) mentions that a majority of the abnormal volume occurs on the day prior to the event date, which is supported by our results. On the other hand, many indices usually refrain from making substantial reallocations before the event date, regardless if the prices rise or fall leading up to the event (Bechmann, 2004; Hedge & McDermott, 2003; Kappou et al. 2007). They state that a potential reason for this is that regulations, or policies, force the portfolio managers to keep their stake as long as possible in order to avoid the tracking error. However, there is a possibility that the strategies the index funds use to make the transition differ, thus yielding different abnormal volumes on the effective date. Over all periods and all indices, there is substantial and significant positive abnormal volume on ED-1. This reaffirms the findings from Bechmann (2002) and Hedge and McDermott (2003). Kappou et al. (2007) argue that, in the hours preceding the close, on the day prior to the event date, the indices start buying (selling) large blocks of the firms' stocks that will be included (excluded), which would explain the results as shown in table 4 and 5.

Looking at the respective index exclusions in table 5, OMX Copenhagen 20 displays significant positive abnormal volume from ED-4 to ED. The other indices have no such pattern nor have they significant positive abnormal volume leading up to the event day, apart from ED-1. This could imply that the index funds tracking the OMX Copenhagen 20 index, have a different approach to that of the other indices. Meaning that, instead of selling off their entire ownership in the excluded firm the day before the event date, they gradually sell off the stock between the announcement and effective date.

As mentioned in the literature section, there is ambiguity as to whether changes to the index composition have temporary or permanent effects. Significant abnormal volume can be observed in figure 7 and 8, as well as a sharp decline after the event date for both inclusions and exclusions in the short-term, which is similar to what Harris and Gurel (1986) found. However, to determine whether there were permanent increases in volume for inclusions, they analyzed whether the volume had changed over a longer period. According to their data, inclusion to the S&P 500 indicates a permanent increase in a security's trading volume. There are some indications of long-term effects on volume for included and excluded firms in this paper, as seen in figure 7 and 8. In figure 7, the cumulative average abnormal volume for inclusions during the early period provide some indications of increased, and persisting, trading volume. However, in the latter period, the volume is lower. For the exclusions, though, the results are more ambiguous. In figure 8, excluded firms experience a cumulative average abnormal volume of almost 200% in this period, whereas the early period is more in line with that of our expectations. Again, it is possible that this ambiguity can be attributed to the smaller sample size for the latter period, thus implying that the early period is more representative of the abnormal volume for excluded firms. If by looking at the number of days, post-event date, that displays significant negative abnormal volume for excluded firms in the early sample, it turns out that the exclusions in the early period show a permanent reduction in trading volume (see Appendix 8 and 9). Nevertheless, Harris and Gurel (1986) attribute the permanent volume increase to funds in general, not only index funds, who might be obliged to only invest in securities on a certain index. Kappou et al. (2007) also found evidence of permanent increases in volume, consistent with the liquidity hypothesis. Also, they endorse the awareness hypothesis developed by Chen et al. (2004). Kappou et al. (2007) argue that the reason the awareness hypothesis is valid is because investors become overwhelmed with the assortment of assets to select from, and thus focuses on those included in, e.g., S&P 500. This, in turn, would imply increased awareness for the newly included firm(s). However, given the smaller number of firms included in the indices investigated in this report, it is possible that the hypothesis does not apply here. Figure 7 and 8 displays the cumulative average abnormal trading volume of inclusions and exclusions over the period 1999-2008 and 2009-2018. Between the two periods, there has been a major shift in trading volume for both inclusions and exclusions. In the early period, inclusion (exclusion) was followed by increased (reduced) abnormal trading volume. However, the later period shows that both inclusions and exclusions enjoy increased abnormal trading volume. Hedge and McDermott (2003) connected trading volume to the bid-ask spreads of securities. Amihud & Mendelson (1986), found that bid-ask spreads are negatively correlated with liquidity. Taking all this into account, the results on cumulative abnormal returns from figure 3 and 4 might be partially explained by the differences in cumulative abnormal trading volume. Therefore, future research on the market microstructure might yield interesting findings regarding the role of the liquidity premium in explaining the index effect.

