THE UNSTABLE INDEX EFFECT

Analysis of scheduled constituent revisions in the STOXX Europe 600 index 2007-2022

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

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This thesis examines the index effect, or the abnormal return and volume effects encountered when a new index constitution is announced and implemented in the STOXX Europe 600 index. The objective is to first establish baseline results for the volume and index effect and then the abnormal returns are further analyzed yearly. The study is conducted using the event study framework and two events of interest are recognized: the announcement date (AD) and the effective date (ED) of the index review. Abnormal returns are measured by using the market model and additional robustness checks are conducted using the market-adjusted return model.

The sample contains 417 scheduled index deletions and 413 additions from 2007 to 2022. The variables collected are daily trading volume and price for both single stocks subject to the index review and for the target index, which acts as a market proxy. The data is collected from the Refinitiv Eikon database.

Compared to their historical averages, trading volumes are elevated in both additions and deletions starting around 20 days prior to the AD and the elevated volume levels continue for both actions until the ED. After the ED, deletions revert to the historical trading level, but additions continue to trade with elevated volume. A significant volume spike is found on the last day of trading before the official reconstitution of the index. The cumulative average abnormal returns are found to be the most prominent during the pre-announcement period starting 20 days prior to the index review announcement. The pre-announcement CAAR for inclusions is +5.4% and -1.9% for deletions in the full sample and the abnormal returns are found to be permanent after the new index constitution is implemented. On the day with the highest trading volume (ED -1), the abnormal return is counterintuitively negative for the additions and positive for the deletions, which could be a sign of arbitrageur actions. The yearly analysis reveals that the index effect is the most prominent in the period from 2018 to 2021 and during the financial crisis recovery in 2009. The evidence suggests that the index effect is rather unstable in the target index and is most likely subject to either trading activity, or macroeconomic conditions.

TIIVISTELMÄ

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Kauppatieteet

Jukka-Pekka Pesonen

EPÄVAKAA INDEKSIEFEKTI
Analyysi STOXX Europe 600-indeksin säännönmukaisista jäsenmuutoksista 2007–2022

Kauppatieteiden pro gradu -tutkielma
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Avainsanat: indeksiefekti, osakeindeksi, epänormaali tuotto, indeksikokoonpanon muutokset, tapahtumatutkimus

Tutkimuksessa tarkastellaan indeksiefektiä, eli epänormaalia tuottoa ja samanaikaista ylimääräistä vaihtovolyymiä kun osakeindeksin uusi kokoonpano ilmoitetaan, tai kun kokoonpano toimeenpannaan. Tutkimuksen kohteena on STOXX Europe 600 -indeksi ja tavoitteena on löytää perustaso indeksiefektille ja laajentaa tutkimusta vuosittaiseen tarkkailuun. Tutkimuksen metodologia perustuu tapahtumatutkimuksen viitekehykseen ja tutkimuksen kohteena on kaksi tapahtumaa: indeksikokoonpanon muutoksen ilmoituspäivä (AD) ja toteutuspäivä (ED). Epänormaaleja tuottoja mitataan markkinaparametreihin perustuvalla mallilla ja markkinatuottoihin perustuvalla mallilla.

Tutkimusaineisto koostuu 417 indeksistä poistetusta ja 413 indeksiin lisätystä yrityksestä vuosien 2007 ja 2022 välillä. Tutkimuksessa tutkitaan vain neljännesvuosittain tehtävien säännöllisten indeksitarkasteluiden kokoonpanomuutoksia. Kohdeyrityksistä ja -indeksistä on kerätty päivittäiset hinta- ja vaihtotiedot. Tutkimusaineisto on peräisin Refinitiv Eikon tietokannasta.

Tutkimuksessa havaittiin, että vaihtovolyymi nousee historialliseen keskiarvotasoon verrattuna jo noin 20 päivää ennen uuden indeksikokoonpanon ilmoitusta ja vaihdanta jatkuu kohonneella tasolla aina ED päivään asti. ED:n jälkeen indeksistä poistettujen yrityksien vaihdanta palaa historialliselle tasolle, kun taas indeksiin lisättyjen yritysten vaihdanta jatkuu pysyvästi korkeammalla tasolla. Volyymissa havaitaan selkeä piikki viimeisenä kaupankäyntipäivänä ennen virallisen indeksikokoonpanon voimaantuloa. Kumulatiivinen ylituotto (alituotto) on suurinta alkaen 20 päivää ennen uuden kokoonpanon ilmoittamista. Lisättävien yritysten ylituotto on +5,4 %, kun taas poistettavien yritysten alituotto on -1,9 %. Yli- tai alituotto on pysyvä, eikä hintataso palaudu kokoonpanon voimaantulon jälkeen. Vuosittainen tarkastelu paljastaa, että indeksiefekti on ollut voimakkainta vuoden 2018 jälkeisellä tarkastelujaksolla, sekä vuonna 2009. Tulokset osoittavat, että indeksiefekti on tarkastellussa indeksissä vuodesta toiseen luonteeltaan epävakaa ja siihen vaikuttavat joko makrotalouden olosuhteet tai osakevaihdannan hetkelliset olosuhteet.

ABBREVIATIONS

AD – The Announcement Day

AR – Abnormal Return

AAR – Average Abnormal Return

CAR – Cumulative Abnormal Return

CAAR – Cumulative Average Abnormal Return

ED – The Event Day

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1 Introduction

“Passive [investing] is only efficient as the active players in the market make it.” said Kenneth Lamont, a senior manager research analyst for passive strategies at Morningstar in a Financial Times interview. Passively managed index tracking funds offer more effective means of diversification than actively managed portfolios, and their market share of the US stock market surpassed all actively managed funds combined for the first time in 2021. (Johnson, 2022) Indeed, the popularity of passive investing as a phenomenon has experienced near-parabolic growth in the 2000s across the Atlantic, as the total net assets of index tracking funds in the US have grown from USD 9.9 trillion in 2010 to 24.9 trillion in 2020. (Investment Company Institute, 2022) In Europe, the growth of the ETF market has been even more substantial, as the Assets under Management of all ETFs grew from just EUR 200 million to EUR 1,330 million in the same time frame (Glow, 2022). The index effect, described as the abnormal returns (losses) experienced when a stock is added to (deleted from) a stock index, has been linked to the growing popularity of passive investing vessels, starting from the earliest index effect studies (Harris and Gurel 1986; Lynch and Mendenhall, 1997).

Counterintuitively, newer literature points to an almost complete disappearance of the index effect in the most followed equity indices, such as the S&P 500, the very index in which the effect was found and studied for the first time (Kappou, 2018; Renshaw, 2020). At some point during the 21st century, the postulated link between index fund popularity and the strength of the index effect has seemingly been broken. While the world is a significantly different place now than in the 1980s, when the first studies were conducted, no one has been able to explicitly state the factor of the diminished, if not disappeared effect. Renshaw (2020) suggests that ETF traders use advanced techniques to trade on any abnormal price movements immediately as they are observed, canceling any abnormal price reactions, but at the same time, the effect can still be found in small- or all-cap indices with more illiquid names. On the other hand, improved market microstructure or greater liquidity could also explain the observed weakening (Kappou, 2018). The consensus among literature is that the index effect varies significantly between different indices, based on their size, popularity, selection methodology, and as a result, their constituents. (Petajisto, 2008; Biktimirov and

Xu, 2019a; Renshaw, 2020) Thus, the results from one index cannot be accepted as a universal truth for all equity indices across the global financial system. This finding makes it interesting and beneficial to study the index effect in the less studied Pan-European setting, enabled by the STOXX Europe 600 index.

1.1 Research Background and Motivation

Index tracking funds are measured by their tracking error, which is the deviation between index performance and fund performance. Maximum tracking accuracy can be achieved by fully replicating the index weighting at any point in time, but in the real world, this method induces considerable transaction costs and therefore an optimal method of fund rebalancing must be found. (Strub and Baumann, 2018) Furthermore, if the index effect is prominent, stocks enter the index at an inflated price, and the price movement could have been captured for the profit of the fund provider if the position was traded accordingly around the index reconstitution event. An inflated price at inclusion is not the only loss a trader can incur when replicating an index, since if abnormal returns are temporary, any adverse movement in price after index reconstitution counts as a direct loss for the investor. (Chen, Noronha and Singal, 2006) As index funds have demonstrably grown in popularity, so has the scale and sophistication of the operations fund providers carry out to provide a selection of these passive investing vessels. (BlackRock, 2021) The upscaling, if done wrong, might lead to a significant amount of profit left on the table, or worse yet, major losses for the fund provider. Combining the threat of losses with the finding of dissimilar index effects in different indices and at different times, warrants continuous research of the index effect across indices and timeframes.

This thesis contributes to the existing literature by examining the price and volume effects of index constituent changes in the less-studied STOXX Europe 600 benchmark index and subsequently studying the effect independently for each year from 2007 to 2022 to analyze yearly deviations in the effect itself. Most of the previous index effect studies focus on the popular S&P 500 index in the US stock market (see e.g. Lynch and Mendenhall, 1997; Hegde and McDermott, 2003; Chen, Noronha and Singal, 2004; Kappou, Brooks and Ward, 2010; Renshaw, 2020), while studies conducted on European multinational indices, especially benchmark-type indices are a glaring omission. Most European studies focus on country-specific indices like the FTSE 100 in the UK, DAX indices in Germany, or other indices mainly followed only in their country or geographical subregion of incorporation (see e.g., Bechmann, 2004; Wilkens and Wimschulte, 2005; Mase, 2007; Fernandes and Mergulhão, 2016).

Moreover, even though the index effect is widely studied in some indices, researchers arrive at vastly different conclusions on the source of the effect and the permanency of the effect. Different methodologies, like using various models and effect windows could play a part in explaining the different results stated by Renshaw (2020) one of the most prominent factors affecting results is the year or the timeframe of the sample itself. Also, the index selection itself affects the outcome largely, Renshaw concludes that some of the most followed equity indices, like the Russell 2000 and S&P 500 have a vastly different index effect in the present. This thesis sheds light on the instability of the index effect within a single equity index over time, while simultaneously creating a baseline result for a 15-year sample of scheduled index additions for STOXX Europe 600. One of the limitations that earlier studies have faced is the small number of observations, particularly when examining the effect on a yearly basis. Due to the selected index and its quarterly review policy, the large number of completed index reconstitution events allows for enough observations for each year of the study for both inclusions and exclusions.

1.2 Research objectives and questions

This thesis focuses on examining the index effect around the index reconstitution period by analyzing abnormal returns and abnormal trading volume around the announcement and the implementation dates in the STOXX Europe 600 index. The effect is examined by first using the complete dataset, after which the dataset is divided into yearly data, to examine the evolution of the effect over time. The abnormal price and volume effects are analyzed in relation to the expected market performance.

Even though widely studied in other major indices, the index effect in the STOXX Europe 600 index has received little to no attention from researchers. To establish if the premises for price pressure effects exist in the target index, the first research question is set as follows:

1. *“Does trading volume increase (decrease) when stock inclusion (exclusion) in an index is being announced or executed?”*

Since academics have not reached a widely accepted consensus on the permanency or the nature of the abnormal price phenomenon that is universal for all indices, the target index in this study is examined with multiple timeframes to find out if any abnormal price movements are present around the index reconstitutions and if these effects are permanent or temporary. In order to reach these goals, the second research question is formed as follows:

2. *“Do stocks exhibit abnormal returns (losses) around the announcement or execution of index addition (deletion) or in the periods prior or subsequent to these events?”*

Prior research has reached inconsistent conclusions on the magnitude of the index effect and the most common disconnection between these studies is the sample period. Due to this seemingly unstable nature of the index effect, it is important to examine if the effect has evolved over time, or if it is present in the first place. To reach this objective, the third research question is set as follows:

3. *“How have the price effects varied over the years?”*

1.3 Thesis structure

This thesis follows the structure presented here. The first section introduces the topic and its background briefly, simultaneously introducing the research questions. In the second section, the theoretical framework and most important hypotheses are presented. The second section also contains a literature review of earlier empirical studies relevant to the matter at hand. In section 3, the target index and its methodology are introduced and its selection for this study is discussed in further detail. The fourth section includes a description of the data collection and presents the methodology and variables used in this study. The fifth section introduces the results, while the sixth section concludes this thesis accompanied by suggested future research directions.

2 Literature Review

2.1 Efficient Market Hypothesis and the Index Effect

Fama (1970) introduced the now widely known hypothesis of efficient capital markets, a foundation on which several subsequent theories and index effect studies are based on (see e.g., Harris & Gurel,1986; Lynch & Mendenhall, 1997; Scholes, 1972). The Efficient Market Hypothesis (EMH) is a good basis for this study as well, as it allows for division between supply and demand-based theories and information-based theories, which is also done by Afego (2017) in their thorough literature survey of recent index effect studies. The formerly mentioned theories usually at least partly contradict EMH, since the index reconstitution events should not contain any new information about the company's future cash flows. On the other hand, if the abnormal price and volume effects are asymmetrical as is the case with information-based theories, the theories loosely support the EMH. (Fama, 1970)

EMH has three levels of market efficiency: weak form, semi-strong form, and strong form efficiency. Each level is stricter than the previous and adds conditions that must be filled to achieve the efficiency level in question. The weak form of market efficiency is achieved when future stock prices cannot be predicted based on historical stock price movements or other previously available stock-related information, such as trading volume or corporate events, like stock splits or dividends paid. This is also referred to as naïve price forecasting. (Fama, 1970) In subsequent studies research has found that market efficiency has improved over time, due to smaller tick sizes and faster information transfer, which have made also trading near-instantaneous. (Bernard and Thomas, 1990; Chordia, Roll, and Subrahmanyam, 2008). On the other hand, studies by Chordia et.al. (2008) and Chung & Hradzil (2010) note that increased liquidity increases market efficiency together with arbitrage interest in a particular stock. This finding suggests that the index effect should be most evident in small stocks with less liquidity since their informational efficiency is lower than for large established companies, with higher liquidity, and a narrower bid-ask spread.

Fama (1970) describes semi-strong form market efficiency as an implication that an investor cannot predict the stock price movement based on publicly available information alone, since every piece of news is already priced into the current stock price. Public information contains everything mentioned in the weak form category, but also adds any press releases, news articles, financial results, or other information that the company or any other related source might publish. Public information encompasses also any information released regarding the company's competitors, market environment or -outlook, or anything that might have a cross-read information capability to the future earnings of the company in question. This efficiency level in the real world also finds varied levels of support from earlier literature. As Li (2020) presented in his study, information asymmetry causes mispricing of stocks, and a larger amount of analyst coverage has a negative effect on the degree of mispricing. Li (2020) also concludes that market efficiency increases with the amount of analyst coverage on a particular stock and these stocks are less likely to be overpriced. This finding was also supported by Chen, Kelly, and Wu (2020), who presented that the sudden reduction in analyst coverage due to corporate events such as mergers or acquisitions increases arbitrage action around the stock and subsequently, fund managers ramp up their information gathering efforts at least partially restoring market efficiency towards the previously achieved level.

The strong form of market efficiency suggests that current stock prices reflect all available public and private information at any given time. The strong form of market efficiency is the strictest as it suggests that stocks are always fairly priced and that the release of any insider information should not affect the stock price, since the information is already included in the price. However, it is noteworthy that even Fama (1970) suggests that the strong form efficiency does not reflect the real world, since the efficiency level would require virtually no price movement to any stock-related news and to reach sufficient conditions for efficient markets, there should be no transaction costs in trading securities. (Fama, 1970)

Considering the EMH, index reconstitution events that affect the stock price violate the semi-strong and strong form of market efficiency, since the inclusion or deletion of a stock from a major index should already be public information. As Lynch & Mendenhall (1997) describe, it should have been possible to determine the future S&P 500 stock additions based on only public information since the indexing company Standard & Poor's only use public information themselves and the company always uses the same methodology when selecting companies to be added to or deleted from the index. However, this conclusion means that any information conveying the effect of a stock addition(deletion) to(from) a particular index should be isolated. In this thesis, the information effect of stock additions/deletions is counteracted by using a strictly rule-based index, where deducing the next index addition is as easy as possible and using only the periodical index constitution events as a sample. Due to these limitations, this thesis should capture the index effect with minor to no interference from any information-based event. However, as noted above, analyst coverage has been noted to increase the pricing accuracy and liquidity, and therefore it should function well as a control variable and any abnormal price or volume effect should be more evident in less liquid, less analyst-covered companies.

