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The Good, the Bad and the Insignificant

A study of the price and volume reactions related to the index revisions on the Euronext markets

Mirjam Malahhov* and Ivika Jäger**

Supervisor: Magnus Dahlquist

Abstract

While the Efficient Market Hypothesis infers that the mere inclusion of a company to an index or exclusion from it should have no effect on the company's market valuation, significant effects have been discovered on various markets. Yet, no unified explanation for the index effects prevails even for the studies conducted on the same markets and an increasing amount of competing hypotheses are proposed to explain the phenomenon. This thesis investigates the price and volume effects related to the revisions of the Euronext market indices N100, AEX, BEL20, CAC40 and PSI20 during the period 2000-2011. The dummy variable approach to event study is used to estimate the price effects and the Mean Volume Ratios (MVR) approximate the changes in the trading volumes. We discover significant anticipatory trading prior to the effective inclusion that reverses during the following weeks both in terms of price and volume. The exclusion effects are more mixed, differing greatly between the markets and remaining mostly insignificant. The CAC40 inclusions and exclusions are found to behave in the opposite way to what is expected on the effective day of the reconstitution and N100 is the only index to produce significant permanent price effects for the stocks added to the index. We conclude with partial support for the Price Pressure Hypothesis and evidence against the Information Content Hypothesis on the investigated markets.

* 40155@student.hhs.se

** 40154@student.hhs.se

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1. Introduction

Since 1884 when Charles Dow created the Dow Jones Transportation Average index (Johnson, 2008), indexing has become an integral part of every stock market as it gives investors a benchmark for the entire market in addition to each individual listed stock. Similarly, since the launch of the first index mutual fund Vanguard 500 in 1976, the passive investment strategy of buying and holding the market portfolio has attracted a lot of capital and the index funds keep gaining market share from actively managed funds in the US (Morningstar, 2011). The index funds are popular among investors especially because they are able to gain easy access to a foreign market by investing in the index stocks without having to learn much about the market and individual stocks. Furthermore, the passive investment strategies often generate above average returns as the high fees in actively managed funds reduce the potentially higher returns (Morningstar, 2011).

It has become apparent that including firms into and removing them from an index impacts the investor behaviour towards the respective stocks which may translate into changes in the prices and trading volume. The behaviour of one of the major investor groups, the index fund managers, is known and expected as they mimic the index performance by including the same composition of stocks into their portfolio. Subsequently, arbitrageurs have found an opportunity to speculate the market and make money out of the index reconstitution events – the strategy termed the "S&P game" by Beneish and Whaley (1996) which entails buying the to-be-included stock when the index revision is announced and selling it when the prices have increased. Especially close to the effective date there is high demand for the stock from index funds who aim to minimise their tracking error, this drives up the price and the arbitrageur can sell the stock at a premium while providing liquidity to the market (Brooks et al., 2004).

However, the arbitrageurs do not correct the market reaction fully because the strategy is not risk-free for them due to the limits to arbitrage which means that even if a positive return should be safe from the theoretical point of view, there are still risks involved. In the case of index revisions, the rational traders (arbitrageurs) face fundamental risk from having no perfect substitutes to hedge their positions and noise trader risk from the unpredictable behaviour of the irrational traders. Thus, it is important to understand what the underlying factors for the index effects are in order to make sense of the markets and the investor behaviour.

There is vast amount of evidence from various markets which prove that an index revision impacts the trading volume and the returns of the respective stocks. However, the magnitude and persistence of the effects as well as the explanations for them have remained ambiguous and inconsistent. The explanations for the effects range from temporary market pressure coming from funds' repositioning activities to permanent changes in the stock's value from newly discovered information and no single explanation prevails as the researchers still report mixed evidence in favour as well as against each of them. The discrepancies in results between numerous research papers are due to varying sample periods and markets, but also a result of using different measures for the returns and volumes and defining differently what is considered to be short and long term.

The majority of previous research uses the US data to explain the effects on the stock markets around the index revisions while an increasing amount of papers aim to add to the topic by presenting evidence from the international markets. Looking at the other markets which differ in their revision rules and market structures may reveal additional information to the proposed explanations. This thesis adds to the current body of literature by investigating the subject on the Euronext European stocks markets that have found very little coverage by scholars thus far. Furthermore, of all the previous research we found on these markets, only one had looked at volume effects and only two had investigated the price effects, which means that in most of those markets either no research exists, or the research is so scarce that no consensus regarding the existence and size of the effects has been established.