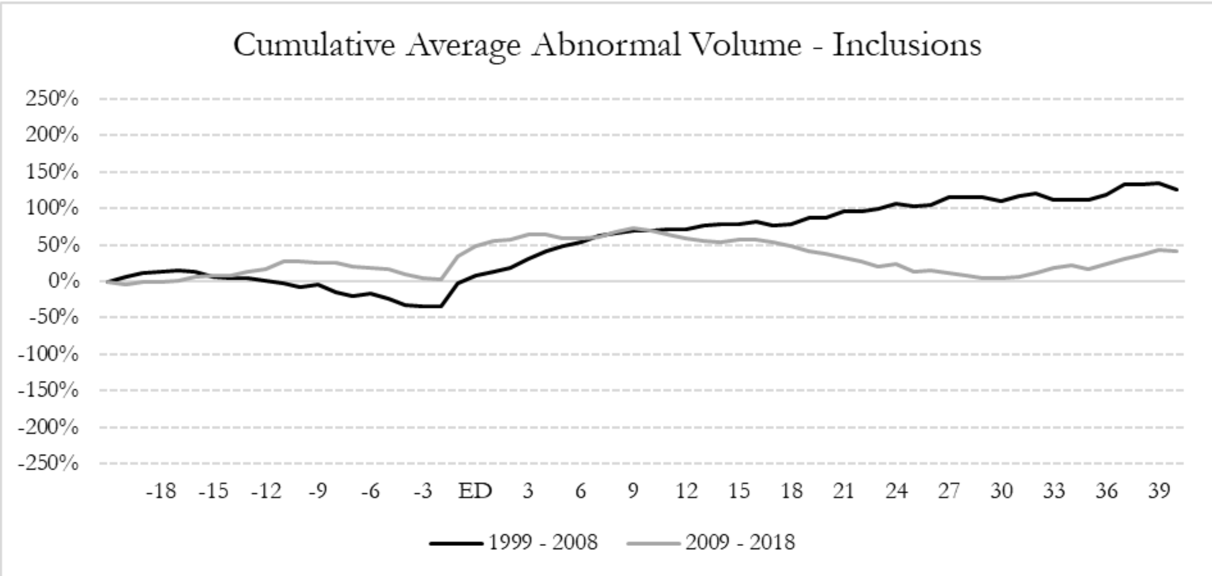

Figure 7. *Display of the Cumulative Average Abnormal Volume*

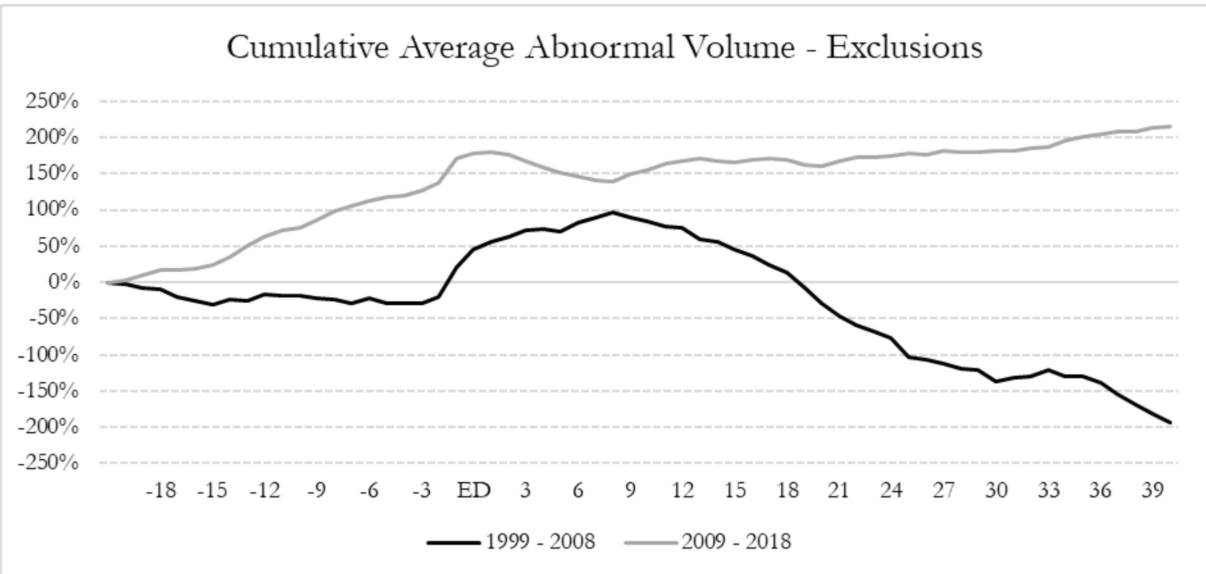

Figure 8. *Display of the Cumulative Average Abnormal Volume*

Figure 9 and figure 10 shows the cumulative average abnormal return (in % on the left axis), together with the daily average abnormal trading volume (in % on the right axis) for the full sample in the period 1999 to 2018. The substantial abnormal trading volume on the day before the event day suggests that a large portion of portfolio reallocation is made on this day (see Appendix 7; Appendix 8; Appendix 9). Furthermore, the abnormal volume coincides with the positive (negative) price shock for inclusions (exclusions), which is in line with our expectations. Similar findings are observed in previous literature on the index effect, and it provides support for the price pressure hypothesis. An interesting observation to point out here, though, is that the price increase in figure 9 occurs before the substantial increases in abnormal volume.

The substantial increase (decrease) in volume on and after the event date, accompanied by a price increase (decrease), provides strong support for the price pressure hypothesis. What slightly deteriorates the strength of this argument, though, is that no significant abnormal returns were observed. However, the figures for both inclusions and exclusions illustrates the existence of a price pressure effect, and the large increase in volume is suggestive of a shift in demand (Harris & Gurel, 1986; Shleifer, 1986). On the other hand, if there is a price pressure effect, it violates the notion of an efficient market (Harris & Gurel, 1986). Since increases or decreases in volume during an index recomposition does not convey any new information, it should not affect prices. Therefore, in spite of strong resemblance to the price pressure effect, the fact that no significant abnormal returns were observed, and that the returns for included firms revert shortly after the event, implies that the market is relatively efficient.

Hedge and McDermott (2003) showed that a decrease in the bid-ask spread is primarily a result of lower direct costs of transacting. There is a negative correlation between the bid-ask spread and trading volume (Amihud & Mendelson, 1986). Hence, if an inclusion leads to higher trading volume, it is possible that bid-ask spreads decrease, thus positively affecting the prices. Conversely, stocks that are excluded will see an increase in the effective spread and thereby transaction costs. As seen in figure 7 and 8, the period 1999-2008 shows increased (decreased) cumulative trading volume for inclusions (exclusions) while prices increased (decreased) as seen in figure 3.

Figures 9 and 10 displays a clear decrease in prices for exclusions, and a corresponding increase for inclusions prior to the event day. As shown in figure 9 and 10, the abnormal returns for inclusion and exclusions, respectively, differ quite remarkably in magnitude. The cumulative average abnormal returns at the event date are approximately 1% for inclusions, and approximately negative 2% for exclusions. Given that the level of abnormal volume during the effective date is quite similar for inclusions and exclusions, the relative effect will be most pronounced for exclusions. This observation contradicts the finding by Chen et al. (2004), who found asymmetric price responses in favor of inclusions. Essentially, the benefits of being included were larger than the corresponding loss of these benefits for excluded firms. Since Chen et al. (2004) connected this to the awareness hypothesis, our results contradict that hypothesis.

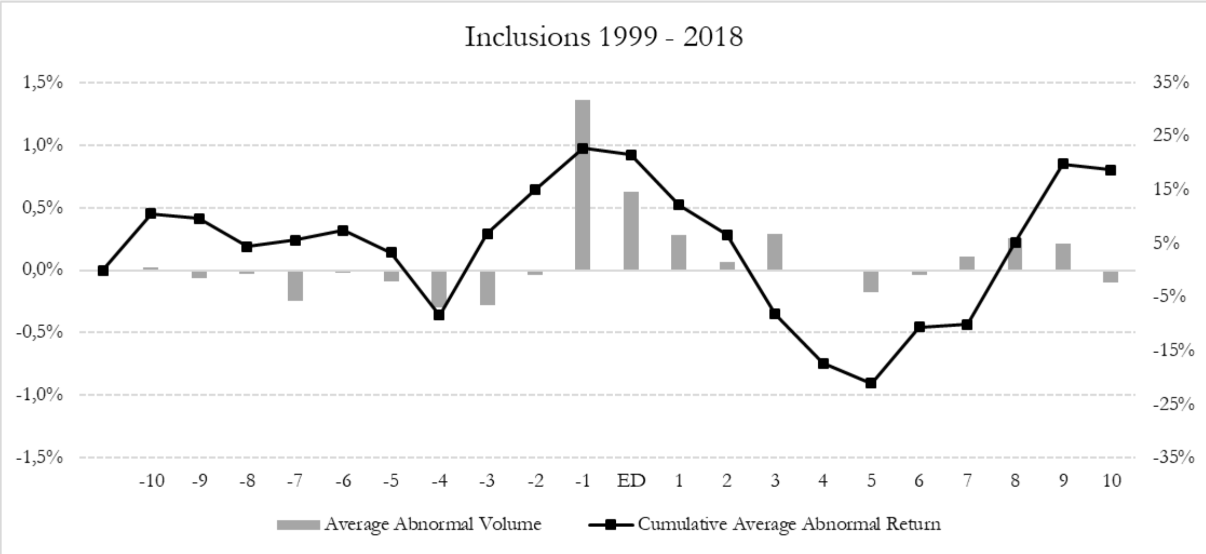

Figure 9. *Full Sample-Display of the Cumulative Average Abnormal Returns and Daily Average Abnormal Trading Volume between 2009 - 2018*