2.2 Supply and demand-based hypotheses

As stated in section 2.1 about EMH, the hypothesis can be used as a good foundation to divide the widely used hypotheses behind the index effect into two categories. This section and its subsections cover supply and demand-based hypotheses which at least partially contradict the semi-strong and strong form efficiency of EMH. However as will be examined in this section, any information effect must be carefully isolated in order to study the index effect from a purely supply and demand-based viewpoint.

2.2.1 Price pressure hypothesis

Scholes (1972) presented the price pressure hypothesis as an argument against the widely acknowledged assumption, that the price of a company’s share is completely independent of the number of shares being bought or sold on the market at any given time since shares are substitutable with other companies’ shares, or other instruments that share an equivalent assumption of their future revenue streams. The implication of the price pressure hypothesis is that even though a small trade might be completed at or near the current market price of the share when trades grow larger, the price of the shares must adjust to accommodate the larger trade. This is based on the assumption that for a share there exists a downward-sloping demand curve in the short term which means that investors are only willing to buy additional shares at a reduced price. Scholes regards this purchase-inducing phenomenon as the “sweetener”, which must be present in cases where investors are required to acquire additional shares of a company, be it through increased market supply or a shares issue. Investors require a constantly higher return on a stock if the underlying company needs continuous equity financing since the investors are required to include more of the company's shares in their portfolios. However, devoid of any information-conveying effects, the long-run demand for a share should be entirely elastic at the full information price, as would be the case in perfectly efficient markets. (Scholes, 1972)

Translated to the index effect, the price pressure hypothesis implies that when the supply or demand of a company's shares grows temporarily, the price must adjust accordingly, but the abnormal price movement should only be temporary. In the case of index additions, the demand grows higher, which drives up share prices, decreasing the existing owners' demand for the stock and resulting in subsequent selling action, since the increased price might satisfy some investors' targeted return for a security. The effect is mirrored perfectly in the case of index deletions since the supply of shares grows temporarily. The existing owners are willing to purchase this excess supply only at a reduced price due to the theoretically increased rate of return without changes to the company's outlook. If the price pressure should be the sole reason behind the index effect, the resulting price pattern should be symmetrical for additions and deletions, and transitionary in nature.

Harris and Gurel (1986) are commonly acknowledged to be the first ones to present empirical evidence of the existence of price pressures in the scope of index effect in the S&P 500 index. They make important observations on the conditions which must be present in order to study price pressures in isolation since the increased supply or demand should occur without any new information for the market. Harris and Gurel (1986) argue that index reconstitution events are an exquisite opportunity to study price pressures, compared to earlier studies about block trades, since a large trade by a significant market participant might be extrapolated to signal previously unknown negative information about a company's future revenues. However, this argument of S&P 500 additions and deletions carrying no information to investors has been challenged in later studies due to the index's constitution methodology. S&P 500 index is not purely rule-based, even though it is designed to represent the US economy as well as possible. Instead, the final index composition is selected by an index committee. Therefore, investors might conclude that a company being added to S&P 500 index is a better company than its peers with otherwise similar financial features. (Chen, Noronha & Singal, 2006; Biktimirov & Xu, 2019a) However, since S&P 500 is used as a target index in a vast majority of index effect studies, these results cannot be omitted, as it is important to recognize that the selection of the index might have alternate channels affecting the presence and strength of the index effect than just the index's popularity or fund ownership for example. Harris and Gurel (1986) also defend the "no-information assertion" in their study rather exhaustively, but it is noteworthy that in the later studies, market conditions and the whole market infrastructure has developed significantly which might lead to diverging conclusions about the S&P 500 information effect.

Harris and Gurel (1986) find a large increase in share demand in stocks being added to the S&P 500 index on the first trading day after the index inclusion is announced, which they conclude to signify shifts in demand that originate from index funds. Simultaneously they observe a statistically and economically significant increase in price, which both are reversed to the earlier level of trading. They conclude that an increase in price is needed in order for existing shareholders to sell their shares in order to satisfy the additional demand from index funds.

Lynch and Mendenhall (1997) studied the index effect for the first time under the new conditions of the S&P 500 introduced in October 1989, where the changes to the index composition are announced prior to their effective date. Lynch and Mendenhall (1997) find a significant positive abnormal return on the day of the index inclusion announcement and a significant positive cumulative abnormal return from the day after the announcement date leading to the effective date. The effect is near perfectly mirrored as negative in the case of index deletions although deletions exhibit a slightly stronger effect. Furthermore, a significant positive abnormal trading volume is observed one day before index reconstitution in both additions and deletions, which they credit to index funds avoiding tracking error as much as possible. (Lynch & Mendenhall, 1997) Kappou, Brooks and Ward (2010) find similar abnormal volume patterns on the last day before the effective date, just minutes before the stock market closes, which they also explain by index fund managers' actions, trading the fund positions to match the new index composition as late as possible. In the latter study, the volume traded is over 16 times the normal trading volume, of which 20% is realized in the last five minutes of trading. In addition to the similar volume results, they agree with Harris and Gurel's (1986) arguments that the S&P 500 index inclusions convey no new information to the market, since it should have been possible to construct the index inclusion ruleset based solely on public information and prior behavior of the S&P 500 index committee, therefore their results must violate semi-strong and strong form market efficiency.

2.2.2 Imperfect substitutes hypothesis

The imperfect substitutes hypothesis (ISH) is a close counterpart to the price pressure hypothesis, as its channel of effect is similar. The ISH states that any company's shares do not have perfect substitutes and therefore their demand curve must be downward sloping in the long term. This leads to the conclusion that if there is a shift in supply or demand, the price should be permanently set at a higher or lower level, contrary to the transitionary effect that should be present in the case of the price pressure effect. (Shleifer, 1986) Translated to the index effect, the price should rise permanently when a stock is added to an index due to excess demand and decrease permanently when a stock is deleted.

Multiple empirical studies find support for the ISH (Liu, 2000; Liu, 2006; Fernandes and Mergulhão, 2016), first of which was Shleifer (1986). Shleifer (1986) finds non-reversing positive price effects for additions in the S&P 500 as well as increased volume around the inclusion date. However, Shleifer (1986) also states that his findings can be explained by the information hypothesis (also called the information signaling hypothesis), which will be discussed later in this thesis.

The validity of the imperfect substitutes hypothesis as a channel for the index effect is often challenged in later literature since it is difficult to prove that the imperfect substitution is the sole reason for the observed effect. Denis et. al. (2003) bring forth that S&P 500 index inclusions might not be completely information free, since companies added to the index statistically perform better than unincluded peers, a phenomenon that is known by investors. The same holds for most earlier studies that examine large block trades as an information-free event since it is impossible to prove that a large institutional investor selling a large number of shares in a block trade possesses no private information about the company's future prospects. Even though Standard & Poor claims the index inclusions to be in no way representative of the indexing company's view of the included or deleted company's future, it can be viewed as such since the indexing company aims to minimize index changes, which in turn requires the included company to be relevant as long as possible. (Denis, et al., 2003)

The ability to isolate the information effects from pure supply and demand has proven to be a challenging task in the empirical literature and the contradicting conclusions even from the same index do not make it easier. For the S&P 500 Denis, et al. (2003) state that the indexing company might unknowingly possess and release previously unknown information about a company being added to the S&P 500 index, or the indexing company might just have superior analytical abilities that the market participants recognize. This argument once again directs focus to the index methodology, which should be as transparent and as devoid of human interference as possible to capture the index effect in only supply and demand format.

2.3 Information-based theories

Information-based theories are the second group of hypotheses to which Afego (2007) divides the previously presented theories for the reason behind the index effect.

2.3.1 Investor awareness hypothesis

The investor awareness hypothesis as introduced by Chen et al. (2004) is based on the principle that investors can only buy stocks of which they are aware. The hypothesis is based on Merton's (1987) shadow cost, which is the reduction of the required rate of return for a stock when a larger number of investors are aware of the company. The investor awareness hypothesis suggests that the index effect should be permanent and asymmetrical when comparing inclusions and deletions. The share prices should rise after the announcement of index inclusion, while the price should not decrease significantly when a company is deleted from an index. The asymmetry is due to investors gaining knowledge of the company's existence from the index inclusion announcement, but in case of deletions, investors do not forget the company as easily. Investors might also be reluctant to sell the stock due to just index deletion since the deletion might not signal any change in the company's future cash flows. (Chen, Noronha and Singal, 2004) It is however noteworthy, that passive index fund managers must buy or sell the index composition regardless of company fundamentals or outlook due to the passive fund methodology, leading to some trading action in both index reconstitution events. The investor awareness hypothesis then covers the rest of the market participants, who might have different investment strategies.

2.3.2 Information signaling hypothesis

The information signaling hypothesis, which is sometimes only referred to as the information hypothesis in the literature, suggests that stock inclusions in a major index, in fact, carry information and can act as proof of a company's quality and longevity. The company can be perceived to hold a position among industry leaders or the company's management might be seen as more capable if added to a major index. (Jain, 1987) Moreover, since S&P aims to minimize turnover in its most followed indices, the newly added company might be seen as a good representation of the current economy now and in the future. Denis et al. (2003) demonstrate this by examining analysts' estimate revisions of stocks that are added to S&P indices. Denis et al. (2003) found out that analysts systematically upgrade their EPS estimates when a company is added to an S&P index, even though the company's fundamentals have not changed, but they do not specifically distinguish the channel of effect between increased management scrutiny, or S&P index event being an information carrying event.

2.3.3 Liquidity hypothesis

The liquidity hypothesis (also referred to as the information cost hypothesis) is largely similar to the information signaling hypothesis, but as is evident in its name, the liquidity hypothesis suggests an increase in the level of liquidity in stocks that are added to a popular equity index. The theory is information-based since the increased liquidity is a consequence of the expansion in information content that is available for a company due to increased analyst and press coverage and the subsequent reduction in the bid-ask spread of the company's shares. In other words, increased analyst and press coverage increases the amount of public information available for a company, decreasing both information asymmetry and the risk of adverse selection. (Chung, et al., 1995) Furthermore, Shleifer (1986) states that the decreased liquidity risk for a stock will drive up prices of the stock due to decreased required rate of return. This implies that the potential price effect around index inclusion should be more evident for companies that are less known. Shleifer (1986) found no evidence to support this by using Fortune 500 membership as a proxy for a company's conspicuousness and arguing further that Fortune 500 membership should attract more institutional ownership than S&P 500 membership due to the former only measuring the size of a company, while S&P 500 membership signifies the importance of a company to the economy.

Shleifer (1986) further explains that both Fortune 500 and S&P 500 contain, and in case of reconstitutions receive such large companies, that it is questionable if the companies experience an increase in attention when added to either of these lists. This argument is challenged in a later study by Chan, Kot, and Tang (2013) who find a significant long-term increase in analyst coverage for the companies added to the S&P 500 index. Gregoriou and Ioannidis (2006) find a similar increase in the likelihood of analyst coverage for inclusions in the FTSE 100 index, while for deletions the analyst coverage decays slower, resulting in an asymmetric price pattern. Furthermore, Chan et al. (2013) explain that the price effects experienced around index additions cannot stem from short-term demand, as the permanent price effect should rather be an effect of increased analyst coverage and improved operational performance. This discrepancy of views can be due to an increase in the number of equity analysts over time, or an overall increase of information-producing capability in the equity markets, but more likely there is a difference in the likelihood of analyst coverage increase depending on the stock index and the company-specific factors. Lesser-known companies that rise from obscurity to a widely followed stock index should logically experience a relatively larger increase in information content surrounding the company, which should consequently lead to a relatively larger narrowing in bid-ask spreads compared to well-known companies, therefore price and volume increases should be larger for lesser-known companies added to an index.

2.3.4 Selection criteria hypothesis

The selection criteria hypothesis suggests that at least a part of the index effect is self-fulfilling due to the different methodologies that indexing companies use when determining the index constituents. The self-fulfillment means that since many index methodologies are based on market capitalization, trading volume, and in some cases (e.g., S&P 500) profitability, there is a general bias in the selected companies and study samples overall since increase (decrease) in the trading factors prior to the index inclusion (deletion) announcement might at least partially explain the index effect. Bechmann (2004) found significant positive abnormal returns for index additions six months prior to the inclusion announcement and vice versa for deletions in the Danish KFX index. Bechmann's results are consistent with the downward-sloping demand curve- or the liquidity hypothesis since a significant increase in trading efficiency is observed for index-included companies versus those not included in the index. However, selection criteria for the index cannot be ruled out completely since the companies might have not been included in (deleted from) the index altogether if the companies did not experience the increase (decrease) in selection criteria factors prior to the announcement. (Bechmann, 2004) The selection criteria hypothesis is somewhat less studied since isolating the premises leading to pure selection criteria price movements is considerably difficult.

The selection criteria hypothesis could also pose to be important when examining the direct effect of the index methodology on the index effect. As Petajisto (2008) demonstrated, index methodologies are linked to the magnitude of the effect, and the more transparent and more observable the index selection methodology is to investors, the lesser the magnitude of the index effect is and any surprise effects that an index inclusion announcement might carry, are diminished. The selection criteria hypothesis is difficult to exclude from studies since the samples of index inclusions cannot be altered, and tampering with the sample based on pre-announcement returns could lead to a vastly biased sample. The selection criteria hypothesis, if supported, should be visible prior to the announcement date, when anticipatory trading might be present. The selection criteria hypothesis suggests that all abnormal returns prior to the announcement date cannot be credited to anticipatory trading.

2.4 Summary of earlier literature and empirical evidence

As is evident from the theories introduced in the second section, there is a multitude of explanations for the existence and nature of the index effect. All presented hypotheses, excluding the efficient markets hypothesis, however, agree on the direction of the index effect, where the index inclusion should lead to a positive price reaction, while index exclusions should lead to a negative price reaction. The timing, symmetry, permanency, and magnitude of the effect are however contradicted both in theory and in the empirical evidence. Due to the existence of multiple explanations, authors of the earlier literature conduct additional analyses to attempt to isolate the source of the index effect to the greatest extent possible.

Harris and Gurel (1986), widely regarded as the first study of price pressure in the context of index reconstitutions, found a significant increase in trading volume and a linked positive (negative) temporary price effect for index additions (deletions) in S&P 500. Their results were partially questioned already in the same year by Shleifer (1986), who found permanent and potentially even gradually increasing abnormal returns over time for index additions. Shleifer (1986) credits the imperfect substitutes hypothesis (Downward Sloping Demand Curve) for the effect, whereas Harris and Gurel (1986) find evidence supporting the price pressure hypothesis. These two studies, however, agree on the magnitude of roughly 3% of abnormal returns on the announcement date and the abnormal trading volume emerging around the effective day of index inclusion, most of which is encountered on the day of the implementation of the new index constitution. Due to the S&P 500 methodology then, the announcement and implementation was done effectively at the same time, so the day 1 volume relates to the first possible chance to trade the stocks while possessing the published information. Both studies also agree that the observed volume and price effects have grown stronger over years, likely due to index-tracking funds' growth in popularity. To rule out possible information-conveying effects, Shleifer (1986) also analyses the magnitude of the index effect when compared to the company's S&P bond rating, but he finds no significant evidence to neither support nor completely reject information-based hypotheses.