NYSE Euronext is the largest stock exchange in continental Europe with a total market capitalisation of 1,958 billion EUR which is nearly twice the size of the second largest Deutsche Börse (Federation of European Securities Exchanges, 2012). Such an important market is of interest especially to overseas investors who wish to gain exposure to the European market. Moreover, the stock exchanges of Belgium, the Netherlands, Portugal and France with the local market indices combined under the same regulatory and organizational system provides a great setting for comparing the effects between the different countries as well as between the countries and the wider region (NYSE Euronext, 2012a).

On one hand, the effects should be similar in the 4 markets because the indices are almost identical in terms of various characteristics, such as the composition and revision rules as well as the timing of the index revisions. On the other hand, the countries are quite different culturally and economically, which is why investors have different attitude towards them. For example, investors may see Portugal as a riskier region to invest in than France. Thus, looking at the Euronext system as a whole makes it possible to contrast the index effects and reveal the differences between the markets. Furthermore, since the country indices differ greatly in the size of the constituent companies, we may be able to infer how the effects differ between large and small companies when comparing the index effects for indices with smaller and larger constituents.

This thesis investigates the stock return and trading volume effects accompanying the index revisions of the Euronext European indices (N100, BEL20, AEX, PSI20 and CAC40) around the day when the change becomes into effect over the period 2000-2011. We have focused on the effective day (ED) because the revision rules are publicly available and based on quantifiable measures. This means that the index revisions should not convey any new information to the markets and the effects on the announcement day (AD) should be negligible. Of course we verify this assumption by conducting the same analysis using AD as the event; we simply do not present all the results regarding the effects around the announcement of the index revision outcome. We will look at the differences between the inclusions and the exclusions and aim to identify whether the effects are present, how large they are and which explanations posed by previous scholars are supported by the data.

The paper is structured as follows. Chapter 2 gives an overview of the Euronext indices, and chapter 3 covers the theoretical background regarding the explanations to the index effects. Chapter 4 follows with reviewing the previous literature on the subject and chapter 5 describes the data and the methodology. The hypotheses about the expected results are introduced in chapter 6 and chapter 7 presents the empirical results for the price and volume effects as well as the robustness checks. The results are further discussed in chapter 8 together with limitations to the research and suggestions for further research. Chapter 9 concludes.

2. Background

The following section presents an overview of the 5 Euronext indices investigated in this paper. Over our research period of 2000-2011, the indices portray very similar price behaviour (Appendix 1) indicating high interconnectedness. Table 1 summarises the main characteristics and the main principles of composition and reconstitution of the indices. In this section we present the current rules for the indices, however, it must be noted that the rules for the indices have changed over time. For example, for a long time most of the indices were reviewed only annually and the quarterly reviews were introduced to AEX, BEL20 and PSI20 as recently as in 2010 (NYSE Euronext, 2010).

Table 1. Index characteristics. Source: NYSE Euronext.

Index	Country	Time of launch	Number of constituents	Review frequency	Main revision criteria
N100	-	Dec 31, 1999	100	Semi-annual	Ranking: based on market capitalisation Conditions: listing on the main market of Euronext, 12-month velocity of at least 20%
AEX	Netherlands	Jan 1, 1983	25	Quarterly	Ranking: based on the value of regulated turnover Conditions: listing or significant assets / employees / HQ in Netherlands, trading velocity >=10%, free float >=25%
BEL20	Belgium	Dec 30,1990	20	Quarterly	Ranking: based on market capitalisation Conditions: listing or significant assets / employees / HQ in Belgium, free-float market capitalisation >BEL20*300,000
CAC40	France	Dec 31, 1987	40	Quarterly	Ranking: based on free float-adjusted market capitalisation and regulated turnover Conditions: listing or significant assets / employees / HQ in
PSI20	Portugal	Dec 30, 1992	20	Quarterly	Ranking: based on the value of regulated turnover Conditions: listing or significant assets / employees / HQ in France, adequate free-float

2.1. Euronext 100

The benchmark index Euronext 100 (N100) is managed and supervised by the Global Index Group of NYSE Euronext. The index was launched on December 31, 1999 with a base value of 1000. The index has 100 constituents which are chosen based on their market capitalisation, given that they fulfil the conditions of being listed on the main market of Euronext and having sufficient liquidity, 12-month velocity of 20% (i.e. the regulated trading volume over the previous 12 months should represent at least 20% of the total number of the company's shares listed on NYSE Euronext). The weightings for the individual companies in the index are not allowed to exceed (are capped at) 10% (NYSE Euronext, 2011a).

