CHASING THE BREACH –
INVESTIGATING THE INDEX EFFECT ON OSEBX

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DISCLAIMER

This thesis is a part of the MSc program at BI Norwegian Business School. The school takes no responsibility for the methods used, results found and conclusions drawn.

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Abstract

This paper uses stock price data and news related to the composition of OSEBX from 2008-2019 to investigate the presence of an Index Effect. There are significant findings around the announcement date, but the majority of the abnormal returns occur at the day index funds rebalance their portfolios. Here, included and excluded stocks experience abnormal returns exceeding 3 % (positive for inclusions and negative for exclusions). Furthermore, by dividing the final sample into two subgroups, the paper provides evidence for a shift in the timing of the market reaction; recent years have shown that relatively more of the effect occurs in the days following the announcement and less at the day of rebalancing. This suggests that the Norwegian market has become more efficient.

Contents

1. Introduction

The Index Effect is the abnormal returns that occur from revisions in the composition of a given index. The idea is that a substantial increase in trading volume is caused by index funds that aim at minimizing the tracking error by replicating the index perfectly. This, in turn, will create a shock in demand for stocks affected by the change in composition, which again leads to short-term price pressure. In the United States, the Index Effect became widely studied after S&P 500 changed announcement policy. Previously, the effective change coincided with the announcement, whereas from October 1989, these dates became separated, giving rise to what is called the "S&P 500 game". Beneish and Whaley (1996) found that after the separation, abnormal returns could be made by entering a long position in the included stock after the announcement and sell at the effective change date. This price reaction implies an infringement of market efficiency and our paper investigates if the same market response exists in Norway. Furthermore, this paper divides the data into two subgroups to uncover any notable changes over time.

There exists no peer-reviewed literature on the topic using Norwegian market data. Since findings from the U.S. are not always directly translatable to other markets, this paper contributes to the current research by studying the Oslo Stock Exchange directly. Additionally, the most current literature from the U.S. was published over a decade ago, and since the popularity of index funds has risen continuously over the past ten years, it is of interest to see if the effect has strengthened. By finding evidence for an abnormal price reaction at the day index funds rebalances their portfolios, the paper also showcases large investors' ability to influence stock prices in the short-term. The timing of the price reaction is a breach of market efficiency since the effect should occur at the announcement date.

This study uses the event-study methodology outlined in MacKinlay (1997), which is a systematic step-by-step approach. Similar methodology can be found in several studies on the topic (see Kappou, Brooks, & Ward, 2008; Lynch & Mendenhall, 1997; Bechmann, 2004). We will investigate abnormal returns related to changes in the composition of the index for the period 2008-2019 by using the Market Model and the Fama French 3-Factor Model. The whole sample will be examined before dividing the data into two subgroups (2008-2013 & 2014-2019) to discover any recent changes in the Index Effect.

We have conducted a thorough data cleansing process to reduce the impact of firm-specific events as much as possible. This was time-consuming but gives confidence that the Index Effect has been studied in isolation. There are significant findings at the announcement date with abnormal returns of around 1 % for the full sample. However, results indicate that included and excluded stocks experience abnormal returns exceeding 3 % on the day index funds rebalance their portfolios (positive for inclusions and negative for exclusions), and if the Efficient Market Hypothesis were to hold, most of the effect should occur at the time of announcement. Furthermore, by dividing the final sample into two subgroups, the paper provides evidence for a shift in the timing of the market reaction; recent years has shown that relatively more of the effect occurs at the time of the announcement and less at the day of rebalancing. This suggests that the Norwegian market has become more efficient.

This thesis consists of 12 chapters, starting with an introduction, followed by a presentation of relevant background information which intends to give the reader sufficient knowledge on the topic. Existing literature will be reviewed in chapter 3 to provide context. Chapter 4 will provide insight into possible explanations for the Index Effect. This paper will primarily focus on uncovering the presence of a potential Index Effect without investigating what may cause it. Chapter 5 and 6 will present the actual study and its methodology, while chapter 7 and 8 will present the results and the discussion. In chapter 9, the initial hypotheses will be revisited in light of the presented findings. The thesis will conclude by pointing out its limitations and give recommendations for further research.

2. Background

2.1 Index

A stock index is a measurement tool used to describe the development of a market or a market segment (Ferri, 2002). It is calculated from the market capitalization or price of a selection of stocks. In the pre-technological era, the calculation of indices was kept as simple as possible; one of the most famous indexes in the world, the Dow Jones Industrial Average (DJIA), originally contained 12 stocks and was calculated by adding the prices of these 12 stocks and dividing that number by 12 (Corporate Finance Institute, n.d.). As the technology of computers have advanced, more refined techniques have been established, and most indices today typically use some type of weighting mechanism (Ferri, 2002).

2.2 Standard & Poor’s 500 Index (S&P 500)

Many of the studies we refer to in this thesis have been conducted using the S&P 500 index. We, therefore, find it useful to describe what this index represents and how it is calculated. The S&P 500 Index represents 500 of the largest stocks in the United States based on market capitalization. Shares listed on the S&P 500 represent approximately 80 % of available market capitalization in the United States (S&P Dow Jones Indices, 2019) and is, therefore, a useful tool for tracking the development of the U.S economy. Similar to OSEBX, stocks listed on the S&P 500 are selected by a committee, which is different from indices such as the Russel 1000 which is strictly rule-based. To be eligible for inclusion in the S&P 500, however, certain requirements must be met. This includes satisfying a market capitalization requirement of $8.2 billion, as well as certain liquidity requirements (S&P Dow Jones Indices, 2019).

2.3 OSEBX

OSEBX is an index which mission is to be a representative selection of all listed stocks at the Oslo Stock Exchange (Oslo Børs, n.d.). All stocks listed on the exchange are eligible for inclusion, and there are no requirements for market capitalization nor positive earnings. “Index inclusion is based on objective criteria such as free float methodology, sector representation, and share liquidity” (Oslo Børs, 2016). However, the objective criteria are not revealed to the public. Unlike the S&P 500, OSEBX have two fixed dates where the composition of stocks is revised.

2.4 Differences between the S&P 500 and OSEBX

The most apparent difference between the S&P 500 and OSEBX is the disparity in market capitalization for companies listed on these two indices. The market capitalization of OSEBX, as of 13 March 2019, was NOK 2 701 531 million (Oslo Børs, 2019) compared to NOK 208 985 603 million[1] for the S&P, as of 28 February 2019 (S&P Dow Jones Indices, 2019). The higher market capitalization implies that there are vastly more shareholders on the S&P 500 compared to OSEBX, which should result in a smaller bid-ask spread. Benston & Hagerman (1974) found that a doubling in the number of shareholders is associated with a 16.5 % decrease in spread. The average spread on NYSE was 0.64 % between 1900-2000 compared to the Oslo Stock Exchange which had an average spread of 3.9 % between 1980-2008 (Ødegaard, 2009).

Furthermore, the industries represented on these indices differ. The Energy sector makes up 36.1 % of the market capitalization on OSEBX[2], followed by the Financial sector (18.3 %) and the Consumer goods sector (13.2 %) (Oslo Børs, 2019). For the S&P 500 the largest sectors are Information technology (20.6%), Health Care (14.8 %) and Financials (13.3 %) (S&P Dow Jones Indices, 2019).

2.5 Index Funds

Index funds can be traced back to the article by Renshaw & Feldstein (1960), which argued that investment companies had not consistently outperformed stock markets on average and that the case could be made for creating a company "dedicated to the task of following a representative average" (p. 43). However, it was not until 1976 that index funds were made available to the public through the Vanguard Group (Steverman, 2016).

The introduction of index funds was met with initial skepticism from traditional providers of mutual funds, which could partially stem from the fact that they had no reason to endorse a product that would reduce their profits. Additionally, there

[1] Exchange rate for USD/NOK as of 28 February 2019. Retrieved from Norges Bank (2019).
[2] The sector representation is for all companies listed on the Oslo Stock Exchange. OSEBX is a representative selection of all stocks listed on the Oslo Stock Exchange and we therefore assume these numbers to be representative for OSEBX.

was a general concern in the markets as to if such a trading strategy was "self-defeating"; moving stock prices with their automatic trading strategy (Calderwood, 1977). The arguments presented in Calderwood is supported by other studies that have observed a relationship between the increased popularity of index funds and the occurrence of the Index Effect (Shleifer, 1986; Beneish & Whaley, 1996). This discussion is increasingly relevant due to the increased market share of these funds over the last years. The percentage of total assets in mutual funds invested in index funds has increased from 13 % in 2012 to 26 % in 2018 for the Norwegian market (information retrieved through e-mail correspondence with Verdipapirfondenes forening on 1st of March 2019). This could stem from a strengthened belief in fund managers' inability to consistently outperform the market, combined with the continued decrease in management fees for index funds.

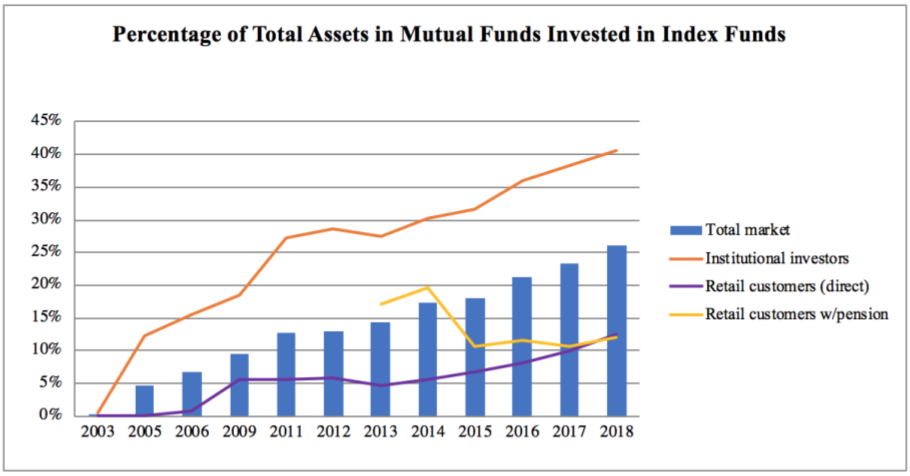


Figure 1: Percentage of Total Assets in Mutual Funds Invested in Index Funds. Retrieved through e-mail correspondence with Verdipapirfondenes forening on 1st of March 2019

2.6 The Index Effect

The Index Effect is the changes that occur in trading volume and price of a stock after its inclusion/exclusion from an index. Already in 1986, Andrei Shleifer presented a study documenting that stocks newly included in the Standard and Poor's 500 Index experienced a significant positive abnormal return at the announcement of inclusion. Since then, similar studies have appeared regularly in financial journals.

2.7 The S&P 500 Game

The "S&P 500 game" came to existence in October 1989 when Standard and Poor (S&P) began its practice of preannouncing changes to the S&P 500 index. This change was made to alleviate the price pressure on the announcement date (Kappou, Brooks, & Ward, 2008). Previously, S&P had announced the change in composition after the close of trading, with the change coming into effect when the market opened the next morning. After the change in policy, the announcement takes place after the market closes, but does not come into effect until five days later (Beneish & Whaley, 1996). Since most index funds are evaluated by its tracking-error in relation to the index, and not in absolute returns, these funds will rebalance their portfolios as close as possible to the day the actual change comes into effect (Chen, Noronha, & Singal, 2004). This may potentially create a quasi-arbitrage opportunity which can be exploited by buying the stock(s) being implemented ahead of the index funds, and selling a few days later.

3. Literature Review

3.1 Beneish & Whaley (1996)

The objective of the study by Beneish and Whaley (1996) was to analyze the effects of the S&P 500's change in announcement policy in October 1989. Up until this date, abnormal returns had already been documented for included firms (see Shleifer, 1986; Harris & Gurel, 1986), but under the new announcement policy, Beneish & Whaley (1996) showed that the average price increase was even more substantial than under the old announcement policy. They argued that this was partly due to the activity of risk arbitrageurs playing the S&P 500 game. Their study examined data from the S&P 500 in the period between January 1986 through June 1994, with their final sample consisting of 103 additions. They found that on the effective change date, the average stock price of included firms increased by 4.1 %. It is, however, possible to criticize this study for lack of data cleansing; the study does not remove firms which are undergoing merger- or spin-off activity in the event-window, nor firms changing CEOs. The lack of data cleansing might contaminate the results of this research, since several studies have indicated that merger and spin-off activity have a large effect on stock prices (see Keown & Pinkerton, 1981; Mitchell, Pulvino, & Stafford, 2005).