The evidence for the growth in the magnitude of the index effect over time is further strengthened by the later study conducted by Lynch and Mendenhall (1997), who documented a positive effective date price effect for additions, and a cumulative abnormal return of 3.8% from after the announcement until the day before the inclusion. The index effect has, however, seemingly grown in strength only to a certain point in time, as demonstrated by Renshaw (2020), who studied the index reconstitution price effects in S&P 500 by dividing the dataset into two subsamples: 1989-2012 and 2013-2018 and found that the index effect has almost completely disappeared in the newer subsample, where it was significant and almost perfectly symmetrical in the earlier subsample. Additionally, Renshaw (2020) conducted the research with a rolling three-year window, which shows a gradually declining and eventually disappearing magnitude in the index effect for more recent years, although with a spike in magnitude around the financial crisis in 2008, especially for deletions. Furthermore, he argues that the index effect is more likely to be present in small (or all) -cap indices rather than only mid- to large cap indices and, is also more likely to be observable in cases of deletions than additions.

There are multiple explanations for why the index effect has gradually decreased in the large-cap indices, even though, if the effect is linked to index tracking funds' activity around index reconstitutions, the decline might seem counterintuitive given the rise in popularity of the passive investment vessels. According to Evans et al. (2017), the ETF market is currently constructed with a three-day trading period, during which the new fund composition must be realized in full, complemented with an additional three-day "grace period", thereby extending the possible trading window up to six days. The additional trading time not only makes the trading action around index reconstitutions harder to find and explicitly link to ETF-rebalancing due to the fuzziness of the trade timing per portfolio, but it also allows index fund managers to utilize advanced trading techniques to minimize market impact.

The six days of trading, however, is not even nearly the maximum time of possible trading for index funds. BlackRock (2021) states that equity-index fund managers use a multitude of trading techniques to minimize both the tracking error and market impact, like constructing and buying projected "Pro-forma"-indices even before the new index constituents are announced, which are then transferred to the index funds at the reconstitution- or rebalance date. Accounting for this factor, even though Kappou et al. (2010) find a significant increase in trading volume for the last minutes of trading on the effective date (over 20% of the total daily volume in the last 5 minutes before close) the potential volume increase might not capture all index fund rebalancing action. Furthermore, Kappou et al. (2010) suggest that since arbitrageurs aim to take advantage of index fund trading around index rebalances through intra-day trading, they lessen the close-to-close price effects, while retaining, but potentially reshaping intra-day volume. One factor supporting this dissertation of minimal price movement, but increased volume, is that index fund managers increasingly use bilateral trading agreements to buy or sell the appropriate number of shares at the last closing price before the new index constitution which, if used solely, would lead to a substantial volume increase on the day before the index change, but essentially zero price impact. (Blume and Edelen, 2004). In a newer study, Kappou (2018) credits the developed market microstructure, usage of advanced trading algorithms, and improved liquidity as reasons for the diminishing index effect, also recognizing that the selection criteria and the transparency of index methodology all affect the nature of the index effect.

Moving away from research covering S&P 500 index, it is apparent that index and market selection affects the observed index effect, which is widely noted in earlier literature. Kappou et al. (2019a) observe a significant abnormal return of 3.53% on the effective date in NASDAQ, which is over double the magnitude compared to NYSE stocks, which experience a significant 1.65% abnormal return on the same day. Along these lines, Biktimirov and Xu (2019a) argue that Nasdaq 100 index is a better candidate for price pressure or information-induced index effect studies than S&P 500 due to four reasons; (1) Nasdaq 100 companies are selected by market value only, limiting possible information content of inclusion announcements. (2) The companies are listed only in one stock exchange, whereas S&P 500 consists of Nasdaq and NYSE stocks, which empirically exhibit different price behavior around index reconstitutions while a single list limits the structural interference of different marketplaces. (3) Nasdaq stocks are usually less liquid and less followed than S&P 500 stocks, therefore any increase in investor awareness should be easier to notice. Finally (4) Nasdaq 100 deletions are historically less likely to be driven by bankruptcies than in S&P 500 index, leading to a more coherent deletion sample. (Biktimirov and Xu, 2019a) These factors are important to analyze when selecting target index for a study, but also when comparing results with earlier ones.

Biktimirov and Xu (2019a) find a significant, permanent increase in price, liquidity, and investor awareness for the first-time additions to the Nasdaq 100 index. They find a significant cumulative abnormal return of 9.38% from 30 days before to a day before the announcement date and a significant event day AR of 1.09% for first-time additions. No statistically significant price effect is observed for repeated additions in the same period nor is the effect symmetrical, but opposite in the case of deletions, thereby making the results consistent with the investor awareness hypothesis. (Biktimirov and Xu, 2019a) The results from Nasdaq 100 are consistent with Gregoriou and Ioannidis' (2006) study covering FTSE 100 index over the period 1984-2001, lending support to the liquidity hypothesis, as it is apparent that even though the index inclusion itself might not signal any information about the company's outlook, the awareness and information content surrounding the company certainly increase. However, Mase (2007) finds inconsistent evidence from the same FTSE 100 index between 1992 and 2005, with results supporting the price pressure hypothesis.

The difference in these two studies might be due to non-matching sample periods, even though they overlap with each other. These time-based discrepancies support the explanation, that the index effect varies over time. Several explanations for this have been discussed above. The market microstructure, economic distress periods, and the popularity and coverage of the index itself have all been shown to be factors leading to differing conclusions on the source of the index effect as well as the effect's features itself.

2.5 Hypotheses

To support the examination of the research questions presented in the first section of this thesis, research hypotheses are set in line with previous studies. The first research question *"Does trading volume increase (decrease) when stock inclusion (exclusion) in an index is being announced or executed?"* is complemented by three hypotheses H1-H3. The first hypothesis is formed in line with the findings of Lynch & Mendenhall (1997), who report significant abnormal trading volume starting on the day before the announcement date and continuing consecutively until five days after the announcement when changes are implemented for most of the sample. The first hypothesis is set as follows:

H1: The trading volume of a stock being included or excluded is at a higher level before the announcement date and is present until the effective date of the index reconstitution

In order to reveal whether the nature of volume effects around index reconstitutions is transitionary, as would be the case in the price pressure hypothesis, or whether it could be permanent, consistent with information-based hypotheses or the downward sloping demand hypothesis, the second research hypothesis is set as follows:

H2: The trading volume of an included (excluded) stock is permanently higher (lower) than the historical average after official index inclusion (exclusion)

As earlier studies from the beginning of the noted index effect studies have found, the most significant single-day volume effect is observed on the last trading day before the new index constituent list is realized (See e.g. (Harris and Gurel, 1986; Lynch and Mendenhall, 1997; Mase, 2007; Kappou, Brooks and Ward, 2010; Fernandes and Mergulhão, 2016). Based on these findings, the third hypothesis is set as follows:

H3: There is a significant spike in trading volume on the day prior to the official index inclusion or exclusion

The second research question *"Do stocks exhibit abnormal returns (losses) around the announcement or execution of index addition (deletion) or in the periods prior to or subsequent to these events?"* directs in determining the direction and permanency of the index reconstitution-related price-effects. Already in early studies of Harris & Gurel (1986) and Lynch & Mendenhall (1997), the prices of stocks have been reported to rise prior to the announcement date accompanied by excess volume. In more recent studies by Bechmann (2004) and Biktimirov & Xu (2019a), the cumulative abnormal (returns) have shown to be the strongest in the period preceding the inclusion (exclusion) announcement, thereby signaling for either selection criteria or anticipatory trading. The fourth hypothesis is set to test the premises for these explanations:

H4: The included (excluded) stocks exhibit abnormal returns (losses) prior to the announcement date

The fifth hypothesis is set to test both the run-up period returns of stocks and also single-day returns of stocks involved in upcoming index changes. The run-up period returns have seemingly declined from the earlier returns reported by Harris & Gurel (1986) and Lynch & Mendenhall (1997), but for some indices, there are still both run-up period and single-day abnormal returns present for both inclusions and exclusions.

H5: The included (excluded) stocks exhibit abnormal returns (losses) prior to the effective date

Arguably the most controversial topic of index effect studies is the permanency of the price effects. Multiple hypotheses and empirical evidence support permanent price effects, but the price-pressure hypothesis and temporary effects have also received support in multiple previous studies. (Afego, 2017). The sixth hypothesis is set to analyze the permanency of the price effects in the target index:

H6: The price of the included (excluded) stocks will remain at a permanently higher (lower) level after inclusion (exclusion)

The third and final research question *"How have price effects varied over the years?"* is operationalized by hypothesis H7. According to earlier research, the index grows in strength in line with the growth in popularity of index tracking funds (Lynch & Mendenhall, 1997). However, the development has changed direction in more recent studies and multiple papers report a declined index effect, starting at the latest around the financial crisis in 2008. (Kappou, 2018; Renshaw, 2020) Along the findings of later studies, the seventh and final hypothesis is set as follows:

H7: The magnitude of the price effects has lessened over time

3 Target index description and selection

3.1 STOXX Europe 600 benchmark index

STOXX Europe 600 is a benchmark-type index that covers the 600 largest companies from the Eurozone and Europe with a free float coverage of approximately 90% of companies from these areas. Compared to STOXX Total Market Indices (TMI), which cover at least 95% of the free-float market capitalization in a certain geographical area, the number of constituents in the STOXX Europe 600 benchmark index is fixed and the index is subject to quarterly constituent review. In addition to the periodical review, STOXX Europe 600 index is updated continuously to maintain the targeted number of constituents, in case a stock is to be removed from the index outside the periodical review. The STOXX-branded indices are maintained by Qontigo, a company that was formed in the merger of DAX, STOXX, and AXIOMA. (Qontiqo, 2022)

Periodical review is completed in March, June, September, and December each year. Starting from the Q2 (June) review in 2018, Qontigo has announced the new results of the periodical index reviews on the first trading day of each review month after the stock market has closed while the review cutoff date is the last trading day of the month preceding the review. The changes are implemented on each month's fourth Monday, allowing for at least two full trading weeks after the announcement before the implementation. This "run-up" period, as the window will henceforth be called in this thesis, is dynamic under the new methodology, and changes each month relative to the calendar. However, prior to the methodology change in 2018, the announcement date was a Tuesday one month before the implementation, allowing for a fixed run-up period of 18 trading days. This schedule was occasionally adjusted for March and December reviews by altering the announcement date by one week, resulting in a run-up period of only 13 trading days. (Qontiqo, 2022)

The STOXX Europe 600 is purely rule-based, and the periodical review is conducted by measuring each stock's market capitalization and trading volume. Only the most liquid stock series of a company is eligible for selection and a stock must have an average daily trading volume of at least one million euros over a three-month period to be considered. Qontigo uses a cascading system of stock universes, where the constituents for the benchmark index are selected from the STOXX Europe TMI. STOXX Europe 600 index also cascades downwards to STOXX blue-chip indices via super sector leadership methodology, although this is out of the scope of this thesis. On the cut-off date, the 550 largest qualifying stocks are selected automatically into the STOXX Europe 600 index, and the remaining 50 stocks are selected by prioritizing current constituents in places 551 to 750 ranked by market capitalization. If the number of stocks is still under 600, the largest non-current constituents will be used to fill the index to an even number of 600 constituents. This system is employed to reduce unnecessary turnover of stocks with a market capitalization near the 600th largest companies in the stock selection universe. (Qontiqo, 2022)

Due to its methodology, STOXX Europe 600 additions and deletions can be driven by market value changes up or downward. In the case of current index members, the market value of an included company can decline below the 750th company in the qualifying selection list or the market value of a non-included company can rise above the market value of the 551st company. Naturally, the reconstitutions can be driven by both upward and downward changes in market values simultaneously. Due to this characteristic, the selection criteria hypothesis is especially crucial to acknowledge since the index methodology contains no human intervention or hidden logic.

3.2 Index selection

The STOXX Europe 600 index is chosen for this study due to its strictly rule-based methodology, and quarterly review schedule, which increases the possible number of index revisions, leading to a larger sample. The prior factor in turn limits the informational content an index inclusion or exclusion might contain about the company’s future. As Biktimirov and Xu (2019a) explain, since S&P 500 relies on the index committee in reducing turnover in the index, investors might conclude that an included company is relevant for a long time compared to other potential candidates, which makes indices transparent selection methodologies better for price pressure studies. Contrary to S&P 500, the STOXX Europe 600 considers only the current situation, and no future outlooks are considered, thus information on future cash flows is not conveyed through inclusion or deletion. However, this does not affect other information effects that might be linked to index inclusion, as suggested in the investor awareness hypothesis, where inclusion in a widely followed index might introduce the company to some investors for the first time. Furthermore, STOXX Europe 600 might induce more investor scrutiny and analyst coverage for the included companies although studying analyst coverage effects is out of the scope of this thesis.

4 Data and Methodology

4.1 Data

The data used in this study consists of STOXX Europe 600 index additions and deletions from March 2007 to September 2022. The deletions and additions data are collected from Refinitiv Eikon, which contains all historical constituent changes since the index's launch in September 1998. In order to be included in the final sample, the index reconstitution event must fulfill the following criteria: 1) the event must be a part of the quarterly review of the index, 2) the company must not be delisted, and 3) it must have been listed 270 days prior to the announcement and must not be delisted for 20 trading days after the event. The final sample is also filtered to not include later merged, acquired, or delisted companies since accurate share price data is not available for these companies. Lastly, December 2022 review is not a part of this study since the data was gathered before the "20 trading days after"-requirement was fulfilled. In the final sample, a total of 830 index reconstitution events are examined, of which 413 are additions and 417 are deletions. Table 1 below shows all index reconstitution events available in the Refinitiv Eikon database from 2007 to 2022 and the filtering effect from the full dataset to the final sample used in this study. From the summary table, it is obvious that events are missing from the gathered list since the number of deletions and additions do not match backward from 2015. STOXX Europe 600 always consists of 600 stocks and any possible unscheduled deletions are replaced without delay, so the two numbers should always match each year. (Thomson Reuters, 2022)

Table 1. Sample size

Table 1 shows the sample size used in this thesis and the filtering effect of quarterly review and listing criteria being applied.

	All Events		Quarterly review		Final	
	Deletions	Additions	Deletions	Additions	Deletions	Additions
2007	63	54	39	33	20	15
2008	81	67	52	40	31	24
2009	43	38	33	29	21	18
2010	46	39	32	28	19	23
2011	53	45	35	31	18	19
2012	46	40	39	34	30	28
2013	44	42	34	34	24	24
2014	45	46	32	34	22	22
2015	47	46	28	28	20	26
2016	53	53	33	33	26	23
2017	43	43	26	26	21	17
2018	59	59	44	44	34	41
2019	42	42	26	26	21	22
2020	72	72	58	58	45	51
2021	57	57	38	38	34	28
2022	61	61	43	43	31	32
Total	855	804	592	559	417	413

After arriving at the final sample of reconstitution events, daily prices, and volumes from 21 days prior to the announcement date until 20 days past the inclusion date are collected to reach the targeted amount of daily price change data. In addition, the daily trading volume and index points of the STOXX Europe 600 index are collected for the same relative periods as market benchmark data. The dataset is then matched with relative days (to/from the announcement or inclusion date) for each company so that the differences in each country's bank holidays or other market closures do not affect the study. Due to STOXX Europe 600 consisting of companies in multiple countries across Europe, the total number of trading days between the announcement and index inclusion may differ, but the effect window's beginning and endpoint remain universal since the announcement day always relates to the same exact day while the inclusion date refers to the first day that the stock is tradeable and part of the index at the market open.

4.2 Methodology

This study is conducted using the Event Study methodology, as presented by MacKinlay (1997), which is widely used to measure economic events' impact on company-specific factors, often market valuation or volume. The Event Study procedure begins with establishing the events of interest for the study and selecting the event window on which the factors of interest are analyzed. Additionally, an estimation window for establishing a normal performance model for each of the companies must be defined, which should reside outside the event windows to avoid any estimation biases from a potential event impact. (MacKinlay, 1997) Most of the studies presented previously in this thesis follow the Event Study methodology with similar, but still slightly different timeframes. To improve comparability with earlier studies this study is conducted using a combination of methods used by Harris & Gurel (1986), Mase (2007), and Biktimirov & Xu (2019a). Every step of the methodology is presented in further detail in the next paragraphs.