The composition of Euronext 100 is reviewed semi-annually in March and September, ranking companies that fulfil the velocity criterion based on their market capitalisation. The 90 highest-ranked companies are automatically included, whereas the remaining 10 are selected from among the companies ranked 91st to 110th and the current constituents are preferred over non-constituents (NYSE Euronext, 2011a).

2.2. Country indices

For the AEX, BEL20, CAC40 and PSI20 indices there are many common criteria. For a stock to be eligible for inclusion to any of these indices, its shares must be listed in the respective Euronext market (Amsterdam, Brussels, Paris and Lisbon, respectively) or if that is not the case, they must i) have significant presence of business assets and/or the head office and/or employ significant amount of staff in the respective country (Netherlands, Belgium, France or Portugal), or ii) have significant trading volumes on related derivative instruments in the respective Euronext market, or iii) have a history of inclusion in indices and fulfil criteria i) and/or ii). The changes to the indices will become effective after the close of the third Friday of March (for the annual review) and June, September and December (the quarterly reviews). The weighing of the constituents in each of the indices is based on the free float-adjusted market capitalisation where the free float is rounded up to the next multiple of 5%. For each of these indices, at least 2 weeks should pass between the publication of the new selection for the index and the actual change date (NYSE Euronext, 2011b). Following we present some of the differing characteristics and requirements for the indices.

AEX index

The Dutch AEX index was launched on January 1, 1983 with a base value of NLG 100. It is composed of 25 companies and the constituents to the index are chosen based on the value of the regulated turnover over 12-month period, given that they fulfil the criteria of trading velocity of at least 10%, and have at least 25% free float. Yet, it is possible to be included with a free float below 25% if the company's free float-adjusted market capitalisation is sufficient. The individual weights for the companies are capped at 15% (NYSE Euronext, 2012b).

The index is reviewed four times a year. At the annual review, 23 companies with the highest values of the regulated turnover are selected; 2 companies are selected from those ranked 24th to 27th whereas preference is given to the current constituents (AEX Index Family Rulebook, 2012). During the quarterly reviews a non-constituent may be added if their regulated turnover ranks 15th or higher in the market. In case the index consists of less than 25 stocks at the time of the review, the highest-ranked non-constituent is added to the index. If the index has more than 25 constituents, the lowest-ranked current constituents are eliminated (NYSE Euronext, 2012b).

BEL20

BEL20 was launched on December 30, 1990 with the base level of 1000 and comprises of 20 companies that are continuously traded on Euronext Brussels. The constituents to the index are chosen based on their market capitalisations given that they fulfil the requirements of having a free float market capitalisation higher than the BEL20 index multiplied by 300,000 EUR and a free-float velocity at least 35%. The current constituents should have the same indicators above BEL20*200,000 EUR and 30%, correspondingly, in order to be eligible to stay within the index (NYSE Euronext, 2011b).

During an annual review by the BEL Steering Committee, the companies that fulfil the previously listed criteria are ranked according to their market capitalisations; the companies ranking 1 to 18 are selected and the two remaining companies come from those ranked 19th-22nd with priority given to the existing constituents and the weights are capped at 12% at the annual review. In order to enter the index during a quarterly review, a non-constituent needs to have its free-float adjusted market capitalisation rank among the top 10 eligible stocks at the review date. If a constituent falls below 30 in the ranking, it is removed. If the number of constituents at the quarterly review is below 20, the highest-ranked companies are included, given that they fulfil the eligibility requirements (NYSE Euronext, 2011b).