3.2 Lynch & Mendenhall (1997)

One year after Beneish & Whaley (1996) released their paper, Lynch & Mendenhall (1997) presented a similar study, where they focused on the period after the S&P 500's change in announcement policy. They found a positive cumulative abnormal return of 3.8 % over the period starting the day after the announcement and ending the day before the effective change date. Their final sample consisted of 55 additions and 53 deletions in the period between March 1990 through April 1995. The final sample was cleansed to remove factors which may otherwise have influenced the stock prices. Firstly, they removed firms were the announcement date was unattainable. Secondly, they removed firms with less than one day in the event window (the period between the announcement date and effective change date). Lastly, they removed firms undergoing merger or spin-off activity at the time of the announcement.

3.3 Denis, McConnell, Ovtchinnikov, & Yu (2003)

Denis, McConnell, Ovtchinnikov, & Yu (2003) wanted to challenge the premise that demand curves for stocks are downward sloping. By analyzing analysts' earnings per share forecasts in the period around index inclusion, and comparing these forecasts to realized earnings after inclusion, they found that companies recently added to the index experienced a significant increase in the forecast for earnings per share, as well as in realized earnings. They used these findings to conclude that inclusion in the index is not an information-free event. Furthermore, they speculate that the reason for their findings may be that a stock's inclusion leads to closer scrutiny of management, which, in turn, may lead to better performance. However, Denis et al. (2003), does not reveal information to whether it is possible to earn abnormal returns by playing the S&P 500 game.

3.4 Kappou, Brooks, & Ward (2008)

Kappou et al. (2008), reexamined the existence of an Index Effect on the S&P 500. In contrast to previously published papers, they used the Fama French 3-Factor Model to allow for firm size and value characteristics, as well as market risk. They argued that the Capital Asset Pricing Model (CAPM) tends to overstate the performance of large firms and to understate the performance of small firms. They found that between 1990-2002, the average included firm experienced an abnormal return of 4.12 % on the first day after the announcement, and an additional abnormal return of 3.39 % over the five days between the day after the announcement and the effective change date. They also found evidence to support that the size and book-to-market effects were more important in the years 1990-1997 for included firms. In this period, medium firms had abnormal returns averaging at 5-5.69 % on the first day after the announcement, compared to large firms which had an average abnormal return of 3.17 %. However, it is important to mention that the study has the same weakness as Beneish & Whaley (1996), since it does not remove firms which are undergoing merger- or spin-off activity in the event-window day, nor firms changing CEO.

4. Possible Explanations for the Index Effect

The following chapter will present relevant hypotheses, which may explain the findings outlined in the literature review above. This thesis is explorative, thus providing reasons for the observed Index Effect is not the primary emphasis. However, in Chapter 9, it is briefly commented on how the findings may relate to the various hypotheses.

4.1 Efficient Market Hypothesis

If the Efficient Market Hypothesis (EMH) holds, the price of a security will fully reflect all available information about the firm it represents. Therefore, an efficient market does not allow investors to earn above-average returns without accepting above-average risks (Malkiel, 2003). This hypothesis has been extensively tested, with contradictive results, ever since Fama presented it in 1970. In his original paper, Fama differentiated between three types of information subsets, which can be used to test a market's "efficiency".

The first information subset considers historical prices, and the market is defined as weak form efficient if investors are unable to predict future prices by using historical prices and trading volumes. The second information subset is whether prices efficiently adjust to other information that is publicly available such as mergers and annual reports. A market is defined as semi-strong form efficient if investors are unable to predict future prices using publicly available information. The last form of efficiency relates to information unavailable to the public, but open to a small group of insiders. If insiders are unable to predict the movement of future prices, the market is regarded as strong form efficient.

There continues to be a debate among scholars whether markets are weak form or semi-strong form efficient. Malkiel (2003), one of the most influential supporters of the Efficient Market Hypothesis, argues that even though there occur occasional empirical findings that violates the conditions for market efficiency, markets may still be efficient. Malkiel claims that the stock market might not be a perfect mathematical random walk, and that it is important to distinguish between mathematical and economic significance. Pointing to studies providing evidence for momentum in the market, thus violating the condition for weak form efficiency, he argues that anyone who pays transactions costs is "unlikely to fashion a trading strategy based on the kinds of momentum found in these studies that will beat a buy-and-hold strategy". He emphasizes this by pointing to Odean (1999), who presented evidence suggesting that momentum traders performed far worse than buy-and-hold investors, even in periods with clear evidence for positive momentum in the market.

4.2 Price Pressure Hypothesis

Kraus & Stoll (1972) investigated the extent to which block trading by institutional investors contributes or detracts from efficient markets. They found that large orders may change the equilibrium price of a security in the short-term. In other words, large orders may create demand shocks which the market cannot fulfill at current price levels. This means that institutional investors, such as index funds may need to pay a premium to get passive investors to sell their stocks. Harris & Gurel (1986) documented an Index Effect on the S&P 500 and argued that the Price Pressure Hypothesis could explain this.

4.3 Imperfect Substitute Hypothesis

The Imperfect Substitute Hypothesis is similar to the Price Pressure Hypothesis in that it claims that stock prices are not only affected by underlying information about the firm, but also by shifts in supply and demand. When a stock has close substitutes, these shifts will not affect the price, since investors should be indifferent to which stocks they hold. The Imperfect Substitute Hypothesis, however, suggests that stocks do not have close substitutes and that investors have preferences for which security they own. Under these conditions, the equilibrium price may change by the actions of large investors (Kraus & Stoll, 1972).

4.4 Information and Liquidity Hypothesis

When examining the Dow Jones Industrial Average, Beneish and Gardner (1995), found evidence suggesting that investors demand a premium for higher trading costs (bid-ask spreads), "...and for holding securities that have relatively less public information available" (p. 135). According to the Information and Liquidity Hypothesis, securities included in an index will receive more attention and be traded in higher volumes than before, thus leading to a price increase through a reduction in the liquidity and information premium (Beneish and Gardner 1995).

4.5 The Market-Segmentation and Investor Recognition Hypothesis

The attention perspective assumes that investors only know of a subset of available securities and the key behavioral assumption is that an investor uses security k in constructing his optimal portfolio, only if the investor knows of security k (Merton, 1987). This implies that investors will not have perfectly diversified portfolios and they are therefore exposed to unsystematic risk. The investor may reduce the unsystematic risk by obtaining information about other securities before making an investment decision. However, if the marginal cost of obtaining information about additional securities is larger than the cost of bearing the unsystematic risk, the investor will continue to hold a subset of all available securities. When a stock is included in an index, it will become more exposed and receive more attention from financial analysts and institutional investors. This will reduce the marginal cost of obtaining information about this firm, and thus, the stock price will increase. Chen et al. (2004) found a permanent price increase for firms included to the S&P 500, but no permanent effect for firms excluded. They explain this asymmetric response by claiming that "investor awareness can increase following a stock's addition to the index, but awareness does not easily diminish when a stock is deleted from the index" (p. 1903).

5. Expectations and Hypotheses

The majority of previous studies on the topic have concluded with a presence of abnormal returns related to changes in the composition of the S&P 500 (e.g., Beneish & Whaley, 1996; Kappou et al., 2008). It is the abnormal returns (AR) around the announcement date that have been the primary focus in studies on the S&P 500, with some studies also investigating stock price reactions in the days surrounding the effective change date. We see no reason why our study on the Norwegian stock market should provide vastly different results than those found on the American stock market. However, since the criteria for inclusions/exclusions on OSEBX are not revealed to the public, it is harder for speculators to predict changes in the composition of this index, compared to the S&P 500 which have more easily detectable and pre-defined conditions for its composition. The announcement of inclusion/exclusion will thus potentially have a stronger price impact for OSEBX, as the market will not have anticipated the event. The selection criteria for OSEBX is also favorable for the accuracy of an event-study as this makes for better isolation of the event.

We believe the primary mechanism behind a potential Index Effect are index funds and large investors, who hold portfolios mimicking the composition of the index. This implies that they do not buy/sell stocks based on underlying information about a firm's prospect, but rather on the security being listed on a given index. This will create an abnormal demand for shares which are being included, thus driving prices up when funds rebalance their portfolios. This usually occurs on the day before the effective change date (ED-1). However, even though we believe that the abnormal demand will occur close to the effective change date, this should, according to the Efficient Market Hypothesis, immediately be reflected in the price of the stock as soon as the information is revealed to the public (AD). Nevertheless, if markets are not fully efficient, the price effect may take place closer to the effective change date, and this will allow for trading strategies that exploit the delay in price reaction. If this study indeed finds evidence for an Index Effect, we further believe that subgroup 2 (the period 2014-2019) will have stronger results than subgroup 1 (the period 2008-2013), due to the continuously increasing popularity of index funds.

The argumentation above allows for the following four hypotheses, were abnormal returns are defined as the difference between actual- and expected returns. Expected returns are calculated by using the Market Model and the Fama French 3-Factor Model.

1. $\overline{AR}_{AD,t-0} \neq 0$
2. $\overline{AR}_{ED,t-1} \neq 0$
3. $\overline{AR}_{AD(1),t-0} < \overline{AR}_{AD(2),t-0}$
4. $\overline{AR}_{ED(1),t-1} < \overline{AR}_{ED(2),t-1}$

Where (1) refers to the first subgroup and (2) refers to the second subgroup.

6. Methodology

6.1 Event-Study

An event-study measure the economic effect of certain events by using the value of the stock(s) as a proxy. The usefulness of these type of studies comes from the assumption of rationality, which means that significant events should immediately be reflected in the stock price (MacKinlay, 1997). The basic statistical format of event-studies has not changed over the last 30 years. However, short-horizon methods are more reliable than long-horizon methods, and the use of daily- rather than monthly stock return data will provide a more precise measurement of abnormal returns (Khotari & Warner, 2006). Published studies on the Index Effect in the U.S. market mainly rely on event-studies as methodology. Furthermore, this methodology has been applied to a large variety of topics such as mergers & acquisitions, earnings announcements, firm structure, etc. (MacKinlay, 1997). We also observe the use of event-study methodology in other areas of social sciences such as management, accounting, economics, operations systems, and marketing (Sorescu, Warren, & Ertekin, 2017).

To investigate the Index Effect on OSEBX, we will use the event-study methodology outlined by MacKinlay (1997). This is a comprehensive framework which will provide a suitable structure for our thesis. We will use the following steps:

- Defining the Event and the Event-Window
- Identification of Selection Criteria
- Selection of Model for Estimating Normal Performance
- Expected- and Abnormal Returns
- Defining the Estimation Period
- Presentation of Results
- Analysis of Results

6.1.1 Defining the Event and Event-Window

The first step of an event-study is to define the event(s) and the event-window(s). When examining systematic movements in stock prices caused by inclusions/exclusions from OSEBX, there are two events most research on the topic deem as particularly interesting: The announcement date (AD) & the effective change date (ED) (see Kappou et al., 2008; Lynch & Mendenhall, 1997; Bechmann, 2004). On AD, the index composition for the next two quarters is revealed. It is announced online by the Oslo Stock Exchange at www.newsweb.no, and the information is immediately made available to all investors. It is, however, possible to trade the stocks immediately before and after this information is revealed. According to the Efficient Market Hypothesis, if inclusions/exclusions from OSEBX contains any new information, we expect to observe the most significant price movement at AD. ED, on the other hand, is the date when a stock is effectively included/excluded from OSEBX. If the market is efficient, we should not observe any abnormal movements of the included/excluded stocks on this date, as no new information is revealed.

Furthermore, we define our event-windows as AD ± 10 trading days and as ED ± 10 trading days. The number of days between AD and ED is not fixed, but varies between approximately 2-3 weeks. Thus, dividing the study into two events makes it easier to investigate the hypotheses systematically. By applying shorter event-windows, we decrease the possibility of falsely detecting abnormal returns, which are due to firm-specific factors and not the event itself.