4.2.1 Events of interest

The events of interest in this study are the announcement date (AD) and the effective date (ED) of the new index composition. Due to the STOXX Europe 600 methodology, the announcement under the new methodology is done after the close of stock markets in Europe, usually just before midnight. This means that any direct consequence of the publication should be visible on the AD +1 in each revision. ED is the first day when a stock is officially included or absent from the index from the stock market opening. Due to the changed index methodology and more specifically the new index methodology, the trading days between AD and ED are not fixed. Prior to the methodology change, there were generally 19 trading days between the AD and ED, but in some years during March and December reviews, there were only 14 days between the dates depending on the calendar. This is because prior to the methodology change, announcements were done on the last Tuesday of the previous month, adjusting the date if necessary to allow for at least 14 trading days. After the methodology change which was implemented as of the June review in 2018, the days between AD and ED are highly dynamic since the announcement is done on the first trading day of each review month. In the sample under the new methodology, the average number of days between the two dates is 14, and the range is 11 to 15 days.

4.2.2 The event windows and estimation period

The event windows in this study are selected to reflect a combination of earlier studies with guidance from MacKinlay's (1997) event study guide. The event windows used in this study are a combination of the ones used by Harris & Gurel (1986), Lynch & Mendenhall (1997), Chen, Noronha et. al (2004) Mase (2007), and Biktimirov & Xu (2019a). A combination is used to increase comparability to earlier literature as well as to examine price and volume effects, both temporary and permanent. Volume effects will be examined relative to ED and AD. Short-term price effects will be examined using event windows of -5 to +5 and -1 to +1 days relative to AD and ED. The following long-term event windows will be employed (summarized in Figure 1 below):

1. Pre-announcement window: AD -20 to AD
2. Run-up window: AD +1 to ED -1
3. Post-implementation window: ED to ED +20
4. Post-announcement window: AD +1 to ED +20
5. Full effect window: AD -20 to ED + 20

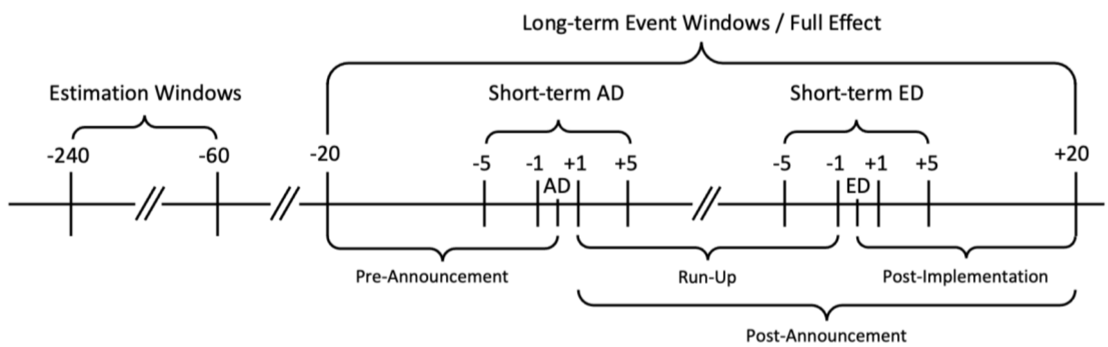

Figure 1. Summary of the estimation and event windows

The pre-announcement window of AD -20 to AD is selected as a midpoint between Mase's (2007) AD -10 to AD -1 and Biktimirov & Xu's (2019a) AD -30 to AD -1. However, to create similar conditions, the pre-announcement window is extended to AD, since the information is released after the stock market close, therefore the information cannot be used in trading until AD +1. The run-up window is implemented as Lynch & Mendenhall (1997) presented, while the post-implementation window is adjusted by extending the period from ED +10 to ED +20 in line with Chen et al. (2004). Lastly, the full effect window is employed in the spirit of Biktimirov & Xu (2019a) and is used to test the permanency of the potential price effects that might be caused due to anticipatory trading.

The estimation window can be characterized as the "normal" conditions of a company in the sense of an event study, where a company is not affected by the event of interest. MacKinlay (1997) suggests that the estimation window and any event window should not overlap, and an appropriate estimation window could be 90 days to 250 days before the event. Therefore, in this study, the estimation window starts 90 days before the announcement and extends backward 180 days for alpha and beta estimation, while lasting 60 days for baseline volume estimation. The volume estimation window is selected reflecting Harris & Gurel (1986) who utilized a 60-day window in their study, although the window is moved back to avoid capturing possible anticipatory effects into the baseline that might occur even before the event windows. This selection window should assist in examining if the trading level has increased (or decreased) already when entering the event window, but also can be utilized to distinguish possible trading spikes around the days.

4.2.3 Abnormal volume

Abnormal trading volume around the event windows will be measured by following the methodology of Harris & Gurel (1986) by using a market-volume adjusted mean volume ratio (MVR). The mean volume ratio is calculated for each day as follows:

$$MVR_t = \frac{1}{N}\sum_i VR_{it}$$

Where

$$VR_{it} = \frac{V_{it}}{V_{mt}} \cdot \frac{V_{m.}}{V_{i.}}$$

(1)

where V_{it} signifies the trading volume of a single stock and V_{mt} is the total market trading volume of the market proxy STOXX Europe 600 index at the time *t*. $V_{i.}$ and $V_{m.}$ respectively represent the average trading volumes of the stock and the market 60 days prior to the AD. If the volume is at the same relative level to the market as in the estimation period, a value of 1 is expected. This approach allows examining of abnormal volume before the event window since a baseline ratio is calculated for the estimation window. Also, if the volume effects around index reconstitutions are systematic, using the volume ratio approach should diminish the observable effect, since the market proxy index also experiences an increase in volume around these days. Statistical significance is tested using a t-test against a difference from 1.

4.2.4 Abnormal returns

Abnormal returns are measured as the difference between the stock's expected return and the stock's actual return at a time of interest. Prior studies use multiple methods for measuring normal returns, for example, the market model (Denis et al., 2003; Mase, 2007), the Fama & French three-factor model (Gowri Shankar and Miller, 2006; Biktimirov and Xu, 2019a), and a proprietary AXIOMA risk model (Renshaw, 2020) have previously been used. However, Lynch & Mendenhall (1997) and Chen et al. (2004) all utilize the raw difference between market returns and actual returns without any adjustments (usually referred to as market-adjusted return), both arriving at very similar results to studies conducted using the market model approach. Furthermore, Shankar and Miller (2006) employ three measures of abnormal returns (market-adjusted returns, the market model, and the Fama & French three-factor model), and for the major part, the results are very similar. Choosing the expected return model therefore should not adversely affect the outcomes of the study. In this thesis two measures of abnormal return are used: the market model and the market-adjusted returns. The latter measure is used to examine the robustness of the results. The expected return of a stock is calculated with the market model formula:

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

(2)

Where R_{it} is the expected normal return of the stock i at time t, α_i and β_i are the alpha and beta coefficients of the stock i estimated during the estimation window using linear regression. R_{mt} represents the market return at the time and the remaining residual term ε_{it} signifies the abnormal return that the model is unable to capture. While the market model uses company-specific estimates for beta and alpha, the market-adjusted return model can be calculated simply by setting alpha to 0 and beta to 1, thus including only the market return and the residual. The abnormal return can be calculated as follows:

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

(3)

While Equation 3 measures the abnormal return for a single day, cumulative abnormal returns (CAR) are used to measure abnormal returns over an event window, all of which were introduced in subsection 4.2.2 , CAR is simply the sum of daily abnormal returns over a given timeframe, calculated as follows:

$$CAR_i(t1, t2) = \sum_{t1}^{t2} AR_i$$

(4)

To analyze the full sample at a time, average abnormal returns (AAR) and cumulative abnormal returns (CAAR) are calculated for each day. These can be calculated by calculating the mean of abnormal daily returns and then summing them to achieve cumulative average abnormal returns. AAR and CAAR are calculated as follows:

$$AAR_t = \frac{1}{N} \sum_{i}^{N} AR_{it}$$

(5)

$$CAAR(t_1, t_2) = \sum_{t1}^{t2} AAR_t$$

(6)

To test statistical significance, t-tests are used for AARs and CAARs for each day and each effect window, respectively.

5 Results

In this section, the empirical results of the study are presented and then discussed. The section is divided into subsections, first analyzing the volume effect to examine trading patterns around the announcement date and effective date. Second, the price effects are examined, to extend the insights gained in the volume section. The price effects are analyzed in three subsections, first by examining single-day and short-term abnormal returns, then expanding the window to medium- to full-term windows. The third subsection is devoted to the analysis of yearly changes in the index effect by dividing the dataset into yearly subsets. Throughout this section, statistical significance is denoted as *** for $p<0.01$, ** for $p<0.05$, and * for $p < 0.1$.

5.1 Abnormal trading volume around index reconstitutions

Figure 2 below shows the average volume ratio around the announcement date, where 0 is the announcement date and the additions start to be implemented at the earliest on day 11. Due to the dynamic nature of the relative implementation date, this graph should be examined more thoroughly only until day 10, since the relative effective dates differ and after day 11 a part of the sample's changes can already be implemented. Figure 2 shows that trading levels do not rise dramatically before the announcement date, as the largest volume ratio achieved before the AD for additions (deletions) is 1.23 (1.20). Furthermore, the future additions and current index constituents to be deleted seem to trade roughly in line with each other with only slight deviations in the timing of the experienced volume.

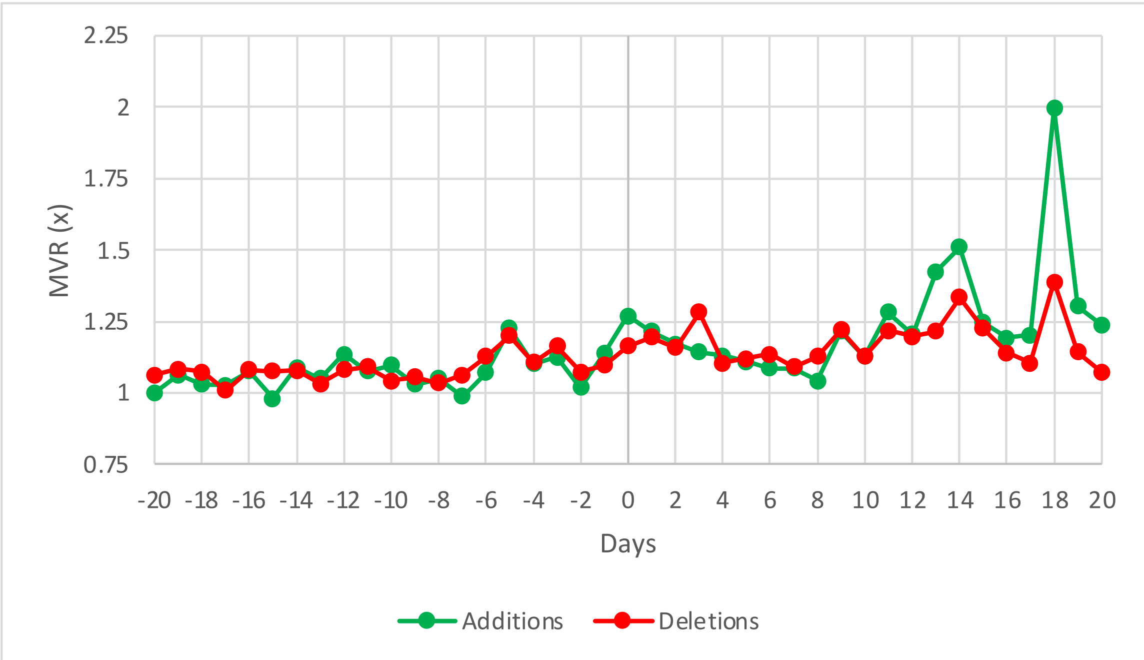

Figure 2. Mean volume ratio (MVR) around AD. *AD is day 0.*

Appendix 1 represents the volume ratio around the announcement date in tabular form complemented by the statistical significance of the one-tailed test, for the true mean being above 1. On most days before the announcement date, the volume ratio exceeds the historical average with statistical significance, and the day with the largest volume prior to the information being published is AD (1.27x for additions). Volume exceeding the historical average before the announcement date altogether could be a sign of anticipatory trading conducted by either fund managers or alternatively arbitrageur trading aimed to take advantage of the reconstitution event. However, anticipatory trading before the announcement seems to have economically near negligent impact on the volume. Starting from AD until AD +10 the volume ratio stays significantly above its historical level (all days except AD +8 for additions). From the volume peak of AD, the volume level gradually decreases until the changes start to be implemented. A similar pattern can be observed for deletions, except for AD +3 which has a volume ratio of 1.28(***). The increased activity before the AD and the gradual decline a few days after (until AD +7) is well in line with the expected market behavior discussed in the literature review and could be a sign of arbitrageurs, fund managers (if allowed by index rules) or other market participants either trying to match the index composition or trying to counteract it to take some profits with the published information. However, based on volume alone conclusions cannot be made of market participants' possible buy/sell directions, and these will be discussed in the price section later. What can be concluded from volume around the announcement date is that the volumes mostly exceed the historical levels for both additions and deletions, suggesting mostly continuous increased trading activity of the stocks that are part of the quarterly review. However, no clear spike in volume can be observed around the announcement date.

Figure 3 shows the volume ratios organized relative to the effective date of index reconstitutions. The same principle for analyzing these results applies as above, where in this graph ED -20 to ED -10 overlap with announcement dates and therefore should be examined with care. Contrary to the muted effects around the announcement date, the trading volumes experience a significant spike on ED -1, which is the last day before the changes become effective preceding the next stock market opening. Appendix 2 shows the information in a tabular format together with the significance of the t-test statistics.

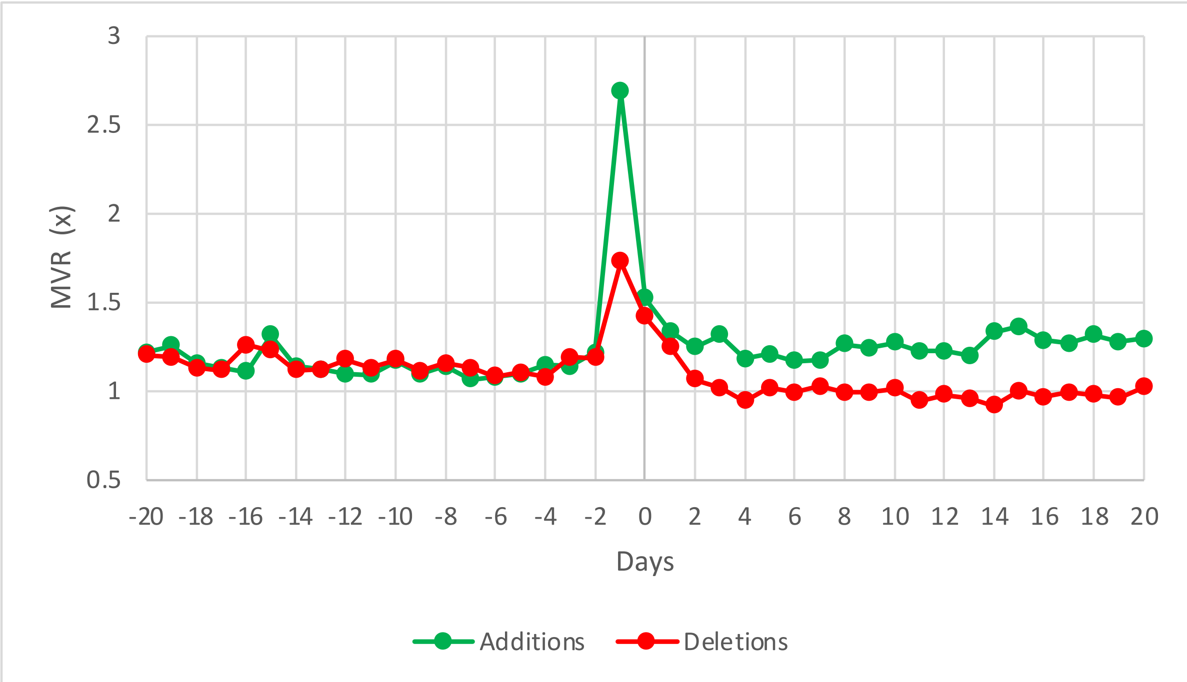

Figure 3. Mean volume ratio (MVR) around ED. *ED is day 0.*

Analyzing the additions first, the volume ratio is significantly above the historical level throughout the examined window and stays above the historical level, after the reconstitution is completed (every day on and after ED at the 1% risk level). This result suggests that membership in STOXX Europe 600 index permanently increases the trade volume of a company. Furthermore, the additions' trading volume seems to increase slightly from the level experienced at ED -20 to ED -2. The volume ratio on ED -1 for additions is 2.69x the historical level, while for deletions it is 1.73x, both being statistically significant at the 1% level. Due to index-tracking funds' goal of tracking error minimization, trading a fund position to match the index on the last day before the effective date, exactly at the stock market closing price, would lead to zero tracking error. Acknowledging the previous, the passive index-tracking fund managers' actions can be credited at least as a contributing factor to the results.