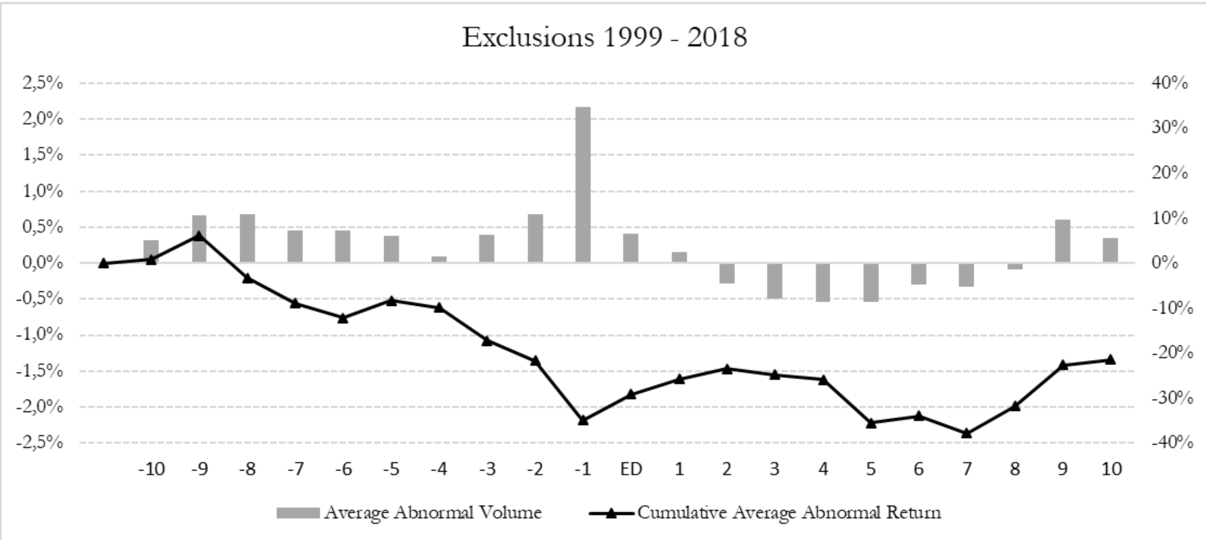

Figure 10. *Full Sample-Display of the Cumulative Average Abnormal Returns and Daily Average Abnormal Trading Volume between 2009 – 2018*

Conclusion

This paper investigated the index effect associated with changes to the OMX Helsinki 25, OMX Copenhagen 20, and OMX Stockholm 30 indices. The abnormal return and abnormal volume indicated that there were signs of an index effect following changes in these indices. However, the (cumulative) abnormal returns were not significant. While the duration of the effects are mostly centered closely around the event date, there were some indications of long-term effects on prices and volume. In the period 1999-2008 the abnormal returns exhibited signs of a price pressure effect in relation to the abnormal volume around the event date, while the period 2009-2018 did not. The early period showed signs of both a price pressure effect around the event day, and positive (negative) price drifts for inclusions (exclusions). The later period, however, did not exhibit any considerable price effects during the full event window, despite significant abnormal volume around the event day. The support for the price pressure hypothesis was mostly attributable to the OMX Helsinki 25 index and the period 1999-2008. The liquidity hypothesis was another relevant hypothesis for this paper, as the early period suggest that increased (decreased) liquidity coincided with positive (negative) cumulative abnormal returns over a longer period for inclusions (exclusions). While a majority of the previous literature has been conducted on the S&P 500, we strive to contribute to the field by providing a more comprehensive analysis of the index effect on Nordic stocks than is currently available. By studying the index effect in a "no information" setting, this research contributed to a more distinct analysis of the index effect.

Future research

Upon finishing this research, we believe that there are two main areas, connected to liquidity, which should be investigated further. First, as we observed relatively stable positive (negative) cumulative abnormal returns for inclusions (exclusions) over approximately 20 days after the event, future research should extend the event window further to investigate long-term price stability of inclusions and exclusions. Secondly, future research could investigate the market microstructure of the Nordic exchanges, over time, to investigate if liquidity plays a role in explaining the index effect on Nordic stocks. We believe that both these areas could uncover evidence for the liquidity premium's role in explaining the index effect.

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Appendix

Appendix 1: List of Inclusions and Exclusions from OMXH25

OMX Helsinki 25

Effective date	Inlcuded	Excluded
1999-02-01	Hartwall A	
1999-02-01	Helsingin Puhelin E	
1999-08-02		Hartwall A
1999-08-02	Stora Enso A	
1999-08-02	Amer-yhtymä	
2000-02-01		Finnlines
2000-02-01	Perlos Oyj	
2000-02-01	Eimo Oyj A	
2000-08-01		Rautarukki
2000-08-01		KCI Konecranes International
2000-08-01		Huhtamäki van Leer
2000-08-01	Teleste Oyj	
2000-08-01	Talentum Oyj	
2000-08-01	F-secure Oyj	
2000-08-01	Elcoteq A	
2000-08-01	Comptel Oyj	
2000-08-01	Aldata Solution Oyj	
2001-02-01		Talentum
2001-02-01		Raisio Yhtym Vaih-os
2001-02-01	Stonesoft Oyj	
2001-02-01	Outokumpu Oyj	
2001-08-01		Metsä Serla
2001-08-01		F-Secure
2001-08-01	Wärtsilä Oyj	
2001-08-01	Kone Oyj B	
2001-08-01	KCI Konecranes International	
2001-08-01	Instrumentarium	
2002-02-01		Stonesoft Oyj
2002-02-01		Elcoteq A
2002-02-01		Teleste Oyj
2002-02-01	Kemira Oyj	
2002-02-01	Huhtamäki	
2002-02-01	Oyj Hartwell Abp A	
2002-08-01		Comptel Oyj
2002-08-01	Kesko Oyj B	
2002-08-01	Nokian Renkaat Oyj	