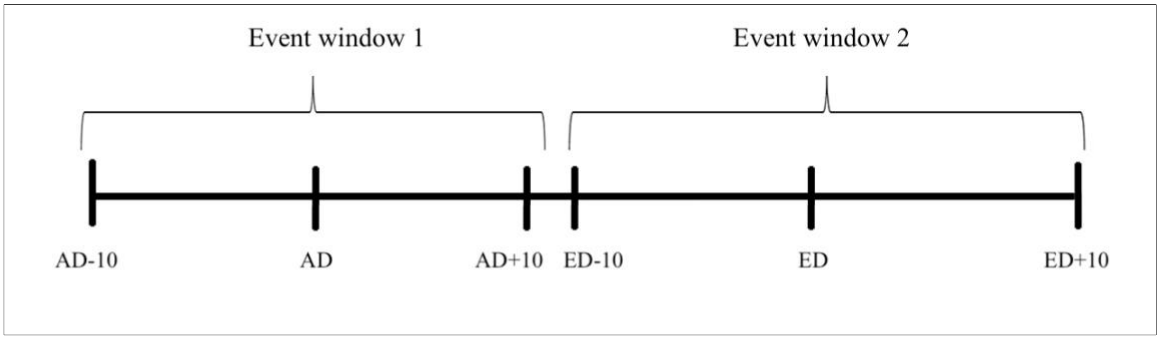


Figure 2: Event-windows

6.1.2 Identification of Selection Criteria

MacKinlay (1997) states that "after identifying the event, it is necessary to determine the selection criteria for the inclusion of a given firm in the study" (p. 15). The selection criterion in our study is that the company was included or excluded from OSEBX in the period from 2H 2008 – 1H 2019. In the given period there have been 105 additions to and 107 deletions from OSEBX (a company can be included/excluded several times, and each time is considered an observation). However, our final dataset consists of fewer observations since we performed screening processes to delete observations that violated two predefined conditions. The rationale behind the screening process is that we want to investigate unbiased data that are unaffected by extraordinary circumstances, thus isolating the Index Effect.

Firstly, each observation needs to have sufficient and accurate data to be included in this study. The firm must be listed on the Oslo Stock Exchange for a period of at last three years before the announcement date since this is the basis for calculating expected returns. We collected data from Bloomberg and discovered that the database did not consider Norwegian holidays as non-trading days if the holiday occurred on a weekday. Bloomberg would in these cases repeat the prices from the previous day. To account for this problem, we removed observations if both the index and the share price were unchanged from the day before. We then used the closing share prices, adjusted for corporate actions including dividends and stock splits, and verified them against alternative sources and excluded observations with discrepancies. This constraint reduced the addition (deletion) sample by 53 (45), of which 44 (32) were due to lack of historical prices and 9 (13) were due to deviations in the share price (mainly caused by errors in data due to name- and ticker changes).

For the second condition, we used NewsWeb to investigate the announcements made by companies around the time of the event window. We searched for news which had the potential of affecting the share price and that were not part of daily business operations. Ideally, we would have removed all observations with news that was unexpected and therefore not already incorporated in the share price, but this would require a deep understanding of each company and the impact of each specific announcement. Furthermore, it would potentially have reduced the sample size drastically, and we argue that since unexpected news can be both positive and negative, they will cancel out when looking at a large enough cross-sectional sample. We, therefore, chose to focus on announcements regarding takeover/merger activity, CEO changes and severe financial distress. This further reduced the deletion sample by four. Our final sample consists of 52 additions and 58 deletions, which is 49.5% and 54.2%, respectively, of the original sample. Our screening process is similar to that of Lynch & Mendenhall (1997) and Kappou et al. (2008). These papers have a final sample of 34.5% and 77.1%, respectively, relative to their original sample. The drawback of excluding a large portion of stocks from the initial sample is the possibility of underestimating the Index Effect. However, the advantage of performing a thorough screening process, is that the likelihood of assigning the Index Effect too great explanatory power is reduced (Chen et al., 2004)

6.1.3 Selection of Model for Estimating Normal Performance

Capital Asset Pricing Model

CAPM was the first model that formally quantified the relationship between risk and return in capital markets. The model was first presented by Sharpe (1964) and Lintner (1965), who built on the work from Markowitz (1952). They showed that if investors have homogeneous expectations and hold mean-variance efficient portfolios then, in the absence of market frictions, the portfolio of all invested wealth, or the market portfolio, will itself be a mean-variance efficient portfolio (Campbell, Lo, & MacKinlay, 1997). The CAPM model was widely used in event-studies from the 1970s, but has more recently received criticism because the restrictions it imposes on the market is found to have anomalies (Fama & French, 1996; cited in MacKinlay, 1997). Studies applying the CAPM may, therefore, be sensitive to the specific CAPM restrictions (MacKinlay, 1997). Consequently, we will in this study use the Fama French 3-Factor Model and the Market Model.

Nevertheless, the CAPM calculates expected returns as follows:

$$E(R_{i,t}) = R_{f,t} + \hat{\beta}_i * [R_{m,t} - R_{f,t}]$$

Where

$E(R_i)$ = Expected return

R_f = Risk-free rate

R_m = Market return

$\hat{\beta}_i$ = Estimated component of stock return related to market return

The Market Model

"The market model is a statistical model which relates the return of any given security to the return of the market portfolio" (Campbell et al., 1997, p. 155). The underlying assumption of the market model is that the return of an individual security, $R_{i,t}$, can be modeled by using a component, β_i, linearly related to some market index, $R_{m,t}$. The unsystematic component, α_i, is assumed to be independent of $R_{m,t}$ and therefore referred to as the abnormal return. Linear regression is used on the data from the estimation period to find the least squared estimates of the intercept and slope coefficient for each security. These coefficients are then held constant for the event-window and used to calculate expected returns from the Market Model (Coutts, Mills, & Roberts, 1994). The model can be expressed as follows:

$$E(R_{i,t}) = \hat{\alpha}_i + \hat{\beta}_i * R_{m,t} + \varepsilon_i$$
$$E(\varepsilon_i = 0), \quad Var(\varepsilon_i) = \sigma^2{}_{\varepsilon i}$$

Where

$E(R_i)$ = Expected return

$\hat{\beta}_i$ = Estimated component of stock return related to market return

R_m = Market return

$\hat{\alpha}_i$ = Unsystematic return

ε_i = Error term

Fama-French 3-Factor Model

MacKinlay (1997, p. 18) argues that "…factor models are motivated by the benefits of reducing the variance of the abnormal return by explaining more of the variation in the normal return". He, therefore, acknowledges the possibility that additional factors besides the market return can serve as proxies for capturing the systematic risk in a more precise manner. This is consistent with the findings of Fama & French (1992), who found evidence for increased accuracy with the use of three factors to explain differences in returns. Two of the factors are based on firm characteristics, where the first is firm size, SMB_t (small minus big), and the second is the book-to-market ratio, HML_t (high minus low). The third factor is the market risk premium.

The rationale for including the two firm-specific factors is that they reflect risk factors investors demand compensation for. "Firms with a low stock price relative to book value signals sustained low earnings on book equity" (Fama & French, 1995, p. 132) and HML_t is, therefore, a proxy for the likelihood of financial distress. Fama & French (1995) also find that size is related to profitability, where "small stocks tend to have lower earnings on book value than do big stocks" (p. 132). Another reason for including a size effect is that small firms typically have less trading volume, which implies that the size effect may capture a liquidity concern.

Consequently, the size and value factors capture a portion of systematic risk that is not included in the market beta.

The model is expressed as follows:

$$E(R_{i,t}) = R_{f,t} + \hat{\beta}_{i,1}(R_{m,t} - R_{f,t}) + \hat{\beta}_{i,2}SMB_t + \hat{\beta}_{i,3}HML_t$$

Where

$E(R_i)$ = Expected return

R_f = Risk-free rate

$\hat{\beta}_1$ = Estimated component of stock return related to market return

R_m = Market return

$\hat{\beta}_2$ = Sensitivity to the SMB factor

SMB = Factor based on company size

$\hat{\beta}_3$ = Sensitivity to the HML factor

HML = Factor based on book-to-market

In 2015, Fama & French created a five-factor model to replace the three-factor model from 1992. The factors added are profitability and investment, and they argue that this model better describes average returns in their sample (Fama & French, 2015). However, since the new model was developed relatively recently, it has not been fully adopted by practitioners, and a study performed on the Chinese stock market found that the five-factor model was not a significant improvement of the three-factor model (Jiao & Lilti, 2017). In addition, we retrieved the HML and SMB factors from Ødegaard (2019) to calculate expected returns. Through an e-mail sent to us on the 6th of May 2019, he explained that he had decided not to present the profitability and investment factors since they are impossible to obtain for the years before 2011, due to the nature of Norwegian accounting policies. Therefore, since we are studying a period from 2008, it is most convenient to operate with a three-factor model instead of a five-factor model.

6.1.4 Expected- and Abnormal Returns

The measurement of expected return is an important component in event-studies (MacKinlay, 1997). The expected return is the return one would expect to observe if the event did not take place. In our study, the expected stock return is calculated based on the Market Model (MM) and the Fama French 3-Factor Model (FF3). We have used OSEAX as a proxy for market returns since it includes the most extensive variety of Norwegian stocks. Furthermore, the 10-year Norwegian government bond is used as the risk-free rate.

For MM, we have regressed the market return on weekly returns for stock i at time t in the estimation period to obtain estimates for the intercept and slope.

$$R_{i,t} = \hat{\alpha} + \hat{\beta}_1 R_{m,t}$$

We then hold the estimated coefficients constant and use them to calculate the expected return for stock i at time t in the event window.

$$E(R_{i,t}) = \hat{\alpha} + \hat{\beta}_1 R_{m,t}$$

For FF3, we have regressed market risk premium, Small Minus Big (SMB) and High Minus Low (HML) on the returns in excess of the risk-free rate for company i at time t in the estimation period.

$$R_{i,t} - R_{f,t} = \hat{\beta}_0 + \hat{\beta}_1 \left(R_{m,t} - R_{f,t}\right) + \hat{\beta}_2 SMB_t + \hat{\beta}_3 HML_t$$

We then hold the estimated coefficients constant for the three factors and use them to calculate the expected return for company i at time t in the event window.

$$E(R_{i,t}) = R_{f,t} + \hat{\beta}_1 \left(R_{m,t} - R_{f,t}\right) + \hat{\beta}_2 SMB_t + \hat{\beta}_3 HML_t$$

The abnormal return is then defined as the difference between the realized return for company i at time t, $R_{i,t}$, and the expectation, $E(R_{i,t})$, derived from the two models above.

$$AR_{i,t} = R_{i,t} - E(R_{i,t})$$

The purpose of this study is to detect the presence of abnormality in returns in the event windows for the cross-sectional sample. We are, therefore, interested in the average abnormal return (AAR) for each day.

$$\overline{AR}_t = \frac{1}{N}\sum\nolimits_{i=1}^{N} AR_{i,t}$$

After assessing whether there are particular days with abnormal returns in the event windows, we will examine different periods to see if there are intervals with abnormal returns. It is possible to have i.e., three consecutive days with no significant abnormal return and still have significant cumulative abnormal returns for the interval. To perform this exercise, we measure the average cumulative abnormal return (CAAR).

$$\overline{CAR}_{t_1;t_2} = \sum\nolimits_{t=t_1}^{t_2} \overline{AR}_t$$

6.1.5 Defining the Estimation Period

Our estimation period consists of weekly observations over three years, ending four weeks before AD. This leads to a small gap between the estimation period and the event window. The gap exists to remove the possibility of overlap since the use of daily observations in the event window starting at AD-10 might, in theory, be 3-4 weeks before AD, given enough non-banking days. Placing the estimation period close to the event window is supported by MacKinlay (1997). Lynch & Mendenhall (1997) however, stop their estimation-window two years before the event-window, because stocks included in the S&P 500 usually have had good economic performance before inclusion in the index, due to the selection criteria of the S&P 500 (four positive consecutive quarters are required for inclusion). However, this is not a problem with OSEBX, as there are no similar economic performance criteria. We select an estimation period of three years, which is equal to 156 weekly observations. This number of observations is approximately an average of the observations used by Lynch & Mendenhall (1997), who have 199 daily observations and Dhillon & Johnson (1991), who have 129 daily observations. This study, however, uses weekly observations to reduce the impact of the larger volatility of the Oslo Stock Exchange compared to the U.S. market. (Bugge, Guttormsen, Molnár, & Ringdal, 2016). We use the same estimation period for both event windows.