On the other side, the trading of deletions is volume-wise roughly in line with the upcoming additions until ED -1. On ED +3 the deletions' volume reverts permanently to the historical level since volume does not significantly (at better than the 5% level) exceed 1 after ED +1. The volume does neither fall below the historical levels, making the effect asymmetric in the observed window. It is noteworthy, that in case of deletions, the estimation period covers the period when a stock was a constituent of the index. Hence, a significant drop below this trading volume would hint at the index membership itself leading to excess volume only for the remainder of the membership. However, as no major drop below the historical level is observed, the results lend support to the investor awareness hypothesis, since investors are unlikely to forget the existence of a company no longer included in an index, thereby explaining why trading interest is mostly retained. Also, since the drop in volume for deletions is very clear-cut in the sample after ED, it is likely that the continued excess volume observed during the observation window is most likely due to portfolio rebalancing in anticipation of the reconstitution around both AD and ED.

Combining the results around AD and ED, they support the research hypothesis H1 as trading volumes for both inclusions and exclusions are significantly above the historical level between the announcement date and the effective date. The results also partly support hypothesis H2, according to which the trading volume of an included stock is permanently higher for additions after index inclusion. However, for deletions, the trading volume tapers down after exclusion, but the level does not decline below the historical average, suggesting no effect on awareness of the stock. Hypothesis H3 is fully supported, as there is a significant spike in trading volume on the ED -1 for both additions and deletions. This behavior is most likely a sign of last-minute trades of fund managers minimizing tracking errors of their portfolios by adjusting their positions to match the index composition effective on the next trading day.

The volume effects help gain insight into the trading interest in stocks that are a part of the quarterly index review results. Summarizing the findings of this section, elevated trading levels exist around index reconstitution events for both index inclusions and deletions. The elevated trading levels could sometimes lead to up- or downward price pressures if the market has insufficient liquidity. The most notable price effect should then be visible on the day before the execution of the constituent change, but the direction cannot be determined from volumes only.

5.2 Short-term price effects

Throughout this section, price effects are examined on a single day and in a short-term (-5 to +5 days) window relative to the AD or ED. The term "short-term event window" always refers to this specific timespan.

Table 2 shows the single-day average abnormal returns around the announcement date for both additions and deletions. Additions will be analyzed first, and they show statistically significant upward pressure on four out of five days before the announcement date. On or after the announcement date, the abnormal returns are no longer statistically significant. Moreover, the average abnormal returns turn negative for the first time in this short-term event window on AD +2, which is the second day when the information on new index constituents is available. Using the market return model, the -0.19% AAR is also weakly significant at the 10% risk level. Additionally, the statistically significant positive abnormal returns for additions coincide with the significant abnormal volume on days AD -5, AD -4, and AD -1 as presented in the previous section.

Table 2. Single-day abnormal returns around the AD

The table shows the Average Abnormal Return (AAR) percentages for both additions and deletions on a single day basis, and the Cumulative Average Abnormal Returns (CAAR) during the pre-defined three- and eleven-day event windows of AD -1 to AD +1 and AD -5 to AD +5. The table contains AAR figures obtained with the Market Model (MM) and the Market-adjusted Return Model (MR).

	Additions (n=413)				Deletions (n=417)			
DAY	AAR (%) (MM)		AAR (%) (MR)		AAR (%) (MM)		AAR (%) (MM)	
AD -5	0.396	***	0.353	***	-0.367	**	-0.394	***
AD -4	0.232	**	0.213	**	0.079		0.050	
AD -3	0.071		0.026		-0.079		-0.150	
AD -2	0.200	**	0.179	**	-0.083		-0.082	
AD -1	0.507	***	0.511	***	0.009		-0.125	
AD (0)	0.129		0.116		-0.202		-0.243	
AD +1	0.175		0.097		-0.057		-0.075	
AD +2	-0.124		-0.188	*	0.136		0.086	
AD +3	-0.045		-0.039		-0.352	***	-0.388	***
AD +4	-0.058		-0.070		-0.049		-0.043	
AD +5	0.094		0.085		-0.162		-0.199	

	CAAR (%) (MM)		CAAR (%) (MR)		CAAR (%) (MM)		CAAR (%) (MR)	
(-1, +1)	0.811	***	0.724	***	-0.250		-0.444	
(-5, +5)	1.576	***	1.282	***	-1.128		-1.565	**

On the AD, the statistically significant abnormal volume is still present, being at its highest level before implementation, but the significant average abnormal returns disappear. Over the course of the three trading days surrounding AD (-1 to +1) additions gain an overall +0.81% CAAR (+0.72%*** with MR model), which is statistically significant at the 1% risk level. Over the course of eleven trading days (AD -5 to AD +5), the CAAR has expanded to +1.58%*** (1.28%*** using MR), almost fully accumulated before the AD. This price movement, together with the premises of continued abnormal trading volume, could be a sign of arbitrageurs starting to sell their positions, while the demand and price are supported by index fund managers and other market participants buying the upcoming index constitution into their portfolios. The results around the announcement date support hypothesis H4 as the additions exhibit both single-day and cumulative abnormal returns prior to and after the AD.

For deletions, the results are not as pronounced, as only two days in the examined window exhibit significant negative abnormal returns. Still, the sign is consistent with the hypothesis, and also the market return model shows a significant negative CAAR on the 11-day window, which supports the hypothesis. CAARs accumulated over the days from -1 to 1 and from -5 to 5 around AD are negative (-0.25% and -1.12% using MM, -0.44% and -1.57%** using MR.) The only statistically significant single-day AARs are encountered on the AD -5 and AD +3, both of which are negative. These days also coincide with the largest single-day abnormal volumes in the short-term window excluding AD. The volume ratios for AD -5 and AD +3 are 1.20x and 1.28x respectively, suggesting that stocks scheduled to be deleted face downward price pressure around the AD, which most likely is linked to the excess volume.

Overall, the results obtained using either the MM or the MR model are largely in line with each other, but the MR produces constantly more negative results, which can be explained by the negative mean alpha in the sample, used in the MM. Statistical significance is retained using both models in the cases where MM delivered statistically significant results. Using MR made the negative results even more significant, bringing the p-value of deletion CAAR (-5, +5) to less than 5%. The similar results both validate the selected model but also point towards the insignificance of model selection.

The short-term event window results for the ED presented in Table 3, show that in the case of additions, no significant CAAR around the ED in either the 11-day or the 3-day window exists. For additions, all single-day AARs are negative before the ED according to both models, but the only significant AAR is on ED -1 at -0.41% (-0.43% using MR). However, the sign of the result is unexpected, as the largest abnormal volume is encountered on the same day (2,69x historical volume) and it is the last day on which the stock can be traded before inclusion. The price pressure should face upward if there was any price pressure caused plainly by index fund trading action. The negative sign could be a sign of arbitrageurs closing their positions on the day, effectively driving down price, while the excess volume could be explained by fund manager trading using for example bilateral agreements, which effectively have no effect on price. To fully confirm this conjecture, an intraday analysis of the volume and price effect should be conducted. This negative return is effectively canceled on the ED, where AAR is +0.47%. Comparing results obtained using the MR model, the AARs of the ED -1 and ED are even more perfectly mirrored than with the MM model, with a difference of only 0.03%. The self-canceling single-day returns and the change of sign around the ED explain the near-nonexistent price movement around the short-term CAAR windows.

Table 3. Abnormal returns around ED
The table shows the Average Abnormal Return (AAR) percentages for both additions and deletions on a single day basis, and the Cumulative Average Abnormal Returns (CAAR) during the pre-defined three- and eleven-day event windows of ED -1 to ED +1 and ED -5 to ED +5. The table contains AAR figures obtained with the Market Model (MM) and the Market-adjusted Return Model (MR).

	Additions (n=413)				Deletions (n=417)			
DAY	AAR (%) (MM)		AAR (%) (MR)		AAR (%) (MM)		AAR (%) (MR)	
ED -5	-0.012		-0.029		-0.423	***	-0.428	***
ED -4	-0.132		-0.200		-0.049		-0.115	
ED -3	-0.155		-0.169		-0.357	**	-0.342	**
ED -2	-0.118		-0.166		-0.117		-0.180	
ED -1	-0.409	***	-0.427	***	0.400	**	0.326	*
ED (0)	0.467	***	0.458	***	0.117		0.064	
ED +1	0.086		0.008		-0.153		-0.240	
ED +2	0.150		0.130		-0.168		-0.225	
ED +3	0.029		0.052		-0.343	**	-0.410	***
ED +4	0.069		0.043		0.026		-0.029	
ED +5	-0.027		-0.040		-0.011		-0.068	
	CAAR (%) (MM)		CAAR (%) (MR)		CAAR (%) (MM)		CAAR (%) (MR)	
(-1, +1)	0.144		0.039		0.364		0.150	
(-5, +5)	-0.052		-0.339		-1.080	**	-1.645	**

On the deletions' side, the single-day results behave largely in line with the additions' AARs until the ED -1. After the ED, where the sign of additions' returns turned positive, deletions stay negative. On ED -5 and ED -3 statistically significant AARs of -0.42% and -0.36% are observed, to which the MR model largely agrees. However, on ED -1 the direction of the AAR is yet again peculiar, considering a hypothesized selloff by fund managers. The statistically significant single-day AAR of +0.40% further solidifies the argument of arbitrageurs closing their positions, this time on the short side, while the fund managers can utilize bilateral agreements here as well, driving up the volume, but not the price. Over the course of the shorter three-day window, the earlier negative returns are partially reversed for the first two days but turn negative on the last day, resulting in a CAAR of 0.36% on ED -1 to ED +1. However, the result is statistically insignificant. For the whole 11-day period, the CAAR is negative at -1.08%, being statistically significant at the 5% level.

The results reject the hypothesis H5 for the short term, as the additions experience a significant negative abnormal return on ED -1, from which positive abnormal returns were hypothesized. For deletions, while single-day abnormal returns before ED -1 are all negative, the sign on the ED -1 is unexpected. Due to the sign of the single day returns around ED, the price and volume patterns around the ED cannot be credited to fund managers, at least alone. While the price pattern results in a nearly zero CAAR over the short term, suggesting price reversal for additions, the direction is simply contrary to this explanation and is more akin to arbitrageur action. Furthermore, the short-term results are not symmetrical between additions and deletions, which further makes the price pressure explanation invalid.

5.3 Medium to long-term price effects

In this section, price effects from AD -20 to ED +20 are examined on a rolling basis and on the pre-determined event windows. Figure 4 below exhibits CAAR of the full sample, relative around the AD, where AD is day 0. The figure contains results for both MM and MR models and the single-day results with statistical significances can be found in Appendix 3. From the figure, it is apparent that the statistically significant abnormal returns before the AD that were presented in the previous section are in fact a part of a longer upward (downward) trend in case of additions (deletions). Expanding the examination window substantially changes the observed nature of the price drift for both additions and deletions, where additions start cumulatively gaining abnormal returns already 20 days before the announcement date, potentially suggesting early speculation of future index constituents.

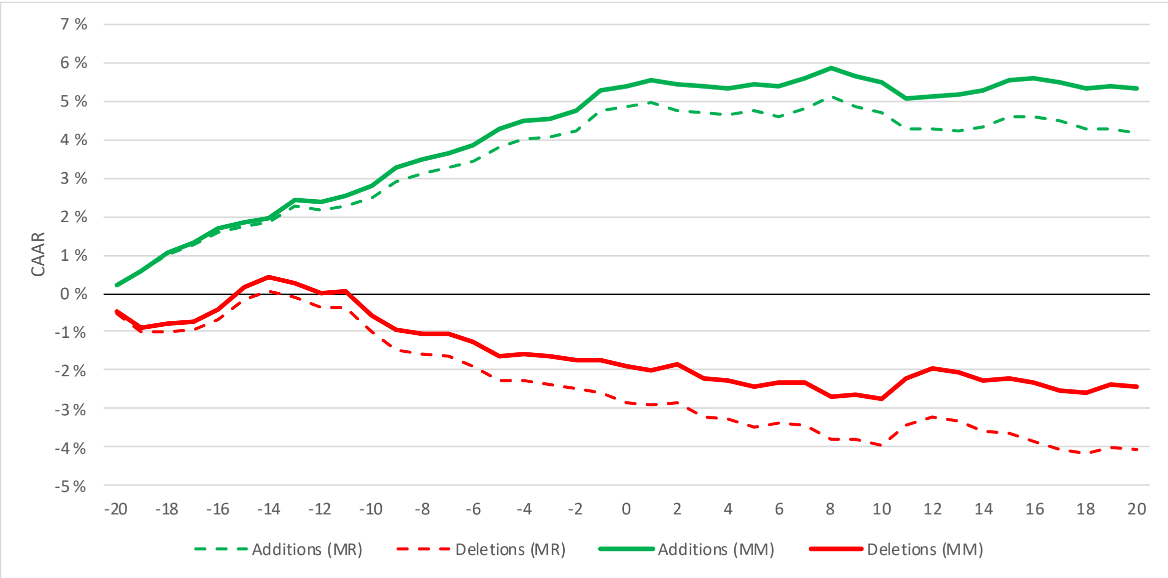

Figure 4. Cumulative abnormal returns relative to AD. *AD is day 0.*

It is noteworthy that speculative trading cannot directly be distinguished from the selection criteria hypothesis, since the additions might not have been included in the STOXX Europe 600 altogether if they did not gain market capitalization in this manner, relative to market movement. Analyzing just the results around the announcement date suggests that companies do in fact enter the index at an inflated price, which does not reverse fully to the expected return levels when the companies are included in the index as all index reconstitutions have been completed at the latest on the day AD +20. In case of deletions, the share price has gained a CAAR of around -2% when the index inclusion is announced, which also can be at least partially explained by the selection criteria hypothesis since the stock might not have been deleted from the index in the first place if the market value did not decline as presented here. All index reconstitutions have been completed during the AD graph (AD +11 to AD +19), but it is once again noteworthy that the relative day of index reconstitution is not the same in the graph, making returns fuzzy due to coinciding with another event of interest.

While the effects are not perfectly symmetrical in their magnitude during the AD -20 to AD +20 window, the pattern itself is almost perfectly mirrored. This is especially the case if the window was shortened to start from AD -10 when deletions start a constant downward price trend, which is not broken until AD +10. However, additions would still gain more CAAR than what the deletions lose during the same period. Figure 4 also shows that the market model and the market-adjusted return model agree well with each other, but the MR constantly produces more negative results.