CAC40

CAC40 is the principal index of Euronext Paris, launched on December 31, 1987 with a base value of 1000. CAC40 comprises of 40 stocks based on the ranking of the free float adjusted market capitalisation and turnover, given that they fulfil the criterion of a free-float adjusted annual trading velocity of at least 20%. The weights of the individual stocks in the index are capped at 15% (NYSE Euronext, 2012c).

CAC40 index is reviewed quarterly by Conseil Scientifique and the companies to be included in CAC40 are selected from a combination of two rankings: i) the value of Regulated Turnover observed over a 12-month period, and ii) the free-float adjusted market capitalisation on the Review Date (NYSE Euronext, 2012c).

PSI20

PSI20 is the principal index of Euronext Lisbon, comprising of the 20 most traded companies listed on the exchange, subject to some limitations. The index was launched on December 30, 1992 with a base value of 3000. The index universe for PSI20 comprises of the companies whose head office is in Portugal or whose main listing is on Euronext Lisbon, i.e. the share of volume traded on Euronext Lisbon compared to the volume of the company's stock traded on all the regulated markets which the company is listed on, must be at least 66.7%. Additionally, the companies must have an adequate free-float (NYSE Euronext, 2011c).

The index composition is reviewed annually with quarterly fast entry or replacement, if applicable. During an annual review, the 18 highest ranking companies and 2 companies from 19th to 22nd position are selected, giving preference to the current constituents. The index weights are capped at 15% at the annual review. In quarterly reviews the current constituents are removed if they rank lower than 25. Non-constituents are added if at the date of the quarterly review they rank 15th or higher; if the index temporarily consists of less than 20 companies, the highest-ranking non-constituent(s) are added at the review (NYSE Euronext, 2011c).

3. Theoretical background

According to the strongest form of the efficient market hypothesis (EMH), the stock price incorporates all of the available information about a company, both public and private information. If that were true, an inclusion to or an exclusion from an index should have no effect on the company's market valuation. The EMH in general has been set under doubt already in the early 1970s but the first evidence of significant positive price impacts from the event of including a stock to the S&P 500 index was reported by Shleifer and Harris and Gurel in 1986. Harris and Gurel (1986) argue that the price increase is short term and related to the temporary price pressure from trading while Shleifer (1986) promotes a permanent effect and attributes it to the downward-sloping long run demand curve for stocks as the shares are not perfect substitutes to the index funds. From the opposing side, the EMH has been supported by Edmister et al. (1994) and Dhillon and Johnson (1991) who claim that the observed non-reversing price effects are due to fundamental changes. All in all, the literature refuting the EMH prevails and the index effects have undoubtedly been observed and proven to be significant in various markets. However, the magnitude of the effects is extremely sensitive to the sample period and the effects for the individual companies can vary to a large extent. For example, Yahoo's share price jumped by as much as 24% on the day before being included in the S&P 500 (CNET News, 1999).

Since there is a vast amount of evidence that is not consistent with the EMH, several competing explanations have been posed in order to explain the stock price and volume behaviour around the index revisions. We address the five most commonly discussed explanations: the price pressure, the imperfect substitutes, the liquidity, the investor awareness and the information content explanations. These explanations differ in various characteristics, for example the persistence of the changes in price and trading volume and the type of information revealed in the event (Table 2).

All in all, the explanations are not necessarily mutually exclusive – they can contribute to the index effects simultaneously in differing levels. Now we describe the five prevailing explanations in more detail.

Table 2. Competing explanations to index effects. Source: compiled by authors based on previous research.

Explanation	Price effect	Volume effect	Event type	Description
Price pressure	Temporary	Temporary	Info-free	Excess demand/supply from index trackers pressures prices and volumes
Imperfect substitutes	Permanent	Temporary	Info-free	Change in effective supply creates new equilibrium
Liquidity	Permanent	Permanent	Info-free	Changes in trading frequency have an impact on trading and information costs
Investor awareness	Permanent / temporary*	-	Info-free	Impact on required return via risk reduction from greater attention
Information content	Permanent	Temporary	Info-rich	Information is conveyed to market about firm's future prospects