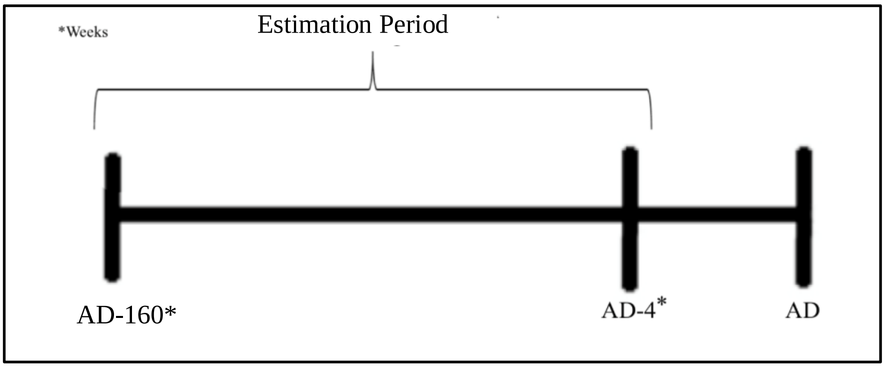


Figure 3: Estimation Period

7. Presentation of Results

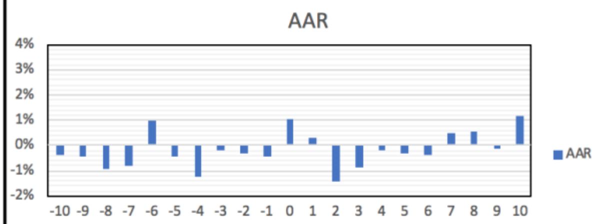
This study was initially conducted using the Market Model. Since the Market Model is a simplistic model which does not factor in variables such as size (which has proven to have a predictive capability on expected returns (Fama & French, 1995)), we supplement by repeating the same procedure using the Fama French 3-Factor Model. Many of the findings are similar across the two models and the validity of the study on the Index Effect, therefore increases. To further enhance the robustness of the results, the study later separates the data into two subgroups (2008-2013 & 2014-2019), to discover potential changes in the Index Effect in more recent years.

This chapter will present the findings from each event window (AD & ED), before investigating the difference between the two subgroups (s1 & s2). Furthermore, the most interesting findings will be discussed in the next chapter.

7.1 Full sample

Inclusions - Market Model - AD

Y= 2008-2019
N = 52



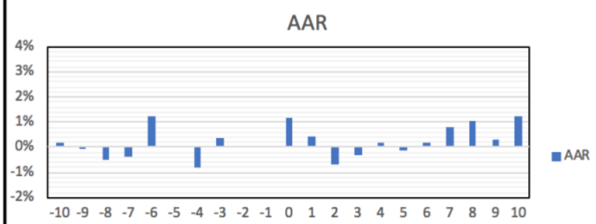
Interval	CAAR	t-Stat
[T-10, T-0]	-3,110 %	-1,286
[T-0,T+10]	0,407 %	0,258
[T-1,T+1]	0,902 %	1,245
[T-10, T-1]	-4,170 %	-1,762
[T-5, T-0]	-1,594 %	-1,335
[T-5, T-1]	-2,654 %	-2,461*
[T-0, T+3]	-0,933 %	-1,34
[T-0, T+5]	-1,389 %	-1,538

Day	AAR	t-Stat	Positive
-10	-0,365 %	-1,188	37 %
-9	-0,416 %	-0,696	29 %
-8	-0,916 %	-2,378*	37 %
-7	-0,800 %	-2,408*	35 %
-6	0,982 %	0,884	44 %
-5	-0,465 %	-0,903	46 %
-4	-1,230 %	-2,379*	21 %
-3	-0,214 %	-0,412	52 %
-2	-0,293 %	-0,617	40 %
-1	-0,451 %	-1,289	44 %
0	1,060 %	2,508*	60 %
1	0,293 %	0,708	46 %
2	-1,404 %	-4,38***	29 %
3	-0,882 %	-2,73**	35 %
4	-0,174 %	-0,427	38 %
5	-0,283 %	-0,650	44 %
6	-0,374 %	-0,805	35 %
7	0,510 %	0,974	46 %
8	0,575 %	1,619	62 %
9	-0,099 %	-0,231	54 %
10	1,184 %	1,879	52 %

Table 1: Presentation of AAR and CAAR for the entire sample of inclusions with respect to AD, using MM. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

Inclusions - Fama French 3 Factor - AD

Y= 2008-2019
N = 52



Interval	CAAR	t-Stat
[T-10, T-0]	1,329 %	0,721
[T-0,T+10]	4,256 %	3,759***
[T-1,T+1]	1,637 %	2,643**
[T-10, T-1]	0,162 %	0,086
[T-5, T-0]	0,780 %	0,822
[T-5, T-1]	-0,388 %	-0,44
[T-0, T+3]	0,587 %	1,082
[T-0, T+5]	0,401 %	0,571

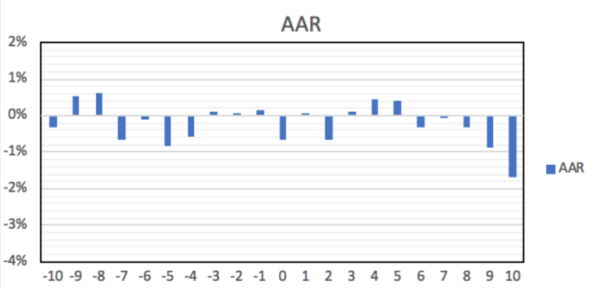
Day	AAR	t-Stat	Positive
-10	0,179 %	0,610	50 %
-9	-0,051 %	-0,088	33 %
-8	-0,485 %	-1,292	46 %
-7	-0,347 %	-1,097	50 %
-6	1,253 %	1,163	54 %
-5	0,001 %	0,002	58 %
-4	-0,814 %	-1,701	27 %
-3	0,375 %	0,823	56 %
-2	0,037 %	0,077	48 %
-1	0,012 %	0,037	52 %
0	1,167 %	2,946**	62 %
1	0,458 %	1,156	58 %
2	-0,713 %	-2,471*	42 %
3	-0,325 %	-1,007	44 %
4	0,178 %	0,433	40 %
5	-0,099 %	-0,243	40 %
6	0,187 %	0,437	54 %
7	0,830 %	1,651	50 %
8	1,018 %	2,647**	67 %
9	0,301 %	0,673	58 %
10	1,253 %	2,246*	58 %

Table 2: Presentation of AAR and CAAR for the entire sample of inclusions with respect to AD, using FF3. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

AD – Inclusion: Table 1 & 2 suggest that the market reacts positively to index inclusions at the announcement date, with significant results in both MM and FF3. However, FF3 shows significant results at the 99 % level, while MM shows significance at the 95 % level. Furthermore, holding the included stocks for ten days following the announcement, will, according to FF3, provide an abnormal return of 4.256 %, which is significant at the 99.9 % level. On the other hand, this effect is not present in the results from MM.

Exclusions - Market Model - AD

Y= 2008-2019
N = 58

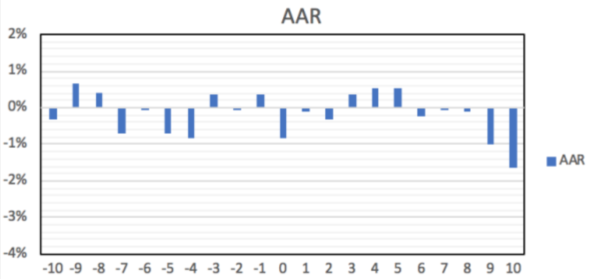


Day	AAR	t-Stat	Negative
-10	-0,337 %	-0,442	62 %
-9	0,523 %	1,355	33 %
-8	0,622 %	1,204	52 %
-7	-0,666 %	-1,295	57 %
-6	-0,089 %	-0,201	57 %
-5	-0,845 %	-0,671	41 %
-4	-0,573 %	-1,302	52 %
-3	0,127 %	0,197	55 %
-2	0,035 %	0,059	40 %
-1	0,143 %	0,377	48 %
0	-0,657 %	-1,571	62 %
1	0,013 %	0,032	57 %
2	-0,679 %	-1,571	57 %
3	0,086 %	0,217	45 %
4	0,462 %	0,544	52 %
5	0,421 %	1,252	47 %
6	-0,305 %	-0,862	53 %
7	-0,054 %	-0,122	55 %
8	-0,304 %	-0,860	53 %
9	-0,865 %	-2,722**	69 %
10	-1,676 %	-3,308**	66 %

Interval	CAAR	t-Stat
[T-10, T-0]	-1,717 %	-0,871
[T-0,T+10]	-3,558 %	-2,528*
[T-1,T+1]	-0,501 %	-0,752
[T-10, T-1]	-1,060 %	-0,561
[T-5, T-0]	-1,770 %	-1,19
[T-5, T-1]	-1,113 %	-0,805
[T-0, T+3]	-1,237 %	-1,487
[T-0, T+5]	-0,354 %	-0,308

Table 3: Presentation of AAR and CAAR for the entire sample of exclusions with respect to AD, using MM. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

Exclusions - Fama French 3 Factor - AD Y= 2008-2019 N = 58



Interval	CAAR	t-Stat
[T-10, T-0]	-1,812 %	-0,898
[T-0,T+10]	-2,863 %	-2,874**
[T-1,T+1]	-0,600 %	-1,101
[T-10, T-1]	-0,961 %	-0,486
[T-5, T-0]	-1,737 %	-1,257
[T-5, T-1]	-0,886 %	-0,68
[T-0, T+3]	-0,922 %	-1,329
[T-0, T+5]	0,165 %	0,185

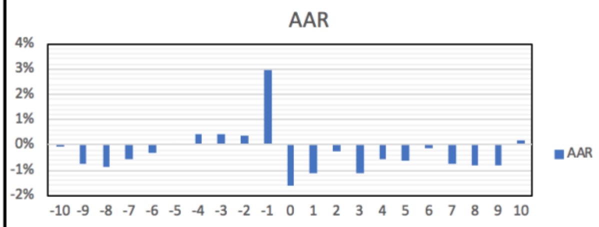
Day	AAR	t-Stat	Negative
-10	-0,315 %	-0,406	64 %
-9	0,645 %	1,506	38 %
-8	0,384 %	0,838	41 %
-7	-0,710 %	-1,432	57 %
-6	-0,080 %	-0,189	57 %
-5	-0,690 %	-0,554	40 %
-4	-0,850 %	-1,723	57 %
-3	0,366 %	0,592	55 %
-2	-0,065 %	-0,113	48 %
-1	0,352 %	1,003	40 %
0	-0,851 %	-2,028*	62 %
1	-0,102 %	-0,274	59 %
2	-0,310 %	-0,748	47 %
3	0,341 %	0,912	45 %
4	0,553 %	0,654	57 %
5	0,534 %	1,682	47 %
6	-0,246 %	-0,644	50 %
7	-0,053 %	-0,114	50 %
8	-0,088 %	-0,251	52 %
9	-0,991 %	-2,9**	67 %
10	-1,650 %	-3,291**	64 %

Table 4: Presentation of AAR and CAAR for the entire sample of exclusions with respect to AD, using FF3. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

AD – Exclusion: FF3 shows that the market reacts negatively to the announcement of exclusion at the announcement date with a significance at the 95 % level, while MM shows no similar results. However, both models show that 62 % of the observations are negative. It is further evident that excluded stocks will experience negative cumulative returns the ten days following the announcement of -2.863** % and -3.558* % if FF3 and MM is used, respectively.