Figure 5 shows the CAAR of additions and deletions organized relative to the ED, which is denoted as day 0. For deletions, the whole window is mainly a downward drift, especially when all the announcements have been completed around ED -10. The downward drift continues after the index deletion has been completed, implying that the negative price effect of index exclusion is in fact permanent, and the trend starts already before the announcement date. The run-up period after the announcement is negative for both additions and deletions, but additions show a more stagnant price pattern with a drawdown of less than one percent before the ED. On ED, the directions of the price movements reverse in both cases, already observed in the previous section, but then continue an upward trend for additions and a downward trend for deletions. From ED to ED +20, the effects are almost perfectly mirrored in magnitude, although deletions exhibit more volatility in their AARs. The results seem permanent in both cases, but this is further examined using the fixed event windows later in this section. The single-day abnormal returns can be found in Appendix 4.

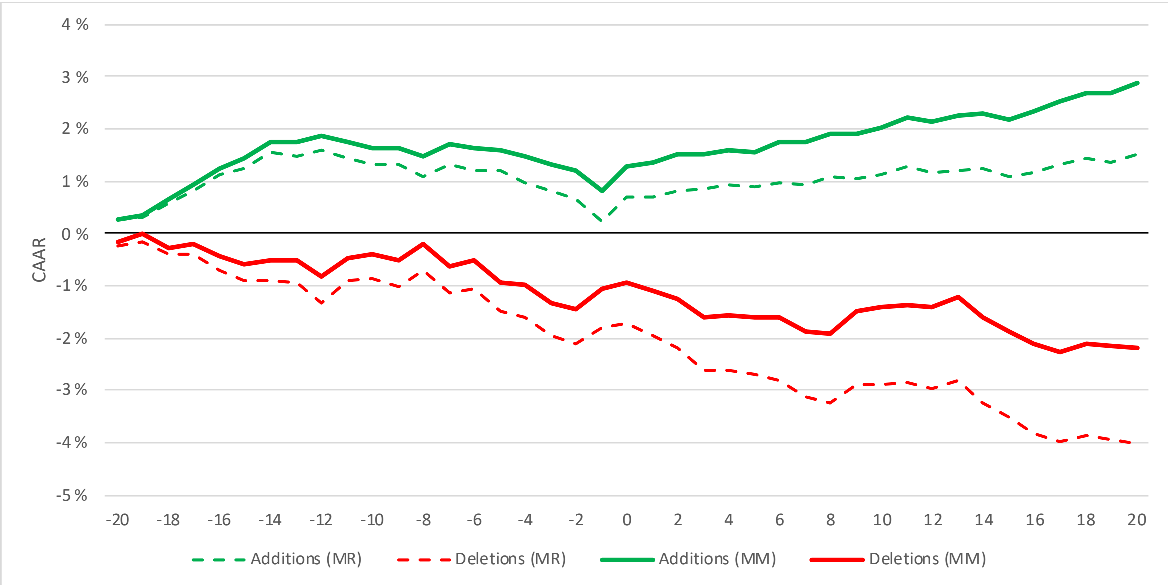

Figure 5. Cumulative abnormal returns relative to the ED. *ED is day 0.*

Table 4 represents the results for the pre-determined medium- to long-term event windows. In line with the graph analysis above, the most significant price effects are observed before the announcement date for both directions. For additions, the pre-announcement-period CAAR from days AD -20 to AD is 5.39% for the full sample, which is statistically significant at the 1% level. For additions, the run-up period returns are slightly negative, but only the MR model produces statistically significant results. The negative sign suggests price reversal, which was already observed in the graphs above. However, this price reversal is not full, and the CAAR of 2.07% gained during the post-implementation-period cancels the slight reversal completely. This cancellation can be then observed in the post-announcement window, during which additions gain a total of 1.51% of CAAR. During the full period, additions gain a total CAAR of 6.90% which is statistically significant at the 1% level. The price effects can therefore be deemed permanent, and additions do therefore enter the index at an inflated price. The abnormal returns are generated mainly in the pre-announcement period, where drawing conclusions on the reasons behind the effect is particularly hard and the price patterns could be a sign of either arbitrageur or fund manager trading or alternatively, the effect could be explained by the selection criteria hypothesis. The selection criteria hypothesis can be accepted in two ways: either the prices rise naturally due to corporate actions or performance outlook, thereby resulting in the index inclusion. Alternatively, the prices are inflated due to betting on index inclusion. However, the effects are almost impossible to separate, even with additional analysis of the upcoming index additions list.

Table 4. Cumulative Average Abnormal Returns, medium- to long-term event windows

The table shows the Cumulative Average Abnormal Returns (CAAR) for additions and deletions using both models, denoted MM and MR. The periods relate to the AD or ED as follows: Pre-Announcement: AD -20 to AD, Run-Up: AD +1 to ED -1, Post Implementation: ED to ED +20, Post Announcement: AD +1 to ED +20 and Full Period: AD -20 to ED +20.

n	Direction (Model)	Pre Announcement CAAR (%)	Run-Up Period CAAR (%)	Post Implementation CAAR (%)	Post Announcement CAAR (%)	Full Period CAAR (%)
413	Addition (MM)	5.390 ***	-0.556	2.066 ***	1.510 **	6.900 ***
413	Addition (MR)	4.852 ***	-1.009 **	1.272 ***	0.263	5.115 ***
417	Deletion (MM)	-1.923 ***	-0.512	-1.108	-1.619	-3.543 ***
417	Deletion (MR)	-2.844 ***	-0.877	-2.229 ***	-3.101 ***	-5.950 ***

In the case of deletions, the effect is mirrored during the pre-announcement and full-period event windows, but the effects are not perfectly symmetrical in magnitude with each other. Deletions gain a CAAR of -1.92% during the pre-announcement period and the abnormal losses deepen further for a full period CAAR of -3.54%. For the run-up period, the returns of both additions and deletions are surprisingly similar, both encountering a cumulative loss between -0.51 and -0.56%. For all other periods, the directions are opposite, well in line with expectations. Looking at the results from the market return model, the full-period returns are almost perfectly mirrored, with a +5.12% CAAR for additions and -5.95% CAAR for deletions. In both cases the effects are permanent, supporting hypothesis H6, and therefore price pressure can be effectively ruled out as an explanation.

The results are also partially consistent with the imperfect substitutes hypothesis since the trading volumes for an included stock stay consistently above the historical levels after inclusion and the abnormal returns are simultaneously permanent. The opposite effect is observed for deletions where trading volumes revert to the historical level after the companies are deleted from the index and the price is permanently reduced. A mix of the investor awareness hypothesis and the liquidity hypothesis also is in line with the results. Using only the market model as a basis would lean support more toward the investor awareness hypothesis, but the addition of the other model balances the results toward the liquidity hypothesis. The most likely candidate is that the results presented here can be explained with a combination of multiple hypotheses, most prominent of which are the liquidity hypothesis and the selection criteria hypothesis. Due to the index methodology and the most significant returns occurring before the index inclusion announcement, the information signaling hypothesis is not a likely explanation, since there is no analysis done on the added or deleted companies which would be superior compared to the market. Furthermore, the timing suggests that analysis on index inclusions has already been done by market participants prior to the announcement, further casting doubt that any information or superior company analysis is released upon an index reconstitution event in this index.

5.4 Price-effects’ evolution over time

The evolution of the price effects over years is analyzed by dividing the dataset into yearly observations. The aim of this procedure is to determine whether the observed index effect is similar every year, or whether the effect has intensified or diminished over the years. The yearly analysis also allows for determining whether the index effect is independent of the market conditions, or whether the results are mixed every year.

Table 5 shows the CAARs of the pre-determined medium-to-long-term event windows divided into each year in the sample for additions, estimated using the market model. The number of annual observations stays at a reasonable level throughout the sample period, being at its lowest at 15 in 2007. The effect is dissimilar in most years and the pre-announcement CAARs have grown larger and more significant over the last few years in the sample. The pre-announcement period cumulative abnormal returns combined with the full period returns are observably the largest and the most significant throughout the sample. The year 2009 stands out, as the full period returns are the largest of the sample, combined with the second largest pre-announcement CAAR. This could be explained by the market direction reversal and strong recovery after the financial crisis in March 2009. All statistically significant results are of the same sign among their significant counterparts each year, except for the run-up period in 2010. This observation is reassuring since it suggests the effect has stayed roughly similar in nature over the course of 15 years, but also, it is instantly noticeable that for most of the years, the index effect has not been statistically significant. This brings uncertainty to the returns that could be obtained by implementing the trading strategies based on the findings of this thesis, although over the full sample period, systematic trading around index inclusions and exclusions could still have generated both economically and statistically significant abnormal returns.

Table 5. Yearly cumulative abnormal returns of additions, market model

The table shows the yearly development of the CAARs for additions. The event windows are fixed and correspond to the pre-determined windows used throughout the thesis. CAARs are calculated for each calendar year and each window is independent of others. No reconstitution event appears twice or more in the years presented. (MM) stands for the Market Model, used to calculate expected returns.

n	Year (Model)	Pre Announcement	Run-Up Period	Post Inclusion	Post Announcement	Full Period
15	2007 (MM)	1.75	-1.70	0.81	-0.89	0.86
24	2008 (MM)	1.87	-2.95 *	-0.62	-3.57	-1.70
18	2009 (MM)	10.24 ***	2.83	2.06	4.89	15.14 ***
23	2010 (MM)	-1.79	3.23 *	0.73	3.96 **	2.17
19	2011 (MM)	2.85	0.58	-0.39	0.19	3.03
28	2012 (MM)	-0.92	0.12	2.54 **	2.66 *	1.73
24	2013 (MM)	2.70 *	1.79	2.27	4.06	6.76 *
22	2014 (MM)	2.17	0.85	-2.29	-1.44	0.74
26	2015 (MM)	4.89 **	2.18	-0.03	2.15	7.04 **
23	2016 (MM)	3.44	1.31	2.71	4.03	7.46
17	2017 (MM)	2.24	-1.13	-0.06	-1.19	1.04
41	2018 (MM)	7.64 ***	-1.09	4.05 ***	2.96 *	10.61 ***
22	2019 (MM)	9.18 ***	0.57	4.31 **	4.88 **	14.06 ***
51	2020 (MM)	10.03 ***	-4.71 **	6.68 ***	1.97	12.00 ***
28	2021 (MM)	13.90 ***	-2.86 *	2.47	-0.39	13.51 ***
32	2022 (MM)	6.58 **	-1.56	0.10	-1.46	5.12

The results are contradictory compared to earlier studies on the development of the direction of the index effect over recent years. Renshaw (2020) presented a diminishing index effect for multiple indices and especially, S&P 500 has incurred an attenuation of index effect using multiple buy-and-hold strategies. These results can be a sign of the growth in the

Assets under Management of index funds, but this explanation is unlikely, considering that full replication index tracking funds cover only 0.2% of STOXX Europe 600 market capitalization as of the end of 2022 (Thomson Reuters, 2022). More significant results constantly emerge only after the STOXX methodology change in 2018, but the methodology change did not alter the implementation rules or methodology severely, only changing the announcement and cut-off dates of the quarterly review. In 2018, Qontigo also launched the STOXX Europe 600 ESG-X index, which contains the same companies as the regular STOXX Europe 600, with ESG exclusion criteria. (Qontiqo, 2022) This could partially explain higher abnormal returns in 2018 and after, but the effect of the index launch is unlikely to be so profound on the main index's price effects. Also, since the highest price effects have tapered off in 2022, with the full period returns no longer being statistically significant, it might be too early to call the index effect permanently increased in present times as the effect might just be sensitive to specific market conditions.

The robustness of the additions' yearly results is also analyzed using the market return model, which is presented in Table 6. The results align with the market model, but the price effects are significant for more years than in the previously presented results. Furthermore, these results show slightly incremental growth in pre-announcement CAAR before the year 2018, but the results do not otherwise change dramatically. The permanent price effect appears and disappears over the years, with the 2018-2022 period being the longest continuous timespan with significant results. Contrary to the full sample comparison between the market model and the market return model, not all the abnormal returns measured with the market return model are smaller than their market model counterparts.

Table 6. Yearly cumulative abnormal returns of additions, market-adjusted return
The table shows the yearly development of the CAARs for additions. The event windows are fixed and correspond to the pre-determined windows used throughout the thesis. CAARs are calculated for each calendar year and each window is independent of others. No reconstitution event appears twice or more in the years presented. (MR) stands for the Market-adjusted Return, used to calculate expected returns.

n	Year (Model)	Pre Announcement	Run-Up Period	Post Inclusion	Post Announcement	Full Period
15	2007 (MR)	3.31	0.08	2.15	2.23	5.54
24	2008 (MR)	2.11 *	-2.49	0.02	-2.48	-0.37
18	2009 (MR)	9.78 ***	2.29	1.46	3.75	13.53 ***
23	2010 (MR)	-1.05	3.02 *	0.91	3.93 ***	2.88 *
19	2011 (MR)	3.36 *	0.16	-1.36	-1.19	2.17
28	2012 (MR)	-1.25	-0.48	2.11 *	1.62	0.37
24	2013 (MR)	2.15	0.45	1.50	1.95	4.09
22	2014 (MR)	0.63	0.42	-2.87	-2.45	-1.82
26	2015 (MR)	4.59 **	2.21	-0.91	1.30	5.89 ***
23	2016 (MR)	1.58	-0.76	0.71	-0.04	1.54
17	2017 (MR)	2.49 *	-1.10	-0.12	-1.22	1.27
41	2018 (MR)	6.71 ***	-1.68 *	2.77 ***	1.10	7.81 ***
22	2019 (MR)	8.15 ***	-0.70	2.89 *	2.19	10.35 ***
51	2020 (MR)	9.05 ***	-5.09 **	5.26 ***	0.17	9.22 ***
28	2021 (MR)	11.46 ***	-4.10 **	0.27	-3.84 *	7.62 **
32	2022 (MR)	6.96 ***	-1.28	-0.14	-1.42	5.53 *

The yearly results for deletions are shown in Table 7. The pre-announcement price movements' evolution in recent years is even more pronounced among deletions as none of the results prior to 2018 are statistically significant. Furthermore, the pre-announcement period returns contain mixed signs, where exactly half of the sample years exhibit negative cumulative abnormal returns prior to the announcement date, whereas for the other half, CAARs are positive. Pre-announcement period returns, regardless of the sign are also always below the yearly counterpart of additions, which suggests that companies' market value movements close to the announcement of index reconstitution can in some cases determine the new index constituents. Combining the observations of additions and deletions, the effect of the financial crisis in 2008 becomes apparent, as the post-inclusion abnormal returns for additions were nonexistent (MR model +0.02%), signaling constituent trading near perfectly in line with the index returns. Conversely, the deletions generate abnormal losses of -13.7%** in the same period. In the subsequent year 2009, the effects of the market recovery are also more apparent, as the deletions cumulate an abnormal loss of -1.47% (insignificant) in the pre-announcement period, whereas the additions gain 10.24%*** during the same year. The finding exhibits that the timing of market value gain or loss in companies can be crucial in determining index deletions and additions, as in 2009, the full period CAAR for deletions (15.81***) exceeds the additions' CAAR (15.14%***).

Table 7. Yearly cumulative abnormal returns of deletions, market model

The table shows the yearly development of the CAARs for deletions. The event windows are fixed and correspond to the pre-determined windows used throughout the thesis. CAARs are calculated for each calendar year and each window is independent of others. No reconstitution event appears twice or more in the years presented. (MM) stands for the Market Model, used to calculate expected returns.

n	Year	Pre Announcement	Run-Up Period	Post Exclusion	Post Announcement	Full Period
20	2007 (MM)	0.41	1.76	-0.78	0.98	1.39
31	2008 (MM)	0.70	3.69	-13.74 **	-10.05	-9.35
21	2009 (MM)	-1.47	11.59 **	5.69	17.28 **	15.81 ***
19	2010 (MM)	-4.00	-2.40	-3.52	-5.92	-9.92
18	2011 (MM)	0.57	-9.21 **	-2.12	-11.33	-10.76
30	2012 (MM)	2.81	-0.86	-4.31 **	-5.17	-2.36
24	2013 (MM)	2.52	-3.27	-0.36	-3.63	-1.11
22	2014 (MM)	0.47	0.04	-2.89	-2.85 *	-2.38
20	2015 (MM)	3.72	-8.68	-0.08	-8.76	-5.04
26	2016 (MM)	-2.17	0.89	1.07	1.96	-0.20
21	2017 (MM)	1.60	-0.29	2.10	1.81	3.42
34	2018 (MM)	-8.63 ***	0.90	-1.02	-0.12	-8.75 **
21	2019 (MM)	-5.98 **	2.28	1.52	3.80	-2.18
45	2020 (MM)	-1.70	-2.68	-1.40	-4.07 *	-5.77 *
34	2021 (MM)	-6.66 ***	-0.46	-0.33	-0.79	-7.45 ***
31	2022 (MM)	-7.11 *	-2.49	5.58	3.09	-4.02

Conducting the same robustness check for deletions by using the market return model, it is apparent that the results do not dramatically change depending on the model selection. Table 8 shows the results using the market return model. The number of statistically significant results obtained increases when using the market return model, but the evolution of the effect as well as sensitivity to yearly market conditions are preserved.