2003-02-03		Kemira Oyj
2003-02-03	Elcoteq Network Oyj A	
2003-02-03	Rautarukki Oyj K	
2004-02-02		Perlos Oyj
2004-08-02		KCI Konecranes Oyj
2004-08-02	Perlos Oyj	
2005-02-01		Elcoteq Network Oyj A
2005-08-01		Perlos Oyj
2005-08-01		Kemira Oyj
2005-08-01		Uponor Oyj
2005-08-01	Fortum Oyj	
2006-08-01	KCI Konecranes Oyj	
2007-02-01		Amer Sports Oyj
2007-02-01	Orion Corporation	
2007-08-01		Huhtamäki
2007-08-01		Orion Corporation
2007-08-01	Amer Sports Oyj	
2007-08-01	Uponor Oyj	
2008-02-01		Metsa Board
2008-02-01	OP Corporate Bank	
2008-08-01		Amer Sports Oyj
2008-08-01	Ramirent Oyj	
2009-02-02		Ramirent Oyj
2009-02-02		Uponor Oyj
2009-02-02	Orion	
2009-02-02	Metsa Board	
2009-08-03		Metsa Board
2010-02-01		Ahtium
2010-02-01	Kemira Oyj	
2011-08-01		Tieto
2011-08-01	Ahtium	
2012-02-01		Ahtium
2012-02-01	Amer Sports	
2013-02-01		Sanoma Oyj
2013-02-01	Huhtamaki Oyj	
2015-02-02	Tieto Oyj	
2016-08-01		Kemira Oyj
2016-08-01	Metsa Board Oyj	
2018-08-01		Tieto
2018-08-01	DNA Oyj	

Appendix 2: List of Inclusions and Exclusions from OMXC20

OMX Copenhagen 20

Effective date	Inlcuded	Excluded
2001-06-18	KBHL DC Equity	
2001-06-18	NAVI DC Equity	
2001-06-18		NKT DC Equity
2001-06-18		IDATA DC Equity
2001-12-27		KBHL DC Equity
2002-06-24	TOP DC Equity	
2002-06-24	DSV DC Equity	
2003-06-23	MAERSKA DC Equity	
2003-06-23		D1912B DC Equity
2004-06-21	KBHL DC Equity	
2005-06-20	TORMA DC Equity	
2005-12-19		KBHL DC Equity
2005-12-19		JYSK DC Equity
2006-06-19	JYSK DC Equity	
2006-06-19	BO DC Equity	
2006-06-19		TORMA DC Equity
2006-12-18	FLS DC Equity	
2006-12-18	SYDB DC Equity	
2006-12-18	TORMA DC Equity	
2006-12-18		GR4SEC DC Equity
2006-12-18		SFG DC Equity
2006-12-18		MAERSKA DC Equity
2007-06-18	MAERSKA DC Equity	
2007-06-18	GEN DC Equity	
2007-06-18		JYSK DC Equity
2007-06-18		BO DC Equity
2007-12-27	NKT	
2007-12-27	DS Norden AS	
2007-12-27		Coloplats AS
2008-06-23	Jyske Bank AS	
2008-06-23		GN Store Nord AS
2008-12-22	Coloplast AS	
2008-12-22		Jyske Bank AS
2009-12-21	Jyske Bank AS	
2009-12-21		Coloplast AS
2010-06-21	Coloplast AS	

2010-06-21		Genmab AS
2010-12-20	GN Store Nord AS	
2010-12-20		Jyske Bank AS
2010-12-20		H Lundbeck AS
2010-12-20		DS Norden AS
2011-06-20	TDC AS	
2011-06-20	H Lundbeck AS	
2011-06-20	DS Norden AS	
2011-06-20		Nordea Bank
2011-12-19	Nordea Bank	
2011-12-19		Pandora AS
2011-12-19		DS Norden AS
2012-06-18	Pandora AS	
2012-06-18		Sydbank AS
2012-12-27	Jyske Bank AS	
2012-12-27		NKT AS
2012-12-23	Genmab AS	
2012-12-23		H Lundbeck AS
2014-06-23		Topdanmark AS
2016-06-20	H Lundbeck AS	
2016-06-20		Tryg AS
2016-12-19		Nordea Bank
2016-12-19		FLSmidth & Co. AS
2017-06-19	Nordea Bank	
2017-06-19	FLSmidth & Co. AS	
2017-06-19		Demant AS
2017-12-18	Demant AS	
2017-12-18		FLSmidth & Co. AS
2018-06-18	Ambu AS	
2018-06-18	FLSmidth & Co. AS	
2018-06-18	Tryg AS	
2018-06-18		Nordea Bank

Appendix 3: List of Inclusions and Exclusions from OMXS30

OMX Stockholm 30

Effective date	Inlcuded	Excluded
2000-01-03		Scania B
2000-01-03		Stora Enso A
2000-01-03	Icon Medialab B	
2000-01-03	WM-Data B	
2000-01-03	Securitas B	
2001-01-02		Trelleborg B
2001-01-02		Kinnevik B
2001-01-02	Assa Abloy B	
2001-07-02	Eniro	
2003-01-02		WM-Data B
2003-01-02	Swedish Match	
2003-01-02	Alfa Laval	
2006-07-03		Fabege B
2006-07-03	Boliden	
2007-01-02		Holmen B
2007-01-02	Scania B	
2007-07-02	SSAB A	
2008-01-02	Lundin Petroleum	
2008-01-02		Autoliv Inc
2009-07-01		Eniro AB
2009-07-01	Getinge AB	
2009-07-01	Modern Times Group	
2014-07-01	Kinnevik AB	
2016-01-04		Modern Times Group
2016-01-04	Fingerprint Cards AB	
2017-01-02		Nokia Oyj
2018-01-02		Lundin Petroleum
2018-07-02		Fingerprint Cards AB
2018-07-02	Hexagon AB	