Inclusions - Market Model - ED

Y= 2008-2019
N = 52



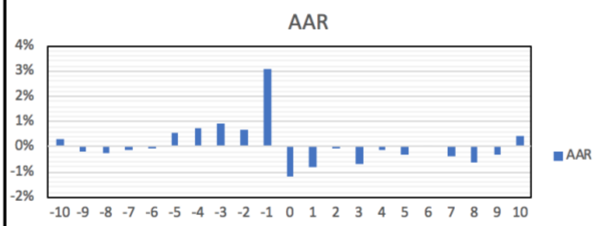
Interval	CAAR	t-Stat
[T-10, T-0]	0,210 %	0,136
[T-0,T+10]	-7,600 %	-4,259***
[T-1,T+1]	0,248 %	0,304
[T-10, T-1]	1,810 %	1,348
[T-5, T-0]	2,703 %	2,293*
[T-5, T-1]	4,303 %	4,129***
[T-0, T+3]	-4,091 %	-4,558***
[T-0, T+5]	-5,251 %	-4,892***

Day	AAR	t-Stat	Positive
-10	-0,005 %	-0,012	46 %
-9	-0,773 %	-2,019*	35 %
-8	-0,847 %	-2,169*	35 %
-7	-0,587 %	-1,489	37 %
-6	-0,281 %	-0,717	44 %
-5	0,048 %	0,111	50 %
-4	0,457 %	0,885	48 %
-3	0,419 %	0,862	48 %
-2	0,385 %	0,700	52 %
-1	2,994 %	4,554***	81 %
0	-1,601 %	-3,368**	27 %
1	-1,145 %	-3,352**	38 %
2	-0,230 %	-0,602	40 %
3	-1,115 %	-3,56***	29 %
4	-0,536 %	-1,591	37 %
5	-0,624 %	-2,37*	31 %
6	-0,154 %	-0,362	42 %
7	-0,729 %	-2,294*	38 %
8	-0,837 %	-2,159*	35 %
9	-0,800 %	-1,834	29 %
10	0,170 %	0,408	54 %

Table 5: Presentation of AAR and CAAR for the entire sample of inclusions with respect to ED, using MM. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

Inclusions - Fama French 3 Factor - ED

Y= 2008-2019
N = 52



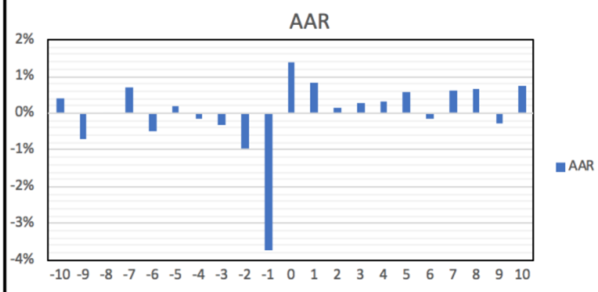
Interval	CAAR	t-Stat
[T-10, T-0]	4,342 %	4,803***
[T-0,T+10]	-4,070 %	-3,371**
[T-1,T+1]	1,055 %	1,576
[T-10, T-1]	5,545 %	6,121***
[T-5, T-0]	4,749 %	5,63***
[T-5, T-1]	5,952 %	6,972***
[T-0, T+3]	-2,786 %	-3,752***
[T-0, T+5]	-3,213 %	-3,817***

Day	AAR	t-Stat	Positive
-10	0,315 %	0,798	52 %
-9	-0,219 %	-0,631	48 %
-8	-0,275 %	-0,727	42 %
-7	-0,132 %	-0,331	50 %
-6	-0,096 %	-0,266	37 %
-5	0,552 %	1,406	58 %
-4	0,736 %	1,539	58 %
-3	0,895 %	1,758	56 %
-2	0,685 %	1,276	56 %
-1	3,085 %	4,966***	85 %
0	-1,203 %	-2,775**	29 %
1	-0,828 %	-2,494*	40 %
2	-0,061 %	-0,163	46 %
3	-0,694 %	-2,118*	44 %
4	-0,126 %	-0,400	37 %
5	-0,301 %	-1,186	46 %
6	0,040 %	0,102	50 %
7	-0,359 %	-1,089	46 %
8	-0,641 %	-1,757	37 %
9	-0,343 %	-0,802	37 %
10	0,445 %	1,146	52 %

Table 6: Presentation of AAR and CAAR for the entire sample of inclusions with respect to ED, using FF3. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

ED – Inclusion: The most significant finding surrounding the effective change date is at ED-1. There are significant positive results for both models, with both models having abnormal returns of approximately 3 % and over 80 % positive observations. Another interesting finding is the negative abnormal returns in the days after the inclusion, with significant results from both models ([T-0, T+3], [T-0, T+5], [T-0, T+10]).

Exclusions - Market Model - ED Y= 2008-2019 N = 58

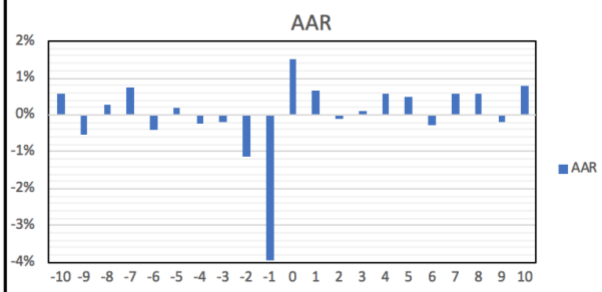


Interval	CAAR	t-Stat
[T-10, T-0]	-3,699 %	-2,594*
[T-0,T+10]	5,151 %	2,508*
[T-1,T+1]	-1,510 %	-1,886
[T-10, T-1]	-5,071 %	-3,861***
[T-5, T-0]	-3,576 %	-3,993***
[T-5, T-1]	-4,948 %	-5,712***
[T-0, T+3]	2,627 %	2,661**
[T-0, T+5]	3,539 %	2,645**

Day	AAR	t-Stat	Negative
-10	0,407 %	1,040	45 %
-9	-0,710 %	-1,538	59 %
-8	-0,032 %	-0,094	47 %
-7	0,691 %	0,792	47 %
-6	-0,479 %	-1,465	52 %
-5	0,205 %	0,503	53 %
-4	-0,149 %	-0,462	55 %
-3	-0,327 %	-0,895	62 %
-2	-0,964 %	-2,777**	69 %
-1	-3,712 %	-6,816***	83 %
0	1,372 %	2,76**	28 %
1	0,830 %	1,716	45 %
2	0,131 %	0,233	48 %
3	0,294 %	0,692	48 %
4	0,327 %	0,934	40 %
5	0,585 %	1,315	43 %
6	-0,169 %	-0,472	57 %
7	0,636 %	1,211	40 %
8	0,682 %	1,487	40 %
9	-0,283 %	-0,783	57 %
10	0,746 %	0,957	48 %

Table 7: Presentation of AAR and CAAR for the entire sample of exclusions with respect to ED, using MM. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

Exclusions - Fama French 3 Factor - ED Y= 2008-2019 N = 58



Interval	CAAR	t-Stat
[T-10, T-0]	-3,150 %	-2,759**
[T-0,T+10]	4,694 %	2,657**
[T-1,T+1]	-1,782 %	-2,244*
[T-10, T-1]	-4,651 %	-4,327***
[T-5, T-0]	-3,786 %	-4,377***
[T-5, T-1]	-10,575 %	-6,13***
[T-0, T+3]	2,173 %	2,549*
[T-0, T+5]	3,235 %	2,764**

Day	AAR	t-Stat	Negative
-10	0,568 %	1,717	41 %
-9	-0,523 %	-1,201	53 %
-8	0,261 %	0,748	48 %
-7	0,748 %	0,863	52 %
-6	-0,418 %	-1,200	53 %
-5	0,200 %	0,503	48 %
-4	-0,221 %	-0,658	52 %
-3	-0,203 %	-0,494	59 %
-2	-1,111 %	-3,147**	67 %
-1	-3,953 %	-6,823***	83 %
0	1,502 %	3,015**	33 %
1	0,669 %	1,423	50 %
2	-0,105 %	-0,190	53 %
3	0,107 %	0,268	53 %
4	0,559 %	1,481	41 %
5	0,502 %	1,200	45 %
6	-0,292 %	-0,794	57 %
7	0,590 %	1,113	41 %
8	0,571 %	1,181	43 %
9	-0,192 %	-0,534	52 %
10	0,783 %	1,025	43 %

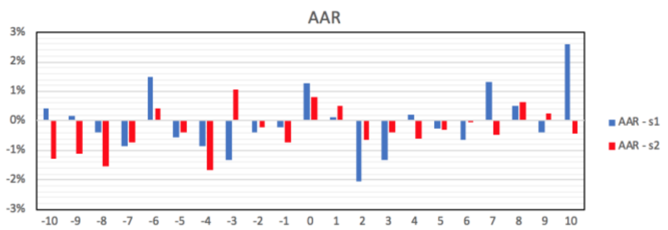
Table 8: Presentation of AAR and CAAR for the entire sample of exclusions with respect to ED, using FF3. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

ED – Exclusion: The findings suggest that there is an even greater effect in absolute terms from exclusion at ED-1, compared to the same date in the inclusion sample. There is evidence of abnormal returns of close to 4 % from both models, and this is significant at the 99.9 % level. Furthermore, the results illustrate a continued downward trend in the coming days following the exclusion ([T-0, T+10]). This is different from inclusions, where the effect appears to be reversing.

7.2 Subgroups

In this section, the significant differences between the two subgroups will be presented. As the popularity of index funds has increased, the expectation is that the Index Effect has strengthened. However, results are not in line with our anticipations, and hypotheses 3 & 4 are rejected.

Inclusions - Market Model - AD

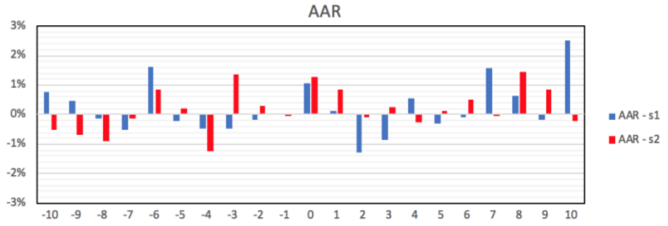


Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	-1,217	-5,319	0,885
[T-0,T+10]	1,372	-0,719	0,639
[T-1,T+1]	1,172	0,587	0,399
[T-10, T-1]	-2,484	-6,137	0,807
[T-5, T-0]	-2,024	-1,911	-0,050
[T-5, T-1]	-3,291	-1,911	-0,638
[T-0, T+3]	-1,969	0,277	-1,578
[T-0, T+5]	-2,020	-0,652	-0,724

Day	AAR - s1	AAR - s2	t-Stat
-10	0,405 %	-1,264 %	2,946**
-9	0,188 %	-1,122 %	1,152
-8	-0,400 %	-1,518 %	1,462
-7	-0,862 %	-0,727 %	-0,203
-6	1,475 %	0,405 %	0,511
-5	-0,541 %	-0,377 %	-0,156
-4	-0,856 %	-1,668 %	0,824
-3	-1,311 %	1,066 %	-2,464*
-2	-0,368 %	-0,206 %	-0,174
-1	-0,215 %	-0,726 %	0,764
0	1,267 %	0,819 %	0,520
1	0,121 %	0,495 %	-0,436
2	-2,041 %	-0,660 %	-2,207*
3	-1,316 %	-0,376 %	-1,450
4	0,201 %	-0,611 %	1,029
5	-0,251 %	-0,319 %	0,078
6	-0,651 %	-0,052 %	-0,644
7	1,336 %	-0,454 %	1,853
8	0,513 %	0,648 %	-0,182
9	-0,386 %	0,235 %	-0,740
10	2,580 %	-0,444 %	2,572*

Table 9: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of inclusions with respect to AD, using MM. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

Inclusions - Fama French 3 Factor - AD



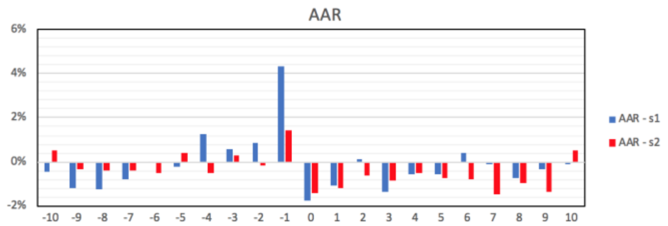
Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	2,011	0,535	0,413
[T-0,T+10]	3,853	4,726	-0,384
[T-1,T+1]	1,229	2,114	-0,716
[T-10, T-1]	0,942	-0,748	0,467
[T-5, T-0]	-0,196	1,918	-1,104
[T-5, T-1]	-1,265	0,636	-1,068
[T-0, T+3]	-0,911	2,335	-3,222**
[T-0, T+5]	-0,649	2,201	-1,991

Day	AAR - s1	AAR - s2	t-Stat
-10	0,763 %	-0,502 %	2,253*
-9	0,476 %	-0,665 %	1,041
-8	-0,122 %	-0,909 %	1,051
-7	-0,523 %	-0,141 %	-0,600
-6	1,612 %	0,834 %	0,381
-5	-0,194 %	0,229 %	-0,412
-4	-0,467 %	-1,219 %	0,824
-3	-0,472 %	1,364 %	-2,13*
-2	-0,167 %	0,276 %	-0,473
-1	0,036 %	-0,015 %	0,079
0	1,069 %	1,283 %	-0,262
1	0,124 %	0,846 %	-0,896
2	-1,266 %	-0,067 %	-2,111*
3	-0,838 %	0,273 %	-1,725
4	0,548 %	-0,254 %	1,010
5	-0,287 %	0,120 %	-0,504
6	-0,096 %	0,518 %	-0,719
7	1,586 %	-0,052 %	1,758
8	0,636 %	1,465 %	0,145
9	-0,152 %	0,831 %	0,131
10	2,529 %	-0,236 %	0,005

Table 10: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of inclusions with respect to AD, using FF3. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

AD: Referring to hypothesis 3, there is no support for greater abnormal returns at the announcement date for subgroup 2 compared to subgroup 1. Nevertheless, subgroup 2 shows that the impact of the announcement is incorporated faster in the market in the days following the announcement ([T-0, T+3]). However, this holds only for the inclusions using FF3. There are no significant differences in the two subgroups for exclusions (see table 15 & 16 in Appendix).