Overall, the results presented in this section reject hypothesis H7 as the index effect has only seemingly grown in strength over the most recent years in the sample. Furthermore, the magnitude and even the sign of the price effects vary from year to year, suggesting that the phenomenon is sensitive to market conditions prevailing at the time of the index review.

Table 8. Yearly cumulative abnormal returns of deletions, market-adjusted-return

The table shows the yearly development of the CAARs for deletions. The event windows are fixed and correspond to the pre-determined windows used throughout the thesis. CAARs are calculated for each calendar year and each window is independent of others. No reconstitution event appears twice or more in the years presented. (MR) stands for the Market-adjusted Return, used to calculate expected returns.

n	Year	Pre Announcement	Run-Up Period	Post Exclusion	Post Announcement	Full Period
20	2007 (MR)	0.29	1.97	-2.12	-0.15	0.14
31	2008 (MR)	0.44	4.37	-13.75 **	-9.38	-8.93
21	2009 (MR)	-1.43	11.26 **	5.27	16.53 **	15.10 **
19	2010 (MR)	-5.00 **	-2.10	-4.02	-6.11	-11.11 *
18	2011 (MR)	1.41	-9.02 **	-3.12	-12.14	-10.73
30	2012 (MR)	2.41	-1.39	-5.09 ***	-6.48 *	-4.07
24	2013 (MR)	2.01	-3.44 *	-0.93	-4.36	-2.35
22	2014 (MR)	-0.32	-0.55	-3.26	-3.81 **	-4.13
20	2015 (MR)	2.74	-9.53 *	-0.83	-10.36	-7.62
26	2016 (MR)	-2.19	0.79	1.01	1.80	-0.38
21	2017 (MR)	0.47	-1.04	0.81	-0.23	0.24
34	2018 (MR)	-8.66 ***	1.08	-1.75	-0.67	-9.34 ***
21	2019 (MR)	-8.57 ***	0.84	-1.05	-0.22	-8.79 ***
45	2020 (MR)	-1.90	-2.30	-2.52	-4.81 **	-6.71 **
34	2021 (MR)	-8.16 ***	-1.37	-1.91	-3.27 *	-11.43 ***
31	2022 (MR)	-12.58 ***	-4.88 ***	1.32	-3.56	-16.14 ***

5.5 Limitations

There are multiple limitations on this thesis stemming from the data and methodology that need to be acknowledged in order to reach the correct conclusions. First, as noted in the data section of this thesis, the data used seems to lose quality sequentially when traveling back in time beyond 2015 as there is a mismatch between additions and deletions in the sample, which should not be possible in a fixed constituent index. Conducting this study again with a perfectly balanced dataset could lead to more definitive answers on the asymmetry and magnitude of the index effect since every index deletion would have a matching inclusion counterpart and a study using pairing of matching companies could be done. Also, the sample size could be made larger by including non-scheduled reconstitutions, potentially improving reliability, but since non-scheduled changes have a non-standard number of trading days between the announcement and the execution, the inclusion of these events could impose more noise on the results.

The event study method and linked variables used also impose limitations on the interpretation of the results. The various event windows used in previous literature might all carry out different results, potentially steering toward different conclusions. The event windows of this study are selected to cover as many points of interest as possible, but due to the seemingly unstable nature of the results, potentially due to market conditions or the evolution of trading behavior, divergent results could be obtained using different event windows. Furthermore, the model used to estimate abnormal returns, the market model, might lead to biased results due to the simplicity of the model itself or alternatively, based on the estimation period of market variables. Obviously, more sophisticated models could be used to estimate normal returns of the stocks, but the added value of this could be limited. This thesis does not aim to dissect the link between market conditions or company, country or trading infrastructure-specific factors that might influence the index effect in the target index, since the study is designed to examine baseline results of the existence and evolution of the index effect in the target index. Delving deeper into the micro-level deviations in the effect would definitely be a great target for future studies.

This thesis does not evaluate whether the sample companies are subject to any economic or index events external to the company and the target index themselves. This means that the companies could have been added to a different index at the same time either in the cascading index universe utilized by STOXX or by another indexing company altogether. Screening for these kinds of factors would make the obtained results more specific but gathering data of all indexes a company might have been involved over a long period of time is difficult, if not impossible.

5.6 Discussion of the results

The empirical results of this study exhibited the nature of the volume and price effects encountered around index reconstitution events. The first research question was formed to analyze the additional or decreased volume for index inclusions and exclusions respectively. The connected hypotheses H1, H2, and H3 were examined in section 5.1 of this thesis and H1 receives full support from the empirical evidence as the trading levels of both directions in the index reviews are elevated between the AD and the ED, suggesting pre-emptive rebalancing of portfolios before the index constitution becomes official. Moreover, the abnormal volume surfaces already before the announcement day, suggesting anticipation over the future index review outcome, but the increase in volume is more substantial and consistent after the information has been published. Research Hypothesis H2 is supported only for additions, as the trading volumes of included stocks rise significantly from their historical levels. By contrast, trading volumes of deleted stocks do not decline below their historical level, but instead, the stocks, revert to trade in line with their historical average in terms of trading volume. Combined with the spike found in trading activity, supporting hypothesis H3 of this paper, the results are in line with earlier literature (Mase, 2007; Fernandes and Mergulhão, 2016) who all report increased volume before the announcement date and in the run-up period. Furthermore, the spike in trading volume on the day before the event is reported by the previously mentioned authors as well as by Lynch and Mendenhall (1997) and Kappou, Brooks and Ward (2010), the reasoning behind the results being jointly credited to fund rebalances.

The second research question of this thesis focused on the price effects around the announcement date and the effective date of index reconstitutions, among the linked hypotheses, H4 and H6 were fully supported, while H5 received a partial support. The strongest abnormal returns (losses) were encountered for additions (deletions) before the announcement date, both on the short and medium-to-long-term event windows. The results are closest to those presented by Biktimirov and Xu (2019a) as they reported a CAAR of 9.4% from 30 days before, until one day before the announcement date for additions in the Nasdaq 100, whereas this thesis found a CAAR of 5.4% for the period starting 20 days before the announcement date in the STOXX Europe 600. For deletions, the results are also similar, as Biktimirov and Xu (2019a) found a significant negative CAAR of -4.9% for the 30-day period, and this thesis found a negative, significant CAAR of -1,9% for the 21-day period. Similar anticipatory effects have been reported earlier for example by Bechmann (2004) and Mase 2007. The obtained result is difficult to credit to one single hypothesis since selection criteria might play a significant role in a strictly rule-based index, such as the STOXX Europe 600. Moreover, the effect cannot be disseminated without analysis of the selection list and its development near the index review, although even then explicit separation might prove to be difficult.

Particularly puzzling is the partial rejection of H5, as the abnormal returns generally behave as expected prior to the effective date as there are significant abnormal returns (losses) for additions (deletions) on the days until ED -2, but on ED -1, the price effects are reversed contradicting the earlier literature. E.g., see. Lynch and Mendenhall (1997), Mase (2007), Kappou, Brooks and Ward (2010), Kappou (2018), Biktimirov and Xu (2019a). It is noteworthy that when comparing the results of this thesis to earlier studies, some authors denote what is considered ED -1 in this thesis as ED due to index methodology differences. However, in this thesis in the case of the additions, the ED -1 and ED abnormal returns effectively cancel out each other nearly perfectly, while for deletions, the unexpected uptick in abnormal returns on ED -1 is not reversed on the next day. This finding is most likely explained by arbitrageurs, who then close their positions of anticipated upward (or downward) price movement before the new index composition is realized. As per the results of this thesis, specifically in the STOXX Europe 600 index, the anticipatory trades have had to be opened before the announcement date to gain profit from the anomaly, since the run-up period does exhibit negative, but insignificant price movement in the sample.

The particularly hot topic of index effect studies is the permanency of the price effects. First, the term “permanent” is not clearly defined and the previous literature has studied permanency over horizons of just two weeks up to one year's worth of trading days (Beneish and Whaley, 1996; Kappou, 2018). While expanding the horizon to months or even to a year after the effective date might seem intriguing, it brings forth issues of its own. Specifically, for the STOXX Europe 600, due to its index review being conducted once every three months, the expansion of the window to anywhere between one to two months after the effective date poses risks of the company being deleted from (or being readded to) the index already in the next review, thus potentially falling under the influence of another economic event. Therefore, the full period price increase of 6.9% for additions and the decrease of 3.5% is considered permanent in this thesis, as the results span 20 trading days, or nearly one month after the effective date, covering roughly a third of the minimum scheduled index membership time. The results in this thesis support the hypothesis H6 of permanent price increase (decrease) for index inclusions (exclusions). The argument is further fortified by the fact that the inclusions do not show any signs of price reversal after the effective date, as the CAAR increases further after inclusion, whereas the deletions mirror the additions, showing a continuous downward price drift after exclusion.

The third and last research question was formed to analyze the yearly development of the price effect. The linked hypothesis H7 is rejected by the empirical results, as the results do not show a clear decline in the magnitude of the index effect. Quite contrary, the price effects seem to have only surfaced consistently in and after 2018 in the examined period. Nevertheless, the substantially stronger index effect around the financial crisis is consistent with Renshaw's (2020) findings in the S&P 500 and S&P 1500 indices. The yearly evaluation further sheds light on why dissimilar results can be obtained even for the same index, since conducting this study on a shorter examination period between 2010 and 2017 would certainly lead to insignificant results, whereas using only post-2018 data would expand the magnitude of the abnormal returns substantially. Biktimrov & Xu (2019b) note the significance of the Great Depression and the growth of index funds as major factors affecting the results over a nearly 100-year examination period, but as this thesis has presented, the variability in results can be substantially more frequent, taking place over years rather than decades.

Overall, the empirical results in this thesis mostly support either the liquidity hypothesis or the investor awareness hypothesis due to permanent asymmetrical results. The price pressure hypothesis is rejected due to the permanent price effect and the downward-sloping demand curve cannot be fully supported due to the found asymmetry. Information signaling hypothesis shares similar characteristics with the supported hypotheses price and volume-wise, but due to the rule-based, transparent methodology of the target index, it can be mostly disregarded, as the investor awareness hypothesis is a better fit. However, the selection criteria hypothesis is one, if not the most suitable explanation the obtained results, as most of the abnormal price movement is encountered well before the index review results are announced, and the price level is mostly retained for the remainder of the examination period. The results lend strong support for the selection criteria hypothesis, as the specific effect of it cannot be separated from the other two supported hypotheses.

6 Conclusion

This thesis examines the index reconstitution event-induced volume- and price effects over the period of 2007-2022 in the Pan-European STOXX Europe 600 index. The effects of both additions and deletions are analyzed around the announcement date and the actual implementation of the new index constitution. Short- and long-term event windows are employed to establish the nature of the effect in the target index as well as in order to determine whether the observed effects are transitionary or permanent. The sample includes 413 additions and 417 deletions. The thesis relies on the event study methodology, replicating model choices and event windows of earlier studies to improve comparability. The robustness of the results is analyzed by using two different models to measure the expected normal return of the stocks: the market model and the market-adjusted return. The results obtained using either of the methods closely resemble each other, suggesting that the model selection should not dramatically change the overall results or their interpretation.

The first research question *"Does trading volume increase (decrease) when stock inclusion (exclusion) in an index is being announced or executed?"* and the linked hypotheses are examined in the first section of the empirical part of this thesis. To answer the question, the trading volume is significantly above the historical level in both additions and deletions on most days starting as early as 20 trading days before the announcement date. In the run-up period, the trading volume is continuously elevated for both directions, and significant volume spikes of 2.69x and 1.73x compared to the historical average level for additions and deletions can be observed on the last day before the implementation respectively. After implementation, the additions' volume stays elevated during the full post-event period, but deletions only revert to their historical level. The results closely parallel the investor awareness hypothesis, as the index membership might introduce the companies to some investors, but existing owners do not forget the deleted companies.

Regarding the second research question *"Do stocks exhibit abnormal returns (losses) around the announcement or execution of index addition (deletion) or in the periods prior or subsequent to these events?"*, it can be concluded that the most significant abnormal returns are generated before the announcement date of index inclusion or exclusion. The observed effect is most likely a cause of anticipatory trading to some extent, but due to the rule-based methodology of the target index, the exact intensity of the trading cannot be determined based on the observed evidence. It is extremely likely, that the observed abnormal returns stem from other company-related information than index inclusion or exclusion, and without such a development, the companies might not have been added to (or deleted from) the index in the first place, thus inverting the causal relationship of index reconstitutions and abnormal returns. However, combined with the increased continuous trading volume before the announcement, the results suggest that some anticipatory trading is present, especially when the exclusions revert exactly to the historical volume after implementation. Thus, the evidence points to a mixture of selection criteria hypothesis and anticipatory trading, most likely by arbitrageurs and fund managers, although with opposing agendas.

The final research question *"How have the price effects varied over the years?"* proved to unlock more insights from the index effect than originally anticipated. First, the evidence on the yearly development contradicts earlier research conducted using data from S&P 500 index. In STOXX Europe 600, the most prominent abnormal price movements have occurred in and after 2018, although during these years, the pre-announcement period abnormal returns are clearly the highest, which could be explained by high market volatility or bullish market state during these years. Moreover, the yearly analysis showed the instability of the index effect. Especially during the recovery from the financial crisis, the abnormal returns are themselves extremely different from the other years, as in 2009 both additions and deletions gained over 15% in terms of CAAR over the full event period, and the timing of pre-review abnormal returns led to the final index compositions in that year. It is too early to conclude whether the index effect has surfaced permanently in the target index, especially when the 2022 full event period returns are no longer significant for the additions. Therefore, it can be concluded that the index effect in the STOXX Europe 600 index is unstable and subject to market conditions. Connecting the dots between the specific macroeconomic or technical trading factors with the intensity and direction of the index effect could be an interesting task for future research to take on.

Table 9 shows a summary of the research hypotheses and the empirical evidence gathered in this thesis. While the rejection of H5 during the run-up period is not particularly surprising due to the rule-based indexing, the inverted abnormal returns on ED -1 certainly are. For future research, it would be interesting to delve deeper into the actions conducted by fund managers and other market participants around index reconstitutions to understand the observed market movements at a deeper level. In addition, an analysis of the abnormal returns in the index selection list from the standpoint of "nearly in" and "nearly out" could help disseminate the difference between the selection criteria hypothesis and anticipatory trading.