Appendix 4: AAR and CAAR for Full Sample between 1999 and 2018

	1999 - 2018					
		Inclusions			Exclusions	
Event Day	AAR	t-stat (ARR)	CAAR	AAR	t-stat (ARR)	CAAR
-20	0,18%	0,12	0,18%	0,64%	0,42	0,64%
-19	0,28%	0,18	0,46%	0,31%	0,19	0,95%
-18	-0,37%	-0,22	0,09%	-0,11%	-0,07	0,84%
-17	-0,54%	-0,37	-0,45%	-0,41%	-0,26	0,43%
-16	-0,40%	-0,24	-0,85%	-0,02%	-0,01	0,41%
-15	0,03%	0,02	-0,82%	0,02%	0,02	0,44%
-14	0,08%	0,06	-0,74%	0,23%	0,16	0,67%
-13	-0,07%	-0,05	-0,82%	0,36%	0,23	1,03%
-12	-0,33%	-0,25	-1,15%	0,25%	0,18	1,29%
-11	-0,29%	-0,19	-1,44%	0,11%	0,07	1,40%
-10	0,45%	0,34	-0,98%	0,05%	0,04	1,45%
-9	-0,04%	-0,03	-1,02%	0,33%	0,23	1,78%
-8	-0,22%	-0,17	-1,25%	-0,58%	-0,41	1,19%
-7	0,05%	0,03	-1,19%	-0,35%	-0,23	0,84%
-6	0,08%	0,05	-1,12%	-0,21%	-0,14	0,63%
-5	-0,18%	-0,13	-1,30%	0,24%	0,17	0,87%
-4	-0,50%	-0,35	-1,80%	-0,10%	-0,07	0,77%
-3	0,65%	0,41	-1,14%	-0,46%	-0,30	0,32%
-2	0,35%	0,23	-0,79%	-0,27%	-0,19	0,04%
-1	0,33%	0,27	-0,46%	-0,83%	-0,63	-0,79%
ED	-0,05%	-0,04	-0,51%	0,36%	0,24	-0,43%
1	-0,40%	-0,30	-0,91%	0,21%	0,15	-0,22%
2	-0,24%	-0,18	-1,15%	0,14%	0,10	-0,07%
3	-0,63%	-0,45	-1,78%	-0,09%	-0,06	-0,16%
4	-0,39%	-0,28	-2,18%	-0,07%	-0,04	-0,22%
5	-0,16%	-0,12	-2,34%	-0,60%	-0,42	-0,82%
6	0,45%	0,28	-1,89%	0,09%	0,06	-0,73%
7	0,02%	0,02	-1,87%	-0,24%	-0,17	-0,97%
8	0,66%	0,47	-1,21%	0,38%	0,25	-0,59%
9	0,62%	0,44	-0,59%	0,57%	0,37	-0,02%
10	-0,04%	-0,03	-0,63%	0,07%	0,05	0,05%
11	-0,12%	-0,08	-0,75%	-0,14%	-0,09	-0,09%
12	0,05%	0,04	-0,70%	0,06%	0,04	-0,03%
13	0,27%	0,19	-0,43%	-0,26%	-0,17	-0,29%
14	-0,04%	-0,04	-0,48%	-0,43%	-0,31	-0,72%
15	0,19%	0,13	-0,29%	0,02%	0,01	-0,70%
16	0,46%	0,34	0,18%	0,26%	0,18	-0,43%
17	-0,04%	-0,04	0,13%	0,23%	0,17	-0,20%
18	-0,14%	-0,11	-0,01%	0,27%	0,19	0,07%
19	0,09%	0,07	0,08%	-0,17%	-0,12	-0,10%
20	0,20%	0,14	0,28%	0,01%	0,00	-0,09%
21	0,52%	0,38	0,80%	0,17%	0,12	0,08%
22	0,33%	0,24	1,12%	0,34%	0,25	0,42%
23	0,29%	0,20	1,41%	-0,26%	-0,19	0,16%
24	-0,33%	-0,23	1,08%	-0,31%	-0,19	-0,15%
25	-0,06%	-0,05	1,02%	-0,45%	-0,30	-0,60%
26	0,09%	0,07	1,11%	-0,05%	-0,03	-0,64%
27	-0,46%	-0,36	0,65%	0,11%	0,08	-0,53%
28	0,10%	0,08	0,75%	-0,49%	-0,34	-1,02%
29	0,04%	0,03	0,79%	-0,16%	-0,11	-1,19%
30	0,17%	0,11	0,96%	0,23%	0,14	-0,96%
31	0,30%	0,21	1,27%	0,94%	0,60	-0,02%
32	-0,09%	-0,07	1,18%	-0,31%	-0,22	-0,33%
33	-0,45%	-0,35	0,73%	-0,37%	-0,27	-0,70%
34	0,07%	0,05	0,80%	0,02%	0,01	-0,68%
35	0,03%	0,02	0,82%	-0,22%	-0,14	-0,90%
36	-0,01%	-0,01	0,82%	0,16%	0,12	-0,73%
37	0,14%	0,09	0,95%	-0,21%	-0,14	-0,95%
38	-0,19%	-0,14	0,76%	-0,12%	-0,08	-1,07%
39	-0,04%	-0,03	0,72%	0,23%	0,17	-0,85%
40	-0,06%	-0,04	0,66%	-0,36%	-0,25	-1,20%