Inclusions - Market Model - ED

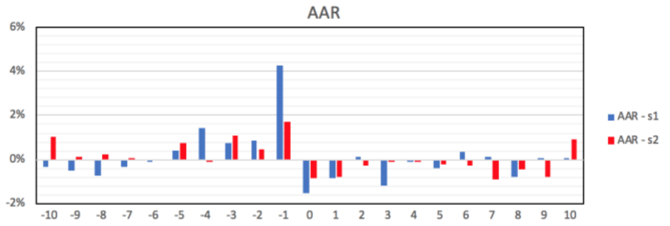


Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	1,266	-1,023	0,718
[T-0,T+10]	-6,097	-9,353	0,893
[T-1,T+1]	1,462	-1,168	1,648
[T-10, T-1]	3,037	0,379	0,954
[T-5, T-0]	4,971	0,057	2,179*
[T-5, T-1]	6,741	1,459	2,702**
[T-0, T+3]	-4,092	-4,090	-0,001
[T-0, T+5]	-5,213	-5,295	0,038

Day	AAR - s1	AAR - s2	t-Stat
-10	-0,440 %	0,503 %	-1,202
-9	-1,166 %	-0,315 %	-1,088
-8	-1,254 %	-0,373 %	-1,156
-7	-0,776 %	-0,365 %	-0,527
-6	-0,069 %	-0,529 %	0,605
-5	-0,237 %	0,380 %	-0,724
-4	1,258 %	-0,478 %	1,798
-3	0,548 %	0,270 %	0,288
-2	0,851 %	-0,158 %	0,961
-1	4,322 %	1,446 %	2,259*
0	-1,770 %	-1,403 %	-0,388
1	-1,089 %	-1,211 %	0,178
2	0,113 %	-0,630 %	1,003
3	-1,345 %	-0,846 %	-0,820
4	-0,585 %	-0,479 %	-0,155
5	-0,537 %	-0,726 %	0,353
6	0,415 %	-0,817 %	1,481
7	-0,107 %	-1,454 %	2,226*
8	-0,743 %	-0,945 %	0,260
9	-0,317 %	-1,363 %	1,197
10	-0,132 %	0,521 %	-0,787

Table 11: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of inclusions with respect to ED, using MM. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

Inclusions - Fama French 3 Factor - ED

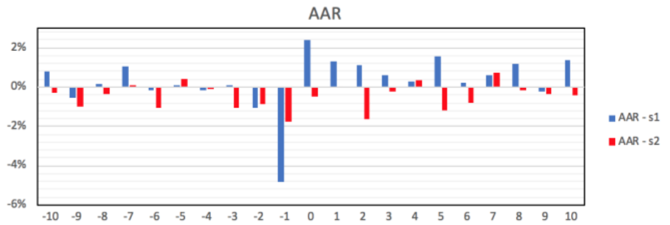


Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	4,245	4,456	-0,112
[T-0,T+10]	-4,306	-3,794	-0,212
[T-1,T+1]	1,887	0,083	1,375
[T-10, T-1]	5,758	5,297	0,250
[T-5, T-0]	6,188	3,070	1,921
[T-5, T-1]	7,701	3,911	2,339*
[T-0, T+3]	-3,484	-1,972	-1,046
[T-0, T+5]	-3,983	-2,314	-1,018

Day	AAR - s1	AAR - s2	t-Stat
-10	-0,311 %	1,046 %	-1,704
-9	-0,496 %	0,104 %	-0,840
-8	-0,712 %	0,234 %	-1,289
-7	-0,307 %	0,072 %	-0,485
-6	-0,117 %	-0,070 %	-0,067
-5	0,391 %	0,739 %	-0,446
-4	1,443 %	-0,090 %	1,698
-3	0,727 %	1,090 %	-0,362
-2	0,881 %	0,455 %	0,413
-1	4,259 %	1,716 %	2,081*
0	-1,513 %	-0,841 %	-0,778
1	-0,859 %	-0,792 %	-0,103
2	0,102 %	-0,251 %	0,486
3	-1,214 %	-0,088 %	-1,793
4	-0,127 %	-0,125 %	-0,001
5	-0,373 %	-0,217 %	-0,299
6	0,332 %	-0,301 %	0,817
7	0,101 %	-0,895 %	1,565
8	-0,804 %	-0,451 %	-0,489
9	0,021 %	-0,766 %	0,931
10	0,027 %	0,933 %	-1,166

Table 12: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of inclusions with respect to ED, using FF3. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

Exclusions - Market Model - ED

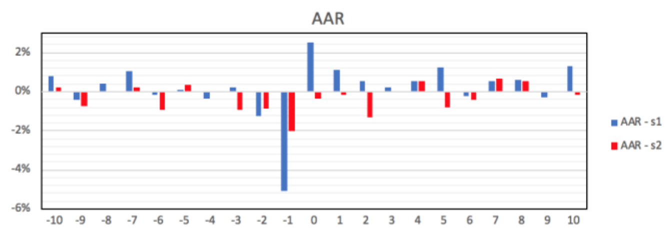


Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	-2,211	-6,321	1,531
[T-0,T+10]	10,442	-4,171	3,659***
[T-1,T+1]	-1,085	-2,260	0,683
[T-10, T-1]	-4,641	-5,829	0,474
[T-5, T-0]	-3,463	-3,774	0,174
[T-5, T-1]	-5,893	-3,283	-1,589
[T-0, T+3]	5,465	-2,375	4,15***
[T-0, T+5]	7,361	-3,196	4,12***

Day	AAR - s1	AAR - s2	t-Stat
-10	0,803 %	-0,290 %	1,471
-9	-0,554 %	-0,985 %	0,509
-8	0,133 %	-0,325 %	0,761
-7	1,033 %	0,089 %	0,668
-6	-0,163 %	-1,036 %	1,244
-5	0,073 %	0,436 %	-0,430
-4	-0,188 %	-0,082 %	-0,168
-3	0,077 %	-1,040 %	1,674
-2	-1,035 %	-0,839 %	-0,287
-1	-4,821 %	-1,757 %	-2,831**
0	2,430 %	-0,491 %	3,305**
1	1,307 %	-0,011 %	1,236
2	1,131 %	-1,631 %	2,469*
3	0,598 %	-0,242 %	0,909
4	0,319 %	0,342 %	-0,033
5	1,577 %	-1,163 %	3,129**
6	0,195 %	-0,811 %	1,408
7	0,592 %	0,714 %	-0,137
8	1,159 %	-0,158 %	1,626
9	-0,254 %	-0,335 %	0,116
10	1,388 %	-0,384 %	1,123

Table 13: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of exclusions with respect to ED, using MM. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

Exclusions - Fama French 3 Factor - ED



Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	-2,070	-5,052	1,443
[T-0,T+10]	8,216	-1,510	2,609*
[T-1,T+1]	-1,376	-2,499	0,644
[T-10, T-1]	-4,618	-4,710	0,047
[T-5, T-0]	-3,787	-3,785	0,000
[T-5, T-1]	-6,335	-3,442	-1,849
[T-0, T+3]	4,451	-1,840	3,698***
[T-0, T+5]	6,246	-2,070	3,455**

Day	AAR - s1	AAR - s2	t-Stat
-10	0,769 %	0,215 %	0,836
-9	-0,404 %	-0,732 %	0,411
-8	0,431 %	-0,040 %	0,755
-7	1,056 %	0,204 %	0,610
-6	-0,136 %	-0,914 %	1,074
-5	0,104 %	0,370 %	-0,334
-4	-0,335 %	-0,020 %	-0,501
-3	0,196 %	-0,906 %	1,463
-2	-1,242 %	-0,879 %	-0,536
-1	-5,057 %	-2,008 %	-2,653*
0	2,548 %	-0,343 %	3,21**
1	1,133 %	-0,148 %	1,243
2	0,567 %	-1,288 %	1,615
3	0,202 %	-0,060 %	0,313
4	0,567 %	0,546 %	0,026
5	1,228 %	-0,777 %	2,385*
6	-0,233 %	-0,397 %	0,223
7	0,546 %	0,669 %	-0,134
8	0,602 %	0,517 %	0,095
9	-0,279 %	-0,040 %	-0,355
10	1,335 %	-0,189 %	0,972

Table 14: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of exclusions with respect to ED, using FF3. The diagram displays AAR visually, with days on the horizontal axis where ED = 0, and with AAR on the vertical axis.

ED: The most recent period (s2) has weaker absolute abnormal returns for both inclusions and exclusions at ED-1. For inclusions, the difference between the two subgroups is above 2.5 %, while for exclusions the difference is greater than 3 %. This is contradictory to hypothesis 4, which stated that the abnormal return should be greater for subgroup 2. In the days following the effective change date for inclusions, there are no significant differences between the two periods. For exclusions, however, the picture is different. In the first period, there is a reversal of the effect in the days following the effective change date, while in the latter period, the negative effect seems to continue.

8. Discussion

In the result chapter, we presented evidence of an effect caused by a firm's inclusion/exclusion from OSEBX. These results are consistent with findings on studies performed on the U.S. market. Compared to these studies, however, this paper also divides the sample into two subgroups, and the results suggest that the Index Effect has become weaker in recent year, making it harder to implement trading strategies which takes advantage of the effect.

Financial theory explains that the stock prices should be a function of companies' prospects, implying it should be based on fundamentals (Koller, Goedhart, & Wessels, 2015). If the announcement contains new information, prices should adjust, and a new equilibrium price should be reached immediately. However, the announcement of an inclusion/exclusion from OSEBX entails no such information, and therefore, this cannot be the reason for the abnormal returns. Other causes may, therefore, be important in explaining abnormal returns, such as the Price Pressure Hypothesis. This hypothesis explains the increase in price, even though there are no fundamental changes in the prospects of the firm (see chapter 3). We have not investigated trading volumes, but it is reasonable to assume it will increase on ED-1, since this is the day index funds rebalance their portfolios. Additional explanations such as the Liquidity Hypothesis is not possible to discuss from our results, as our event-window has not a sufficient number of trading days after the event to investigate a short-term price increase, followed by a long-term reversal.

AD – Inclusion/Exclusions (full sample)

The findings from AD suggests that the market incorporates some of the new information about the upcoming inclusion of stocks, as share prices increase at the announcement date (AD-0). Consequently, hypothesis 1 cannot be rejected. This is somewhat consistent with the EMH as a predicted price increase in the future should be incorporated immediately. We would expect similar findings for excluded stocks (in the opposite direction), but there is only support for this in the data using FF3. This gives support to the Investor Recognition Hypothesis (see chapter 3), which claims that included stocks experience an increase in price due to heightened investor awareness, but excluded firms are not "forgotten" and do therefore not experience the same effect (in the opposite direction). However, there are stocks in our sample, which are included and excluded multiple times, and this provides noise to the explanatory power of this explanation. It may instead be beneficial to only use stocks which are included and excluded from the index for the first time.