** Permanent for inclusions, temporary for exclusions*

3.1. Price pressure hypothesis (PPH)

The Price Pressure Hypothesis, advanced by Harris and Gurel (1986), predicates that the index revisions convey no additional information regarding the stocks and the price effects occur due to temporary changes in demand for the included and excluded stocks. As the indices are revised, the fund managers benchmarking to or tracking the index need to rebalance their portfolios, thus resulting in heavy trading around the time of the revision which makes the prices diverge from the equilibrium. The stocks to be included in the index (inclusions) are in high demand which leads to a price increase and the stocks which are to be removed from the index (exclusions) experience a decline in the price as the funds eliminate their positions and create abnormally high supply for the exclusions (Brooks et al., 2004). The effects are especially pronounced because the index funds often hold large positions in the index stocks and are concerned with the tracking error, consequently, large block trades fall into a small time frame before the actual reconstitution which magnifies the effect on the stock prices (Madhavan, 2002). Since the change in the investors' trading behaviour is temporary, PPH predicts that the trading volumes as well as the prices move back to their long run equilibrium level after the event.

3.2. Imperfect substitutes hypothesis (ISH)

The Imperfect Substitutes Hypothesis proposed by Shleifer (1986) aims to explain why the price effects for the index revisions as information free events are permanent and do not exhibit reversal in the long term. If the investors hold diversified portfolios and the stocks are perfect substitutes then the demand curves for the stocks are horizontal (perfectly elastic) and demand shocks resulting from index revisions do not affect the prices. However, if the stocks are not close substitutes then the demand curves for the stocks are downward sloping and the curves will shift to overcome the higher or lower demand for the stocks (Kumar, 2005). The shift in demand is permanent because the institutional holdings are considered to be stable which either increases or decreases the amount of shares in circulation on the market (free-float), thus, the higher price for the inclusions and the lower price for the exclusions represents a new long term equilibrium (Shleifer, 1986). The effect on the trading volume under ISH, however, is expected to be temporary (Brooks et al., 2004).

3.3. Liquidity hypothesis (LH)

Also referred to as the information cost hypothesis, the Liquidity Hypothesis formed by Amihud and Mendelson (1986) states that the price reactions to the index revisions may occur due to the impact on the trading costs from the higher or lower trading volume. The price as well as the trading volume for the inclusions is expected to increase permanently as the higher liquidity is considered an advantage for the stock (Brooks et al., 2004). It is evident that the index stocks are often more attractive to the institutional investors and the inclusion of a stock to an index leads to increased institutional interest and higher trading volume for the stock. A higher level of scrutiny in the market means that the information about the company is more easily available, thus lowering the information costs to the investors and increasing the stock's visibility. Furthermore, the increase in the trading volume is accompanied by narrowed bid-ask spreads and decreased volatility; this reduces the trading costs even more. All the before mentioned factors contribute to increasing the liquidity of the new index additions.

The reasons for why the increased liquidity boosts the stock price for the shares included into an index are several. First, the investors are willing to pay a premium for better liquidity (Kumar, 2005) because the risk is reduced by allowing them to move in and out of the positions immediately and at reasonable prices. Second, higher liquidity increases the firm value via reducing the cost of capital as the information asymmetries between the informed and the uninformed investors are lessened (Amihud and Mendelson, 1986). Third, as the expected future trading costs of the stock are capitalised into the asset price then a permanent reduction in the bid-ask spread or decreased costs for obtaining the information leads to a price increase for the stock included to an index. The exclusions are expected to have an opposite effect – a price reduction as the general trading costs increase due to diminished liquidity (Pinfold and Qiu, 2008).

3.4. Investor awareness hypothesis (IAH)

Based on Merton (1987) and empirically confirmed by Elliot et al. (2006), the Investor Awareness Hypothesis attributes the index revision effects to the greater public awareness which results in lower agency costs for an index stock as compared to a non-index stock (Mazouzand Saadouni, 2007). Considering the vast amount of stocks on the world's stock markets, it is clear that the investors are familiar only with a subset of all the available stocks which leads to the so called "shadow cost" of incomplete information (Brooks et al., 2004). When a stock is included to an index, it will inevitably become better known among the investors via greater media attention and analyst coverage as well as higher interest by the institutional investors. A higher degree of investor recognition, however, reduces the required return on the stock as some of the idiosyncratic risk related to holding a position in a less-known stock is removed when the investors gain easier and less costly access to the relevant and accurate stock information (Hrazdil and Scott, 2009).