Appendix 5: AAR and CAAR for Full Sample between 1999 and 2008

	1999 - 2008					
		Inclusions			Exclusions	
Event Day	AAR	t-stat (ARR)	CAAR	AAR	t-stat (ARR)	CAAR
-20	0,20%	0,11	0,20%	0,74%	0,36	0,74%
-19	0,24%	0,12	0,44%	-0,10%	-0,05	0,64%
-18	-0,55%	-0,25	-0,11%	0,18%	0,08	0,82%
-17	-0,81%	-0,46	-0,92%	-0,58%	-0,27	0,24%
-16	-0,49%	-0,22	-1,41%	0,16%	0,07	0,40%
-15	-0,03%	-0,02	-1,43%	-0,13%	-0,07	0,27%
-14	0,31%	0,19	-1,12%	0,35%	0,19	0,62%
-13	0,03%	0,01	-1,09%	0,20%	0,10	0,82%
-12	-0,20%	-0,12	-1,30%	0,10%	0,05	0,91%
-11	-0,46%	-0,24	-1,76%	-0,05%	-0,02	0,87%
-10	0,67%	0,44	-1,10%	-0,09%	-0,05	0,78%
-9	0,00%	0,00	-1,10%	0,26%	0,13	1,04%
-8	-0,27%	-0,18	-1,37%	-0,61%	-0,34	0,43%
-7	0,11%	0,06	-1,26%	-0,07%	-0,03	0,35%
-6	-0,15%	-0,08	-1,41%	-0,42%	-0,21	-0,07%
-5	0,07%	0,05	-1,34%	-0,30%	-0,17	-0,36%
-4	-0,73%	-0,40	-2,07%	-0,30%	-0,15	-0,67%
-3	1,07%	0,53	-1,00%	-0,62%	-0,30	-1,29%
-2	0,56%	0,31	-0,44%	-0,17%	-0,09	-1,45%
-1	0,34%	0,23	-0,09%	-1,64%	-0,98	-3,10%
ED	-0,06%	-0,04	-0,16%	0,53%	0,29	-2,56%
1	-0,69%	-0,43	-0,85%	0,41%	0,23	-2,16%
2	-0,34%	-0,20	-1,19%	0,20%	0,11	-1,96%
3	-0,54%	-0,32	-1,74%	-0,09%	-0,05	-2,04%
4	-0,63%	-0,37	-2,37%	0,02%	0,01	-2,02%
5	-0,44%	-0,29	-2,81%	-0,67%	-0,39	-2,69%
6	1,03%	0,53	-1,78%	0,24%	0,11	-2,45%
7	0,03%	0,02	-1,75%	-0,08%	-0,05	-2,53%
8	0,94%	0,57	-0,81%	0,32%	0,17	-2,21%
9	0,75%	0,44	-0,06%	0,06%	0,03	-2,15%
10	-0,40%	-0,26	-0,47%	0,08%	0,04	-2,07%
11	-0,03%	-0,01	-0,49%	-0,12%	-0,06	-2,19%
12	0,26%	0,15	-0,23%	-0,02%	-0,01	-2,21%
13	0,28%	0,17	0,06%	-0,30%	-0,16	-2,51%
14	0,17%	0,11	0,22%	-0,19%	-0,10	-2,70%
15	0,07%	0,04	0,29%	-0,07%	-0,03	-2,77%
16	0,78%	0,46	1,07%	0,18%	0,10	-2,58%
17	-0,04%	-0,02	1,04%	0,27%	0,16	-2,31%
18	-0,24%	-0,14	0,80%	0,16%	0,08	-2,16%
19	0,25%	0,16	1,05%	0,00%	0,00	-2,15%
20	-0,04%	-0,02	1,01%	0,04%	0,02	-2,12%
21	0,88%	0,51	1,89%	0,13%	0,07	-1,99%
22	0,41%	0,23	2,30%	0,07%	0,04	-1,92%
23	0,67%	0,37	2,96%	-0,26%	-0,14	-2,18%
24	-0,27%	-0,16	2,69%	-0,40%	-0,21	-2,57%
25	-0,12%	-0,07	2,58%	-0,74%	-0,40	-3,31%
26	-0,05%	-0,03	2,52%	-0,33%	-0,18	-3,65%
27	-0,51%	-0,33	2,02%	0,25%	0,15	-3,40%
28	0,32%	0,20	2,34%	-0,61%	-0,32	-4,00%
29	-0,08%	-0,05	2,26%	-0,22%	-0,12	-4,23%
30	0,08%	0,05	2,34%	-0,06%	-0,03	-4,29%
31	0,36%	0,21	2,70%	1,26%	0,66	-3,03%
32	-0,46%	-0,28	2,24%	-0,65%	-0,36	-3,68%
33	-0,45%	-0,29	1,79%	-0,51%	-0,29	-4,19%
34	0,13%	0,08	1,92%	-0,18%	-0,10	-4,37%
35	-0,10%	-0,06	1,81%	-0,27%	-0,14	-4,63%
36	-0,29%	-0,20	1,53%	0,09%	0,06	-4,55%
37	0,30%	0,19	1,83%	-0,40%	-0,23	-4,94%
38	-0,28%	-0,17	1,55%	-0,36%	-0,19	-5,30%
39	0,00%	0,00	1,54%	0,40%	0,23	-4,90%
40	-0,46%	-0,26	1,09%	-0,55%	-0,29	-5,45%

Appendix 6: AAR and CAAR for Full Sample between 2008 and 2018

	2009 - 2018					
		Inclusions			Exclusions	
Event Day	AAR	t-stat (ARR)	CAAR	AAR	t-stat (ARR)	CAAR
-20	-0,04%	-0,02	-0,04%	0,51%	0,23	0,51%
-19	0,35%	0,15	0,31%	0,89%	0,38	1,40%
-18	0,03%	0,01	0,34%	-0,47%	-0,20	0,93%
-17	0,07%	0,03	0,41%	0,20%	0,09	1,12%
-16	-0,23%	-0,10	0,18%	-0,05%	-0,02	1,08%
-15	0,21%	0,09	0,39%	-0,06%	-0,02	1,02%
-14	-0,38%	-0,17	0,01%	0,09%	0,04	1,11%
-13	-0,30%	-0,13	-0,29%	0,01%	0,00	1,12%
-12	-0,63%	-0,28	-0,92%	0,31%	0,13	1,44%
-11	0,00%	0,00	-0,92%	0,41%	0,20	1,85%
-10	0,05%	0,02	-0,87%	0,22%	0,09	2,06%
-9	-0,20%	-0,09	-1,07%	0,69%	0,32	2,76%
-8	-0,06%	-0,03	-1,14%	-0,29%	-0,13	2,47%
-7	-0,11%	-0,04	-1,24%	-0,38%	-0,17	2,08%
-6	0,59%	0,25	-0,66%	-0,11%	-0,05	1,97%
-5	-0,56%	-0,25	-1,22%	1,06%	0,50	3,03%
-4	-0,07%	-0,03	-1,28%	0,18%	0,09	3,21%
-3	-0,17%	-0,07	-1,45%	-0,03%	-0,01	3,18%
-2	-0,08%	-0,03	-1,53%	-0,44%	-0,18	2,74%
-1	0,29%	0,13	-1,24%	0,63%	0,29	3,36%
ED	-0,01%	0,00	-1,25%	-0,09%	-0,04	3,27%
1	0,18%	0,07	-1,07%	0,02%	0,01	3,29%
2	-0,02%	-0,01	-1,10%	0,10%	0,05	3,39%
3	-0,80%	-0,33	-1,89%	-0,12%	-0,05	3,28%
4	0,22%	0,09	-1,67%	-0,06%	-0,03	3,21%
5	0,51%	0,20	-1,16%	-0,46%	-0,18	2,76%
6	-0,77%	-0,27	-1,92%	-0,06%	-0,02	2,69%
7	0,06%	0,02	-1,87%	-0,44%	-0,19	2,26%
8	0,10%	0,04	-1,77%	0,34%	0,13	2,60%
9	0,10%	0,04	-1,67%	1,46%	0,52	4,06%
10	0,64%	0,26	-1,03%	0,04%	0,02	4,10%
11	-0,38%	-0,15	-1,40%	-0,22%	-0,09	3,87%
12	-0,41%	-0,17	-1,81%	0,23%	0,09	4,10%
13	0,41%	0,16	-1,41%	-0,20%	-0,08	3,90%
14	-0,54%	-0,26	-1,95%	-0,61%	-0,27	3,29%
15	0,25%	0,12	-1,70%	0,09%	0,04	3,38%
16	-0,08%	-0,04	-1,78%	0,28%	0,12	3,66%
17	-0,08%	-0,04	-1,86%	0,29%	0,12	3,94%
18	0,06%	0,03	-1,80%	0,54%	0,24	4,49%
19	-0,29%	-0,13	-2,08%	-0,27%	-0,11	4,22%
20	0,69%	0,31	-1,39%	0,07%	0,03	4,28%
21	-0,20%	-0,09	-1,59%	0,35%	0,16	4,63%
22	-0,01%	0,00	-1,59%	0,83%	0,38	5,46%
23	-0,36%	-0,16	-1,96%	-0,14%	-0,07	5,31%
24	-0,39%	-0,14	-2,34%	-0,22%	-0,07	5,09%
25	0,01%	0,00	-2,33%	0,08%	0,03	5,17%
26	0,41%	0,18	-1,93%	0,35%	0,14	5,53%
27	-0,33%	-0,14	-2,25%	-0,13%	-0,05	5,40%
28	-0,30%	-0,13	-2,55%	-0,30%	-0,13	5,10%
29	0,42%	0,15	-2,14%	-0,35%	-0,13	4,74%
30	0,38%	0,12	-1,76%	0,66%	0,21	5,40%
31	0,26%	0,10	-1,50%	0,03%	0,01	5,43%
32	0,77%	0,36	-0,73%	0,10%	0,04	5,53%
33	-0,35%	-0,15	-1,08%	-0,02%	-0,01	5,52%
34	-0,02%	-0,01	-1,11%	0,28%	0,11	5,80%
35	0,20%	0,08	-0,91%	-0,07%	-0,03	5,72%
36	0,39%	0,17	-0,52%	0,05%	0,02	5,77%
37	-0,08%	-0,03	-0,60%	0,22%	0,08	5,99%
38	0,16%	0,06	-0,45%	0,31%	0,12	6,31%
39	-0,07%	-0,03	-0,52%	-0,06%	-0,03	6,24%
40	0,71%	0,31	0,19%	-0,14%	-0,07	6,10%