ED – Inclusions (full sample)

The significant findings at ED-1 suggest that markets are not fully efficient since abnormal returns occur at the day of rebalancing. This means that hypothesis 2 cannot be rejected. If the EMH were to hold, all the abnormal returns should occur at the announcement date. There is, however, possible to argue that there is some potential for abnormal returns at ED-1, and that the EMH simultaneously holds, if the market cannot fully predict the volume increase that occurs at ED-1. Nevertheless, abnormal returns close to 3 %, may be deemed as too large of a deviation to be explained simply by the difference in expected- and actual trading volumes. However, the observed findings are supported by the Price Pressure Hypothesis, as ED-1 is the date when index funds rebalance their portfolios. The findings are also consistent with those of Beneish & Whaley (1996), who found abnormal returns of 4.1 % at the effective change date. Kappou et al. (2008), however, found the most significant returns at the day after the announcement (AD+1).

ED – Exclusions (full sample)

The findings at ED-1 for exclusions are similar to the results for inclusions, but the average abnormal return is about one percentage point larger for exclusions in absolute terms. Also, there is a stronger effect at ED-1 and a weaker effect at AD-0 for exclusions. This can partly be explained by the fact that it is more difficult and costly to undertake a short position, compared to a long position, and this will be elaborated below:

At the time of the announcement for inclusion, there are two ways to exploit the predicted price change at ED-1. There is the possibility of staying long if the stock is already in the investor's portfolio. The other option is to immediately purchase the stock after the announcement, if the investor does not already hold a long position. These two possibilities are open to investors at AD-0 and will lead to an immediate adjustment of prices. On the contrary, if the announcement is for an exclusion, investors will not always have the same two possibilities. If the investor already holds the stock, he may sell at AD-0 (which might contribute to the negative abnormal returns observed using FF3). If the investor does not own the security already, it is not guaranteed that the information can be exploited. This may be due to high costs associated with undertaking short positions or because the particular stock is unavailable for shorting (no one will lend out their shares). It is, therefore, expected that the effect on AD-0 will be smaller for exclusions compared to inclusions. However, since prices have not adjusted already, they will do so when index funds are forced out of their positions at ED-1, implying a more substantial effect for exclusions at ED-1 compared to inclusions.

Subgroups

There is evidence for an increased price effect in the *days following* the announcement in the second subgroup. This indicates that the market has become more aware of the Index Effect as prices now adjust quicker to the information. The increased awareness may be due to the continuous rise in popularity of index funds, which makes for a renewed interest in earlier studies on the topic. Consequently, it has gotten more difficult for investors to implement trading strategies which exploit the Index Effect. If the explanation for the results around AD is to be consistent with increased market efficiency, one would expect that the impact at ED-1 is weaker for the second subgroup, which indeed is the case.

9. Review of Hypotheses

1. $\overline{AR}_{AD,t-0} \neq 0$

We cannot reject the hypothesis that included stocks, using both MM and FF3, and excluded stocks, using FF3, experience abnormal returns on the announcement date. This is consistent with the Efficient Market Hypothesis, and Kappou et al. (2008), found similar results for the S&P 500 using FF3.

2. $\overline{AR}_{ED,t-1} \neq 0$

We cannot reject the hypothesis that included- and excluded stocks, using both MM and FF3, experience abnormal returns on the day of rebalancing for index funds. This is consistent with the findings of Beneish & Whaley (1996), who found abnormal returns of 4.1% on the day of rebalancing for index funds.

3. $\overline{AR}_{AD(1),t-0} < \overline{AR}_{AD(2),t-0}$

We reject the hypothesis that subgroup 2 will have greater abnormal returns compared to subgroup 1 on the announcement date.

4. $\overline{AR}_{ED(1),t-1} < \overline{AR}_{ED(2),t-1}$

We reject the hypothesis that subgroup 2 will have greater abnormal returns compared to subgroup 1 on the day when index funds rebalance their portfolios.

10. Limitations, Weaknesses and Suggestions for Further Research

10.1 Limitations and Weaknesses

The awareness of limitations and weaknesses of a given study is important, as these may inflict noise on the final results – which in the worst case can make the findings invalid. Therefore, this chapter will present the limitations and weaknesses of this study, making the reader aware of potential noise and errors.

The first limitation occurs from the fact that the final sample is approximately half of the original sample since stocks was deleted for various reasons. The reduction in observations is not necessarily a problem per se, if the final sample is an accurate representation of the population. To avoid the potential problem of selection bias, the authors, therefore, examined the deleted stocks and found no indications that they had common denominators (i.e., many deleted stocks operating in the same industry). However, there may still exist sample bias which the authors were unable to detect.

The second limitation is that both MM and FF3 presume that the estimated betas are constant over time. This is not necessarily the case, because the fundamentals of a company may change throughout its lifespan (e.g., leverage ratio, growth rates, and change of industry). This is supported by the Coutts et al. study from 1994, and the consequence of applying inaccurate betas are wrong estimates of expected returns.

A third limitation is that both MM and FF3 use least square estimation to obtain betas. To draw statistically accurate conclusions from these models, the residuals should be randomly distributed and not exhibit autocorrelation, heteroscedasticity, non-normality, or multicollinearity. Additionally, the residuals should not be correlated with any of the explanatory variables. Coutts et al. (1994) conclude that the data sets used in, at the time, recent event-studies applying MM commonly violate these conditions. Testing the econometric assumptions is not common practice in the field of finance when using MM and FF3 (Coutts et al., 1994), and these assumptions have, therefore, not been tested in our study. Consequently, significant findings should be treated with some caution.

The fourth limitation is that the study does not explicitly mention transaction costs and how they potentially could reduce the abnormal returns. Transaction costs include both the direct brokerage fee and more indirect costs inherent in the bid-ask spread. If one were to implement a trading strategy based on our findings, the investor would be subject to these costs. The most recent study on the Oslo Stock Exchange shows an average spread in the period 1980-2008 of 3.9 % (Ødegaard, 2009). However, it is reasonable to assume that the spread has decreased after 2008 since the number of transactions has almost doubled from 2008 to 2018 (Oslo Børs, n.d.). Even tough transaction costs are not negligible; they are unlikely to make the trading strategy unprofitable given the significance of the abnormal returns. Furthermore, brokerage fees can be ignored as they only account for 0.04 % of the transaction price, or a maximum of 99 NOK (Nordea, n.d.).

10.2 Further Research

In this section, we will present suggestions for future research that can enhance the understanding of the Index Effect on OSEBX.

1. Study the Index Effect using only first-time inclusions and exclusions on OSEBX

We have found no studies that investigate the Index Effect by only examining stocks that are included/excluded for the first time. This is potentially due to the decreased sample size in such a study, but if the current announcement- and inclusion/exclusion policy continues, it should be possible to conduct such studies in a few years and draw inferences. This will contribute to the current literature by examining if the Index Effect is more significant for first-time inclusions/exclusions, and thus give support to the Investor Awareness Hypothesis discussed in chapter 3.

2. Examine differences in the Index Effect in bullish/bearish markets

If the studies conducted on the Index Effect are all performed in a bullish environment, this will restrict the conclusions that can be drawn. By studying the Index Effect in greater depth and in different states of the world, one has the potential to draw conclusions that is valid, regardless of the current market environment. Alternatively, testing the presence of an Index Effect in different market conditions can be done by incorporating NOVIX, which is the Norwegian equivalent to the S&P 500 VIX index and measures volatility in the market.

3. Extension of the event-windows

This thesis has studied the short-term price responses of inclusions/exclusions to the index. It would be interesting to widen the event-window and examine if there is a permanent Index Effect present. A potential challenge with such research is the thorough screening process that is required to isolate the Index Effect, since any unexpected firm-specific news must be accounted- and adjusted for.

4. The relationship between trading volume and the Index Effect

The focus of this paper has been on detecting an Index Effect, and less of the emphasis has been on possible explanations. Although we have touched upon the mandates of index funds and their trading patterns as one explanation for the abnormal returns at ED-1, we have not collected data to quantify and support this view. A model that expands on our work and includes unusual trading patterns will, therefore, contribute to the current literature.

11. Conclusion

This paper has investigated the presence of an Index Effect related to changes in the composition of OSEBX. Both the Market Model and the Fama French 3-Factor Model was used to calculate expected returns for the companies in question, which was then applied in the calculation for abnormal returns. Furthermore, the final sample was divided into two subgroups (2008-2013 and 2014-2019) to examine whether there has been a development of the Index Effect in recent years. Compared to studies on the S&P 500, this paper has the advantage that changes to the composition of OSEBX are less predictive, which means that if an Index Effect indeed exists, it will be easier to isolate and quantify.

Empirical results presented in this paper are consistent with index funds' rebalancing their portfolios as close as practically possible to the effective change date, thus minimizing tracking error. This is seen from the abnormal returns exceeding 3 % in absolute terms at ED-1 for both included- (+3.085 %)[3] and excluded stocks (-3.953 %)[4]. Interestingly, since this paper can predict abnormal returns using publicly known information, there exists a violation of the semi-strong form efficient market hypothesis. In an efficient market, the price reactions should occur at the announcement date, since investors would anticipate the future abnormal returns. On the other hand, it is worth noting the differences between the two subgroups. In the period 2014-2019, we find greater effects in the days following the announcement, which is consistent with improved market efficiency. The reduced abnormal returns at ED-1 further support this view.

These results have important implications for both investors and scholars. First, they suggest benefits from the awareness of index funds' behavior which can lay the foundation for trading strategies where the investor buys/sells ahead of the index funds. Second, the violation of market efficiency is an important finding because this hypothesis is practically considered an axiom among economic scholars. Paradoxically, for every finding that credible present breaches of market efficiency, the market will often incorporate the newfound information, making the equilibrium yet again efficient.

[3,4] Using the Fama French 3-Factor Model

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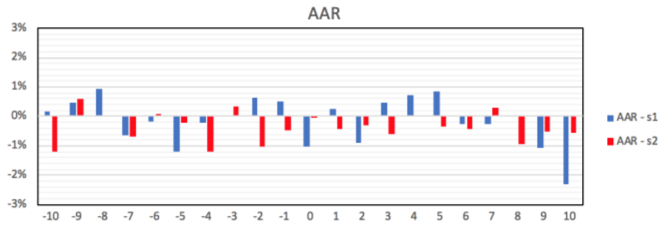
Appendix

AD - Exclusions

Exclusions - Market Model - AD

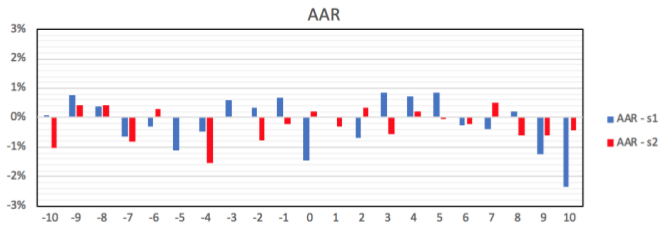


Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	-0,579	-3,722	0,823
[T-0,T+10]	-3,440	-3,767	0,110
[T-1,T+1]	-0,274	-0,900	0,441
[T-10, T-1]	0,448	-3,716	1,084
[T-5, T-0]	-1,309	-2,582	0,419
[T-5, T-1]	-0,283	-2,576	0,809
[T-0, T+3]	-1,181	-1,335	0,092
[T-0, T+5]	0,374	-1,637	0,919

Day	AAR - s1	AAR - s2	t-Stat
-10	0,154 %	-1,203 %	0,718
-9	0,472 %	0,614 %	-0,193
-8	0,941 %	0,059 %	0,979
-7	-0,659 %	-0,679 %	0,023
-6	-0,178 %	0,068 %	-0,290
-5	-1,208 %	-0,205 %	-0,476
-4	-0,213 %	-1,207 %	1,271
-3	0,006 %	0,339 %	-0,304
-2	0,635 %	-1,020 %	1,280
-1	0,498 %	-0,483 %	1,344
0	-1,027 %	-0,005 %	-1,137
1	0,254 %	-0,412 %	0,820
2	-0,888 %	-0,310 %	-0,690
3	0,479 %	-0,608 %	1,607
4	0,707 %	0,029 %	0,500
5	0,848 %	-0,331 %	1,874
6	-0,244 %	-0,413 %	0,238
7	-0,259 %	0,306 %	-0,596
8	0,060 %	-0,946 %	1,451
9	-1,064 %	-0,514 %	-0,912
10	-2,308 %	-0,564 %	-1,839