The effect for the stocks removed from an index is not necessarily symmetric to the one for the included stocks if IAH holds. This is so because deleting a stock from an index does not mean it is deleted from the investors' awareness. Consequently, the positive effect from the reduced shadow cost in the case of the index inclusions is expected to be more pronounced than the negative effect for the exclusions. The asymmetric effect in the form of a permanent price increase for the inclusions and a temporary price decline for the exclusions has been confirmed by Chen et al. (2004).

3.5. Information content hypothesis (ICH)

Jain (1987) introduced the Information Content Hypothesis which claims that the index revision events are not information free but convey firm-specific information which has a permanent impact on the stock prices (Kumar, 2005). If the index methodology is not clearly defined, as is the case for Standard and Poor's whose decisions are based on the Index Committee discussions, then an inclusion to an index signals good news and a deletion is seen as bad news about the stocks' expected performance in the future. The market believes that the decision-makers have private information on which to base the index revisions. For example, it is known that S&P prefers firms that are stable, thus, the investors may think that the inclusion to the S&P 500 reduces the risk related to the stock (Chan and Howard, 2002). Alternatively, it may be that the inclusion to an index will make the management exert more effort as their activities are under closer scrutiny or the company will have advantages over its non-index peers when attracting new capital. Whichever way the causality goes – whether the stock is included because of the improved fundamentals or its performance improves due to being an index constituent – the price impact on the stock is expected to be permanent while the trading volume effect is temporary (Brooks et al., 2004).

Overall, the effects cannot be attributed to only one of the previously discussed explanations as there are many factors simultaneously impacting the market behaviour. This is confirmed by the vast amount of previous literature supporting each of the explanations which is presented in the next section; the support for the different hypotheses by various researchers is also summarized in Appendix 2.

4. Literature review

From the emergence of the index effects related research in 1986 up to 1997, the literature covered solely the US market (Duque and Madeira, 2005). However, since the late 90's the scope of the research regarding the index effects has expanded and indices from all over the world have been under investigation. The literature review section covers the previous research on the index effects starting with the US market and moving on to the Asian, emerging and European markets.

S&P 500 – the most researched index

The United States stock market is by far the largest in the world with a combined market capitalisation of $16.8 trillion for NYSE Euronext and NASDAQ OMX (World Federation of Exchanges, 2012). Standard & Poor's 500 index is considered to be the market equivalent for the US market and is the most followed index among the analysts and the investors alike. The wide use of the S&P 500 index combined with its long data history makes it a well-suited subject for financial research and the index remains to this day the most researched index when it comes to the price and volume effects around the index composition changes.

Already in the 1980s, Shleifer (1986) and Harris and Gurel (1986) find evidence of significant abnormal returns of about 3% for the S&P 500 inclusions. While Shleifer explains the permanent price effect with the downward sloping demand curve and the imperfect substitutes hypotheses, Harris and Gurel claim price reversal after 2 weeks consistent with the price pressure hypothesis. Goetzmann and Garry (1986) prove that the index deletion also provokes a price reaction by investigating 7 stocks removed from the S&P 500 index on November 30, 1983 which exhibited significant negative returns of 2% at the change date. The asymmetric effects for the inclusions and the exclusions for the S&P constituents are supported by Jain (1987). Jain, just as Dhillon and Johnson (1991), attributes the permanent price effects to the information content in the S&P 500 revisions. Similar results but a different explanation – the liquidity cost and price pressure hypotheses – is provided by Woolridge and Ghosh (1986) who also report a temporary increase in the trading volume.

Beneish and Whaley (1996) are the first to investigate the effects after the separation of the announcement and effective dates in the S&P 500 revisions in October, 1989. They find that the policy change has given rise to the so called S&P game as the funds do not rebalance their portfolios right after the announcement but rather wait until the effective date to minimise the tracking error. Beneish and Whaley (1996), as well as Hedge and McDermott (2003), attribute the price effects of the index revisions to changes in liquidity. Lynch and Mendenhall (1997), however, find support for the price pressure hypothesis.