Appendix 7: AAV for Full Sample between 1999 and 2018

1999 - 2018				
	Inclusions		Exclusions	
Event Day	AAV	t-stat(AAV)	AAV	t-stat(AAV)
-20	3,59%	0,72	-0,10%	-0,02
-19	4,18%	0,84	-0,78%	-0,12
-18	1,45%	0,29	1,76%	0,27
-17	1,24%	0,25	-6,15%	-0,94
-16	0,24%	0,05	-2,98%	-0,46
-15	-3,13%	-0,63	-0,97%	-0,15
-14	-2,42%	-0,49	8,68%	1,33
-13	1,52%	0,31	4,83%	0,74
-12	-0,47%	-0,10	10,97%	1,68
-11	1,31%	0,26	1,92%	0,29
-10	-3,53%	-0,71	1,46%	0,22
-9	1,86%	0,37	1,99%	0,30
-8	-7,54%	-1,51	3,75%	0,57
-7	-4,98%	-1,00	-0,22%	-0,03
-6	1,47%	0,29	7,22%	1,11
-5	-5,40%	-1,08	-1,80%	-0,28
-4	-8,29%	-1,66	-0,03%	0,00
-3	-3,14%	-0,63	2,99%	0,46
-2	-0,26%	-0,05	9,14%	1,40
-1	32,35%	6,49	38,90%	5,96
ED	11,16%	2,24	17,41%	2,67
1	6,19%	1,24	6,95%	1,06
2	3,70%	0,74	2,43%	0,37
3	10,72%	2,15	2,38%	0,36
4	6,72%	1,35	-2,45%	-0,37
5	3,41%	0,68	-5,24%	-0,80
6	4,03%	0,81	5,64%	0,86
7	6,23%	1,25	1,58%	0,24
8	4,46%	0,90	4,42%	0,68
9	3,96%	0,79	-0,55%	-0,08
10	-1,50%	-0,30	-1,37%	-0,21
11	0,23%	0,05	0,30%	0,05
12	-2,66%	-0,53	-0,51%	-0,08
13	3,50%	0,70	-7,94%	-1,22
14	-0,33%	-0,07	-3,07%	-0,47
15	1,66%	0,33	-7,43%	-1,14
16	1,88%	0,38	-4,18%	-0,64
17	-4,75%	-0,95	-6,93%	-1,06
18	-0,07%	-0,01	-7,93%	-1,22
19	3,98%	0,80	-14,51%	-2,22
20	-2,11%	-0,42	-13,06%	-2,00
21	4,24%	0,85	-9,28%	-1,42
22	-2,14%	-0,43	-4,74%	-0,73
23	1,48%	0,30	-5,76%	-0,88
24	5,09%	1,02	-4,42%	-0,68
25	-5,29%	-1,06	-13,97%	-2,14
26	1,23%	0,25	-3,42%	-0,52
27	5,34%	1,07	-1,89%	-0,29
28	-0,80%	-0,16	-3,73%	-0,57
29	-1,66%	-0,33	-1,56%	-0,24
30	-2,75%	-0,55	-8,29%	-1,27
31	5,78%	1,16	2,33%	0,36
32	3,76%	0,75	3,16%	0,48
33	-3,13%	-0,63	5,61%	0,86
34	0,25%	0,05	-1,96%	-0,30
35	-1,37%	-0,27	1,85%	0,28
36	7,37%	1,48	-3,97%	-0,61
37	11,14%	2,23	-7,28%	-1,11
38	1,71%	0,34	-9,40%	-1,44
39	3,60%	0,72	-5,84%	-0,89
40	-6,63%	-1,33	-6,55%	-1,00