Table 9. Summary of research hypotheses and empirical support

Research hypothesis	Empirical support
H1: The trading volume of a stock being included or excluded is on a higher level between the announcement date and the effective date of the index reconstitution	**Supported.** The MVR in the case of both deletions and additions is significantly above the historical level between AD and ED.
H2: The trading volume of an included (excluded) stock is permanently higher (lower) than the historical average after official index inclusion (exclusion)	**Supported for additions only.** Additions exhibit a significant rise in traded volume after inclusion, but deletions only revert to the historical level, not below.
H3: There is a significant spike in trading volume a day prior to the official index inclusion or exclusion	**Supported.** On ED -1, additions experience an MVR of 2.69x*** and deletions of 1.73x***.
H4: The included (excluded) stocks exhibit abnormal returns (losses) prior to the announcement date	**Supported for additions and deletions in both short- and long-term windows.** CAAR of 5.4%*** for additions and -1.9%*** for deletions in the pre-announcement period.
H5: The included (excluded) stocks exhibit abnormal returns (losses) prior to the effective date	**Rejected for additions and deletions in both short- and long-term windows.** The run-up period returns are slightly negative but insignificant for both directions. The ED -1 returns are inverted versus the hypothesis.
H6: The price of the included (excluded) stocks will remain at a permanently higher (lower) level after inclusion (exclusion)	**Supported.** Additions full period CAAR is 6.9%***, while deletions CAAR is -3.5%***. After implementation CAAR for additions is 2.1%***, deletions -1.1%.
H7: The magnitude of the price effects has lessened over time	**Rejected.** Price effects are greater in magnitude and more significant during the most recent years of the sample from 2018 onwards. The effect seems to vary greatly yearly, especially around economic distress periods.

It seems more than fitting, that the conclusions of this thesis, which has revolved around index funds, borrow one key point from Key Investor Information Documents for investment funds, as nearly every KIID published contains the following statement in some format: *"past performance is not necessarily a guide to future performance"*. Due to the demonstrably unstable nature of the index effect over time, the same principle should be applied to the index effect as well, as without a time machine, no abnormal return can be deemed certain.

References

Afego, P.N., 2017. Effects of changes in stock index compositions: A literature survey. *International Review of Financial Analysis,* 52, 228-239.

Bechmann, K.L., 2004. Price and Volume Effects Associated with Changes in the Danish Blue-Chip Index: The KFX Index. *Multinational Finance Journal,* 8 (1/2), 3-34.

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

Bernard, V.L. and Thomas, J.K., 1990. Evidence that stock prices do not fully reflect the implications of current earnings for future earnings. *Journal of Accounting and Economics,* 13 (4), 305-340.

Biktimirov, E.N. and Xu, Y., 2019a. Asymmetric stock price and investor awareness reactions to changes in the Nasdaq 100 index. *Journal of Asset Management,* 20 (2), 134-145.

Biktimirov, E.N. and Xu, Y., 2019b. Market reactions to changes in the Dow Jones industrial average index. *International Journal of Managerial Finance,* 15 (5), 792-812.

BlackRock, 2021. *Equity index rebalances.* [online] Available at: https://www.blackrock.com/au/intermediaries/ishares/equity-index-rebalances [Accessed: 27.12.2022].

Blume, M.E. and Edelen, R.M., 2004. S&P 500 indexers, tracking error, and liquidity: a complex answer to profiting. *Journal of Portfolio Management,* 30 (3), 37.

Chan, K., Kot, H.W. and Tang, G.Y.N., 2013. A comprehensive long-term analysis of S&P 500 index additions and deletions. *Journal of Banking & Finance,* 37 (12), 4920-4930.

Chen, H., Noronha, G. and Singal, V., 2004. The Price Response to S&P 500 Index Additions and Deletions: Evidence of Asymmetry and a New Explanation. *The Journal of Finance (New York),* 59 (4), 1901-1930.

Chen, H., Noronha, G. and Singal, V., 2006. Index Changes and Losses to Index Fund Investors. *Financial Analysts Journal,* 62 (4), 31-47.

Chen, Y., Kelly, B. and Wu, W., 2020. Sophisticated investors and market efficiency: Evidence from a natural experiment. *Journal of Financial Economics,* 138 (2), 316-341.

Chordia, T., Roll, R. and Subrahmanyam, A., 2008. Liquidity and market efficiency. *Journal of Financial Economics,* 87 (2), 249-268.

Chung, D.Y. and Hrazdil, K., 2010. Liquidity and market efficiency: Analysis of NASDAQ firms. *Global finance journal,* 21 (3), 262-274.

Chung, K.H., McInish, T.H., Wood, R.A. and Wyhowski, D.J., 1995. Production of information, information asymmetry, and the bid-ask spread: Empirical evidence from analysts' forecasts. *Journal of banking & finance,* 19 (6), 1025-1046.

Denis, D.K., McConnell, J.J., Ovtchinnikov, A.V. and Yu, Y., 2003. S&P 500 Index Additions and Earnings Expectations. *The Journal of Finance (New York),* 58 (5), 1821-1840.

Evans, R., Moussawi, R., Pagano, M. and Sedunov, J., 2017. ETF Short Interest and Failures-to-Deliver: Naked Short-Selling or Operational Shorting? *SSRN Electronic Journal,* [e-journal] 10.2139/ssrn.2961954.

Fama, E.F., 1970. EFFICIENT CAPITAL MARKETS: A REVIEW OF THEORY AND EMPIRICAL WORK. *The Journal of Finance (New York),* 25 (2), 383-417.

Fernandes, M. and Mergulhão, J., 2016. Anticipatory effects in the FTSE 100 index revisions. *Journal of Empirical Finance,* 37, 79-90.

Glow, D., 2022. *EUROPEAN ETF INDUSTRY REVIEW: 2021.* [online] Available at: https://lipperalpha.refinitiv.com/reports/2022/03/monday-morning-memo-review-of-the-european-etf-market-2021-2/
[Accessed: 30.12.2022]

Gowri Shankar, S. and Miller, J.M., 2006. Market Reaction to Changes in the S&P SmallCap 600 Index. *The Financial Review (Buffalo, N.Y.),* 41 (3), 339-360.

Gregoriou, A. and Ioannidis, C., 2006. Information costs and liquidity effects from changes in the FTSE 100 list. *The European Journal of Finance,* 12 (4), 347-360.

Harris, L. and Gurel, E., 1986. Price and Volume Effects Associated with Changes in the S&P 500 List: New Evidence for the Existence of Price Pressures. *The Journal of Finance (New York),* 41 (4), 815-829.

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

Investment Company Institute, 2022. *2021 Investment Company Fact Book. Available at:* https://www.ici.org/system/files/2021-05/2021_factbook.pdf
[Accessed: 11.10.2022].

Jain, P.C., 1987. The Effect on Stock Price of Inclusion in or Exclusion from the S&P 500. *Financial Analysts Journal,* 43 (1), 58-65.

Johnson, S., 2022. *Passive fund ownership of US stocks overtakes active for first time.* [online] Available at: https://www.ft.com/content/27b5e047-5080-4ebb-b02a-0bf4a3b9bc08 [Accessed: 22.2.2023].

Kappou, K., 2018. The diminished effect of index rebalances. *Journal of Asset Management,* 19 (4), 235-244.

Kappou, K., Brooks, C. and Ward, C., 2010. The S&P500 index effect reconsidered: Evidence from overnight and intraday stock price performance and volume. *Journal of Banking & Finance,* 34 (1), 116-126.

Li, K., 2020. Does Information Asymmetry Impede Market Efficiency? Evidence from Analyst Coverage. *Journal of Banking & Finance,* 118, 105856.

Liu, S., 2000. Changes in the Nikkei 500: New Evidence for Downward Sloping Demand Curves for Stocks. *International Review of Finance,* 1 (4), 245-267.

Liu, S., 2006. The impacts of index rebalancing and their implications: Some new evidence from Japan. *Journal of International Financial Markets, Institutions & Money,* 16 (3), 246-269.

Lynch, A.W. and Mendenhall, R.R., 1997. New Evidence on Stock Price Effects Associated with Changes in the S&P 500 Index. *The Journal of Business (Chicago),* 70 (3)

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

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

Merton, R.C., 1987. A Simple Model of Capital Market Equilibrium with Incomplete Information. *The Journal of Finance (New York),* 42 (3), 483-510.

Petajisto, A., 2008. Selection of an optimal index rule for an index fund. *Available at SSRN 1264698,* [e-journal].

Qontiqo, 2022. *STOXX Index Methodology Guide.* [online] Available at: https://www.stoxx.com/document/Indices/Common/Indexguide/stoxx_index_guide.pdf [Accessed: 11.10.2022].

Renshaw, A.A., 2020. The Weakening Index Effect. *Journal of Index Investing,* 11 (1), 17-31.

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

Shleifer, A., 1986. Do Demand Curves for Stocks Slope Down? *The Journal of Finance (New York),* 41 (3), 579-590.

Strub, O. and Baumann, P., 2018. Optimal construction and rebalancing of index-tracking portfolios. *European Journal of Operational Research,* 264 (1), 370-387.

Thomson Reuters, 2022. *Refinitiv Eikon*. [Database] Available at: https://eikon.thomsonreuters.com/index.html [Accessed: 11.11.2022]

Wilkens, S. and Wimschulte, J., 2005. Price and Volume Effects Associated with 2003's Major Reorganization of German Stock Indices. *Financial Markets and Portfolio Management,* 19 (1), 61-98.

Appendix

Appendix 1. Daily Mean Volume Ratio (MVR) around the AD

DAY	Additions (n=413) Volume Ratio		Deletions (n=417) Volume Ratio	
AD -20	1.00		1.06	**
AD -19	1.06	*	1.08	**
AD -18	1.03		1.07	*
AD -17	1.03		1.01	
AD -16	1.08	**	1.08	***
AD -15	0.98		1.08	***
AD -14	1.09	**	1.08	***
AD -13	1.05	*	1.03	
AD -12	1.14	**	1.08	**
AD -11	1.08	**	1.09	***
AD -10	1.10	**	1.04	
AD -9	1.03		1.05	*
AD -8	1.05	*	1.04	
AD -7	0.99		1.06	
AD -6	1.07	**	1.13	***
AD -5	1.23	***	1.20	***
AD -4	1.10	**	1.11	***
AD -3	1.12	**	1.16	***
AD -2	1.02		1.07	**
AD -1	1.14	***	1.10	**
AD	1.27	***	1.16	***
AD +1	1.22	***	1.20	***
AD +2	1.17	***	1.16	***
AD +3	1.14	***	1.28	***
AD +4	1.13	***	1.10	***
AD +5	1.11	***	1.12	***
AD +6	1.09	**	1.14	***
AD +7	1.09	***	1.09	**
AD +8	1.04		1.13	***
AD +9	1.22	**	1.22	***
AD +10	1.13	***	1.13	***
AD +11	1.28	***	1.22	***
AD +12	1.21	***	1.20	***
AD +13	1.42	***	1.22	***
AD +14	1.51	***	1.33	***
AD +15	1.25	***	1.23	***
AD +16	1.19	***	1.14	***
AD +17	1.20	***	1.10	***
AD +18	1.99	***	1.39	***
AD +19	1.30	***	1.14	***
AD +20	1.24	***	1.07	**

Appendix 2. Daily Mean Volume Ratio (MVR) around the ED

DAY	Additions (n=413) Volume Ratio		Deletions (n=417) Volume Ratio	
ED -20	1.22	***	1.20	***
ED -19	1.25	***	1.19	***
ED -18	1.16	***	1.13	***
ED -17	1.13	**	1.12	***
ED -16	1.11	**	1.26	***
ED -15	1.32	***	1.23	***
ED -14	1.14	***	1.12	***
ED -13	1.12	***	1.12	***
ED -12	1.10	***	1.18	***
ED -11	1.09	***	1.13	***
ED -10	1.17	*	1.18	***
ED -9	1.10	***	1.11	***
ED -8	1.14	**	1.16	***
ED -7	1.07	**	1.13	***
ED -6	1.08	**	1.08	***
ED -5	1.10	***	1.10	***
ED -4	1.15	**	1.08	***
ED -3	1.14	***	1.19	***
ED -2	1.22	***	1.19	***
ED -1	2.69	***	1.73	***
ED	1.52	***	1.42	***
ED +1	1.34	***	1.25	***
ED +2	1.25	***	1.06	*
ED +3	1.32	***	1.02	
ED +4	1.18	***	0.95	
ED +5	1.21	***	1.02	
ED +6	1.17	***	0.99	
ED +7	1.18	***	1.03	
ED +8	1.26	***	0.99	
ED +9	1.24	***	1.00	
ED +10	1.27	***	1.01	
ED +11	1.22	***	0.94	
ED +12	1.22	***	0.98	
ED +13	1.20	***	0.96	
ED +14	1.33	***	0.92	
ED +15	1.36	***	1.00	
ED +16	1.28	***	0.97	
ED +17	1.27	***	0.99	
ED +18	1.32	***	0.98	
ED +19	1.28	***	0.96	
ED +20	1.29	***	1.02	

Appendix 3. Daily Average Abnormal Returns (AAR) around the AD

DAY	Additions (n=413) AAR (%)		Deletions (n=417) AAR (%)	
AD -20	0.227	*	-0.552	***
AD -19	0.342	**	-0.453	*
AD -18	0.446	***	0.013	
AD -17	0.228	**	0.027	
AD -16	0.342	***	0.281	*
AD -15	0.149		0.509	**
AD -14	0.091		0.228	
AD -13	0.444	***	-0.146	
AD -12	-0.082		-0.286	**
AD -11	0.099		0.021	
AD -10	0.180	*	-0.644	***
AD -9	0.458	***	-0.453	**
AD -8	0.181	*	-0.115	
AD -7	0.165	**	-0.046	
AD -6	0.186	**	-0.284	*
AD -5	0.353	***	-0.394	***
AD -4	0.213	**	0.050	
AD -3	0.026		-0.150	
AD -2	0.179	**	-0.082	
AD -1	0.511	***	-0.125	
AD	0.116		-0.243	
AD +1	0.097		-0.075	
AD +2	-0.188	*	0.086	
AD +3	-0.039		-0.388	***
AD +4	-0.070		-0.043	
AD +5	0.085		-0.199	
AD +6	-0.120		0.099	
AD +7	0.189	*	-0.069	
AD +8	0.306	***	-0.338	*
AD +9	-0.231	**	-0.015	
AD +10	-0.170		-0.165	
AD +11	-0.460	***	0.542	***
AD +12	0.005		0.193	
AD +13	-0.014		-0.108	
AD +14	0.089		-0.267	
AD +15	0.239	**	-0.044	
AD +16	0.017		-0.210	
AD +17	-0.109		-0.220	
AD +18	-0.205	*	-0.109	
AD +19	0.012		0.182	
AD +20	-0.118		-0.089	

Appendix 4. Daily Average Abnormal Returns (AAR) around the ED

DAY	Additions (n=413) AAR (%)		Deletions (n=417) AAR (%)	
ED -20	0.245	***	-0.248	
ED -19	0.064		0.088	
ED -18	0.282	***	-0.255	*
ED -17	0.212	**	0.029	
ED -16	0.300	***	-0.310	**
ED -15	0.141		-0.205	
ED -14	0.312	***	0.001	
ED -13	-0.067		-0.031	
ED -12	0.083		-0.386	**
ED -11	-0.131		0.395	**
ED -10	-0.125		0.049	
ED -9	-0.016		-0.150	
ED -8	-0.212	*	0.304	
ED -7	0.241	*	-0.437	***
ED -6	-0.122		0.096	
ED -5	-0.029		-0.428	***
ED -4	-0.200		-0.115	
ED -3	-0.169		-0.342	**
ED -2	-0.166		-0.180	
ED -1	-0.427	***	0.326	*
ED	0.458	***	0.064	
ED +1	0.008		-0.240	
ED +2	0.130		-0.225	
ED +3	0.052		-0.410	***
ED +4	0.043		-0.029	
ED +5	-0.040		-0.068	
ED +6	0.115		-0.093	
ED +7	-0.044		-0.332	**
ED +8	0.127		-0.130	
ED +9	-0.030		0.379	**
ED +10	0.069		0.005	
ED +11	0.159		0.008	
ED +12	-0.096		-0.112	
ED +13	0.037		0.149	
ED +14	0.033		-0.396	***
ED +15	-0.146		-0.291	**
ED +16	0.079		-0.312	**
ED +17	0.149		-0.172	
ED +18	0.129		0.124	
ED +19	-0.090		-0.079	
ED +20	0.131		-0.070	