Table 15: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of exclusions with respect to AD, using MM. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

Exclusions - Fama French 3 Factor - AD



Interval	CAAR - s1	CAAR - s2	t-Stat
[T-10, T-0]	-1,169	-2,946	0,430
[T-0,T+10]	-3,661	-1,457	-1,151
[T-1,T+1]	-0,766	-0,309	-0,410
[T-10, T-1]	0,286	-3,159	0,809
[T-5, T-0]	-1,436	-2,267	0,302
[T-5, T-1]	0,020	-2,481	0,943
[T-0, T+3]	-1,261	-0,323	-0,685
[T-0, T+5]	0,339	-0,140	0,292

Day	AAR - s1	AAR - s2	t-Stat
-10	0,077 %	-1,005 %	0,554
-9	0,782 %	0,403 %	0,474
-8	0,366 %	0,417 %	-0,062
-7	-0,657 %	-0,805 %	0,168
-6	-0,301 %	0,311 %	-0,705
-5	-1,090 %	0,015 %	-0,531
-4	-0,457 %	-1,542 %	1,225
-3	0,574 %	0,000 %	0,545
-2	0,323 %	-0,749 %	0,862
-1	0,669 %	-0,205 %	1,313
0	-1,456 %	0,214 %	-1,922
1	0,021 %	-0,317 %	0,449
2	-0,680 %	0,340 %	-1,316
3	0,853 %	-0,560 %	2,16*
4	0,738 %	0,226 %	0,378
5	0,862 %	-0,043 %	1,535
6	-0,253 %	-0,236 %	-0,022
7	-0,383 %	0,528 %	-0,994
8	0,198 %	-0,591 %	1,165
9	-1,219 %	-0,590 %	-0,954
10	-2,343 %	-0,429 %	-2,097*

Table 16: Presentation of AAR and CAAR for the two subgroups (s1 & s2) of exclusions with respect to AD, using FF3. The diagram displays AAR visually, with days on the horizontal axis where AD = 0, and with AAR on the vertical axis.

Full Sample – Before Deletions

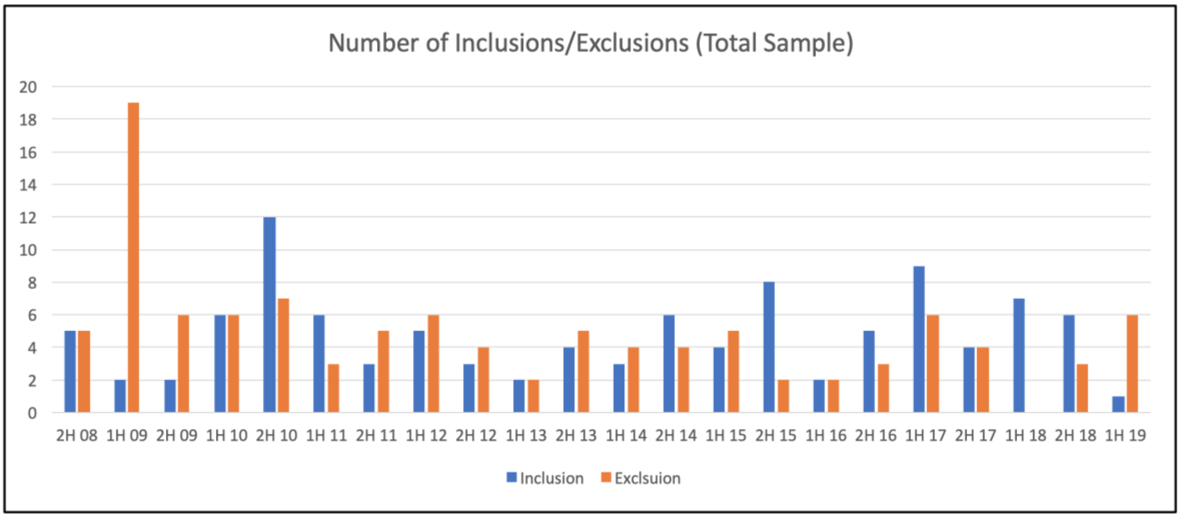


Figure 4: Number of Inclusions/Exclusions (Total Sample)

		In:		Out:
2H 2008	In:	KOG ODFB OLT SPDE VEI	Out:	BWO GOL ITE OCR SAS NOK
1H 2009	In:	QEC SAS NOK	Out:	ASD BIRD BWG COP ELT FUNCOM JIN KOM NLPR NOD ODF OLT PAR PHO SONG SPDE VEI WAVE WWIB
2H 2009	In:	BWG PSI	Out:	AKER CECO ECHEM HNA LSG ODFB
1H 2010	In:	AKER ALGETA COP LSG SONG VEI	Out:	DAT IMAREX KOG ORO PSI QEC

Table 16 (1): Full Sample – Before Deletions

		In:		Out:
2H 2010	In:	BAKKA CLAVIS ECHEM ELT FBU KOG NOD NUT ODF PHO QEC QFR	Out:	AKER BLO COP MAMUT NSG SAS NOK VEI
1H 2011	In:	BWO JIN MORPOL SAS NOK SFR WWASA	Out:	AIK BAKKA ECHEM
2H 2011	In:	AKBM GOL SEAW	Out:	BWO FBU JIN SONG VIZ
1H 2012	In:	AIK AKER BAKKA NSG WWIB	Out:	ACTA AKBM ARCHER KVAER QEC SAS NOK
2H 2012	In:	DETNOR FUNCOM VEI	Out:	AIK MORPOL NSG SEVAN
1H 2013	In:	EMGS SONG	Out:	FUNCOM PHO
2H 2013	In:	AFG ASETEK OLT PLCS	Out:	BAKKA CLAVIS FRO SALM SONG

Table 16 (2): Full Sample – Before Deletions

1H 2014	In:	SAS NOK SALM RECSOL	Out:	HNB EVRY EMGS AUSS
2H 2014	In:	AMSC BIOTEC PHO BAKKA BWLPG HEX	Out:	PLCS SAS NOK ODF CEQ
1H 2015	In:	WEIFA ENTRA SSO XXL	Out:	QFR LSG PHO ASETEK HEX
2H 2015	In:	AVANCE FRO RENO NANO THIN IDEX QFR PHO	Out:	AKA BIONOR
1H 2016	In:	MULTI EPR	Out:	FOE RENO
2H 2016	In:	HEX NEXT SAS NOK AXA GIG	Out:	AKSO AMSC PRS
1H 2017	In:	AKSO AMSC LSG NOFI B2H OPERA ASETEK KIT HNB	Out:	ASC BWLPG GIG SAS NOK AVANCE QFR

Table 16 (3): Full Sample – Before Deletions

2H 2017	In:	GSF SRBANK GIG LINK	Out:	NOFI MULTI AMSC BIOTEC
1H 2018	In:	BDRILL BWLPG QEC TRVX NOFI EVRY FUNCOM	Out:	
2H 2018	In:	BWO NEL FJORD AUSS PCIB BGBIO	Out:	NPRO TRE SDRL
1H 2019	In:	MPCC	Out:	HEX OTELLO WWIB QEC FUNCOM TRVX

Table 16 (4): Full Sample – Before Deletions

Final sample – After Deletions

Period	In:	Out:
2H 2008	KOG, ODFB, VEI	ITE
1H 2009	QEC	ASD, ELT, JIN, ODF, OLT, PAR, PHO, VEI, WWIB
2H 2009	BWG	AKER, HNA, LSG, ODFB
1H 2010	AKER, LSG, VEI	DAT, IMAREX, KOG, ORO, QEC
2H 2010	ECHEM, ELT, KOG, NOD, ODF, PHO, QEC, QFR	AKER, COP, MAMUT, VEI
1H 2011	BWO, JIN	AIK, ECHEM
2H 2011	AKBM	BWO, FBU, JIN, VIZ
1H 2012	AIK, AKER, NSG, WWIB	AKBM, QEC

Table 17 (1): Final Sample – After Deletions

Period	In:	Out:
2H 2012	FUNCOM, VEI	NSG
1H 2013	EMGS	FUNCOM, PHO
2H 2013	AFG, OLT	BAKKA, FRO, SALM
1H 2014	SALM	HNB, EVRY, EMGS, AUSS
2H 2014	AMSC, BIOTEC, PHO, BAKKA, HEX	ODF, CEQ
1H 2015		QFR, LSG, PHO, HEX
2H 2015	FRO, QFR, PHO	
1H 2016		
2H 2016	HEX, GIG	AMSC, PRS
1H 2017	AMSC, LSG, ASETEK, KIT, HNB	ASC, QFR
2H 2017	GSF, SRBANK	AMSC, BIOTEC
1H 2018	BWLPG, QEC, FUNCOM	
2H 2018	BWO, NEL, AUSS	NPRO
1H 2019		HEX, WWIB, QEC, FUNCOM

Table 17 (2): Final Sample – After Deletions

Reasons for Deletion

Period	Ticker	Justification
	Excluded observations	
2H 2008:	OLT	Missing data
	SPDE	Name change
	BWO	Missing data
	GOL	Missing data
	OCR	Takeover/merger activity
	SAS NOK	Missing data
1H 2009:	SAS NOK	Missing data
	BIRD	Name change
	BWG	Missing data
	COP	Missing data
	FUNCOM	Missing data
	KOM	Takeover/merger activity
	NLPR	Name change
	NOD	Missing data
	SONG	Missing data
	SPDE	Missing data
	WAVE	Missing data
2H 2009:	PSI	Name change
	CECO	Name change
	ECHEM	Missing data
1H 2010:	ALGETA	Missing data
	COP	Missing data
	SONG	Missing data
	PSI	Name change
2H 2010:	BAKKA	Missing data
	CLAVIS	Name change
	FBU	Name change
	NUT	Name change
	BLO	Name change
	NSG	Missing data
	SAS NOK	Missing data
1H 2011:	MORPOL	Missing data
	SAS NOK	Missing data
	SFR	Missing data
	WWASA	Missing data
	BAKKA	Missing data
2H 2011:	GOL	Missing data
	SEAW	Name change
	SONG	Missing data
1H 2012:	BAKKA	Missing data
	ACTA	Name change
	ARCHER	Name change
	KVAER	Missing data
	SAS NOK	Missing data
2H 2012:	DETNOR	MIssing data
	AIK	Takeover/merger activity
	MORPOL	Missing data
	SEVAN	Name change
1H 2013:	SONG	Missing data
2H 2013:	ASETEK	Missing data
	PLCS	Missing data
	CLAVIS	Name change
	SONG	Missing data

Table 18 (1): Deleted Stocks – Reasons

1H 2014:	SAS NOK	Missing data
	RECSOL	Missing data
2H 2014:	BWLPG	Missing data
	PLCS	Missing data
	SAS NOK	Missing data
1H 2015:	WEIFA	Name change
	ENTRA	Missing data
	SSO	Missing data
	XXL	Missing data
	ASETEK	Missing data
2H 2015:	AVANCE	Missing data
	RENO	Missing data
	NANO	Missing data
	THIN	Missing data
	IDEX	Missing data
	AKA	Name change
	BIONOR	Name change
1H 2016:	MULTI	Missing data
	EPR	Missing data
	FOE	Missing data
	RENO	Missing data
2H 2016:	NEXT	Missing data
	SAS NOK	Missing data
	AXA	Missing data
	AKSO	Missing data
1H 2017:	AKSO	Missing data
	NOFI	Missing data
	B2H	Missing data
	OPERA	Name change
	BWLPG	Missing data
	GIG	Name change
	SAS NOK	Missing data
	AVANCE	Missing data
2H 2017:	GIG	Name change
	LINK	Missing data
	NOFI	Missing data
	MULTI	Missing data
1H 2018:	BDRILL	Missing data
	TRVX	Missing data
	NOFI	Missing data
	EVRY	Missing data
2H 2018:	FJORD	Missing data
	PCIB	Missing data
	BGBIO	Missing data
	TRE	Missing data
	SDRL	Bankruptcy negotations
1H 2019:	MPCC	Missing data
	OTELLO	Name change
	TRVX	Missing data

Table 18 (2): Deleted Stocks – Reasons