Appendix 8: AAV for Full Sample between 1999 and 2008

1999 - 2008				
	Inclusions		Exclusions	
Event Day	AAV	t-stat(AAV)	AAV	t-stat(AAV)
-20	7,08%	1,07	-2,00%	-0,25
-19	5,18%	0,78	-6,30%	-0,80
-18	1,83%	0,28	-1,37%	-0,17
-17	0,98%	0,15	-10,71%	-1,36
-16	-2,16%	-0,33	-5,43%	-0,69
-15	-5,91%	-0,89	-4,77%	-0,61
-14	-2,92%	-0,44	7,44%	0,95
-13	-0,40%	-0,06	-3,15%	-0,40
-12	-2,69%	-0,41	10,46%	1,33
-11	-3,04%	-0,46	-2,17%	-0,28
-10	-5,48%	-0,83	-0,84%	-0,11
-9	3,48%	0,53	-3,64%	-0,46
-8	-10,89%	-1,64	-0,90%	-0,11
-7	-4,61%	-0,70	-5,11%	-0,65
-6	2,46%	0,37	7,24%	0,92
-5	-7,06%	-1,07	-6,92%	-0,88
-4	-8,99%	-1,36	-1,04%	-0,13
-3	-1,49%	-0,23	0,85%	0,11
-2	0,06%	0,01	8,07%	1,03
-1	32,67%	4,93	41,62%	5,30
ED	9,45%	1,43	24,49%	3,12
1	6,04%	0,91	9,94%	1,27
2	4,75%	0,72	6,98%	0,89
3	12,63%	1,91	9,04%	1,15
4	10,10%	1,52	1,65%	0,21
5	7,07%	1,07	-3,09%	-0,39
6	6,41%	0,97	12,45%	1,58
7	8,08%	1,22	5,97%	0,76
8	3,69%	0,56	8,24%	1,05
9	3,43%	0,52	-7,17%	-0,91
10	-1,06%	-0,16	-5,85%	-0,74
11	2,99%	0,45	-6,09%	-0,78
12	-1,11%	-0,17	-2,99%	-0,38
13	6,80%	1,03	-14,60%	-1,86
14	0,12%	0,02	-3,76%	-0,48
15	1,28%	0,19	-10,61%	-1,35
16	2,49%	0,38	-9,33%	-1,19
17	-5,50%	-0,83	-12,77%	-1,63
18	3,07%	0,46	-11,16%	-1,42
19	8,86%	1,34	-19,77%	-2,52
20	-0,93%	-0,14	-21,05%	-2,68
21	8,32%	1,26	-19,15%	-2,44
22	0,11%	0,02	-11,23%	-1,43
23	4,88%	0,74	-9,91%	-1,26
24	6,64%	1,00	-8,99%	-1,14
25	-3,36%	-0,51	-25,42%	-3,24
26	1,51%	0,23	-3,93%	-0,50
27	9,59%	1,45	-6,20%	-0,79
28	0,48%	0,07	-5,69%	-0,72
29	-0,49%	-0,07	-2,07%	-0,26
30	-4,41%	-0,66	-15,35%	-1,95
31	7,82%	1,18	3,82%	0,49
32	3,09%	0,47	3,21%	0,41
33	-8,44%	-1,27	7,61%	0,97
34	-1,31%	-0,20	-8,19%	-1,04
35	0,59%	0,09	-0,29%	-0,04
36	7,30%	1,10	-9,36%	-1,19
37	13,12%	1,98	-14,75%	-1,88
38	-0,07%	-0,01	-15,54%	-1,98
39	2,51%	0,38	-12,18%	-1,55
40	-9,21%	-1,39	-12,55%	-1,60

Appendix 9: AAV for Full Sample between 2009 and 2018

	2008 - 2018			
	Inclusions		Exclusions	
Event Day	AAV	t-stat(AAV)	AAV	t-stat(AAV)
-20	-3,49%	-0,66	2,82%	0,40
-19	2,16%	0,41	7,68%	1,09
-18	0,68%	0,13	6,56%	0,93
-17	1,77%	0,34	0,83%	0,12
-16	5,12%	0,97	0,77%	0,11
-15	2,53%	0,48	4,87%	0,69
-14	-1,40%	-0,27	10,58%	1,50
-13	5,43%	1,03	17,05%	2,42
-12	4,03%	0,77	11,75%	1,67
-11	10,17%	1,93	8,19%	1,16
-10	0,43%	0,08	4,99%	0,71
-9	-1,43%	-0,27	10,60%	1,51
-8	-0,72%	-0,14	10,87%	1,55
-7	-5,74%	-1,09	7,28%	1,03
-6	-0,56%	-0,11	7,20%	1,02
-5	-2,01%	-0,38	6,06%	0,86
-4	-6,87%	-1,31	1,51%	0,22
-3	-6,50%	-1,24	6,29%	0,89
-2	-0,92%	-0,18	10,79%	1,53
-1	31,70%	6,02	34,73%	4,94
ED	14,63%	2,78	6,55%	0,93
1	6,49%	1,23	2,36%	0,34
2	1,55%	0,29	-4,55%	-0,65
3	6,83%	1,30	-7,83%	-1,11
4	-0,16%	-0,03	-8,73%	-1,24
5	-4,02%	-0,76	-8,53%	-1,21
6	-0,80%	-0,15	-4,80%	-0,68
7	2,46%	0,47	-5,16%	-0,73
8	6,05%	1,15	-1,44%	-0,21
9	5,04%	0,96	9,61%	1,37
10	-2,38%	-0,45	5,50%	0,78
11	-5,38%	-1,02	10,11%	1,44
12	-5,80%	-1,10	3,31%	0,47
13	-3,21%	-0,61	2,28%	0,32
14	-1,25%	-0,24	-2,01%	-0,29
15	2,44%	0,46	-2,54%	-0,36
16	0,63%	0,12	3,72%	0,53
17	-3,22%	-0,61	2,03%	0,29
18	-6,45%	-1,23	-2,99%	-0,43
19	-5,96%	-1,13	-6,46%	-0,92
20	-4,50%	-0,85	-0,82%	-0,12
21	-4,08%	-0,78	5,85%	0,83
22	-6,71%	-1,28	5,21%	0,74
23	-5,45%	-1,04	0,59%	0,08
24	1,94%	0,37	2,58%	0,37
25	-9,23%	-1,75	3,59%	0,51
26	0,67%	0,13	-2,63%	-0,37
27	-3,29%	-0,63	4,73%	0,67
28	-3,40%	-0,65	-0,72%	-0,10
29	-4,04%	-0,77	-0,77%	-0,11
30	0,63%	0,12	2,54%	0,36
31	1,62%	0,31	0,05%	0,01
32	5,13%	0,97	3,09%	0,44
33	7,67%	1,46	2,54%	0,36
34	3,43%	0,65	7,60%	1,08
35	-5,34%	-1,01	5,13%	0,73
36	7,49%	1,42	4,28%	0,61
37	7,10%	1,35	4,18%	0,59
38	5,35%	1,02	0,02%	0,00
39	5,84%	1,11	3,87%	0,55
40	-1,39%	-0,26	2,64%	0,38