Chen et al. (2004) examine the difference between the index effects for the inclusions and the exclusions and find that the price increase for the added stocks is permanent while the decline in the price of the deleted stocks is temporary and explain the result with the investor awareness hypothesis. Zhou (2011) adds to this the finding that the price increase is temporary not only for the deletions but also to the companies re-entering the S&P 500 index who are therefore already known to the investors. The loss reversal for the deletions is further verified by Dash (2002) who points out that the effect is larger for small or low valued stocks. Interestingly, Otchere and Gygax (2007) provide evidence of spill-over of the index effects to the incumbent companies in the S&P 500 index, especially the industry counterparts of the added or deleted stock as it is expected to convey information about the entire industry. Elliot et al. (2006) undertake the challenge to separate the effects for individual explanations to compare their relative contribution to the price impact and conclude that the increased investor awareness after the index inclusion is the main factor explaining the abnormal returns related to the event.

Other indices in the US market

The effects have proven to be present also in several smaller indices related to S&P. Becker-Blease and Paul (2010) verify that the additions to the S&P Small-Cap and Mid-Cap indices over the period 1996-2003 exhibit a significant increase in liquidity and investor awareness which cause a permanent impact on the share prices. However, Shankar and Miller (2006) report temporary positive abnormal returns for the new additions to the S&P Small-Cap index and temporary negative abnormal returns for the stocks transferred from the other S&P indices. The temporary price effects and the accompanying volume effects support the price pressure hypothesis. Similarly to Dash (2002), Shankar and Miller’s result show a more pronounced price effect for smaller firms.

Outside the S&P family, Beneish and Gardner (1995) study the price and volume effects in the Dow Jones Industrial Average index and find significant price decline for the exclusions, which they attribute to the information costs/liquidity.

Global indices

Biktimirov et al. (2004) investigate the Russell 2000 index and confirm the price pressure hypothesis, finding significant but transitory effects for both the additions and deletions. Further, for the deletions they discover significant abnormal trading volumes only on the event day while the additions undergo large abnormal trading also a few days before and after the reconstitution. Madhavan (2002) finds permanent changes in liquidity and temporary effect on the prices for the companies experiencing change in Russell equity indices membership, explaining it with the index funds that create temporary price pressure, high trading costs and return volatility around the reconstitution date.

Chakrabarti et al. (2005) investigate the index effects for the MSCI Standard Country Indices for 29 countries in 1998-2001, finding sharp price increase for additions from the announcement till the actual change and a sustained increase in trading volumes, whereas the deletions experience a steady price decline and no trading volume effects. The authors find considerable cross-country variation between the effects, supporting the downward-sloping demand curve hypothesis but finding some evidence for the price pressure and liquidity effect for Japan and UK. Hacibedel and van Bommel (2006) look at the MSCI Emerging Markets Index, surprisingly finding significantly higher impact for the deleted stocks than for the added stocks, with permanent price effects for both types of events. They consider the inclusion to the MSCI EMI to mean greater integration of these stocks with the world markets, similar to the increased risk sharing between the foreign and local investors.

Other American indices

Chung and Kryzanowski (1998) look at the index effects for the Canadian TSE 300 in 1990-94 and find positive and transitory median changes in the traded volumes for the added and deleted stocks. Masse et al. (2000), investigating the same index in 1984-1994 find positive market reaction for the inclusions whereas no reaction for the exclusions and use it to support the price pressure hypothesis. In a later period, 1991-2000, Jog and Okumura (2003) observe the long-term price changes starting already 12 months before the date of the TSE 300 revision, with positive effects for the included and negative for the excluded stocks but stabilising for both types after the revision; this lends support to the downward-sloping demand curve hypothesis. Calafiore and Jackson (2008) find asymmetric price effects for the changes in Merval index in Argentina during 5 days after the event, but see no trading volume effects around the change day. The authors use both the imperfect substitutes and the investor awareness hypotheses for explaining the price impact.

Asian and Oceanian indices

Greenwood (2005) investigates the Nikkei 225 redefinition and finds significant price changes for the added and deleted stocks, followed by subsequent reversals. Liu (2000) looks at the changes in the price and the trading volume for the Nikkei 500 index changes and finds permanently increased prices for the inclusions and decreased for the exclusions with temporary volume increase for both types of events, consistent with the downward-sloping demand curve hypothesis. India's S&P CNX Nifty index has found coverage by Mohanty and Mishra (2005) and Kumar (2005). Mohanty and Mishra (2005) find support for the price pressure hypothesis and conclude that, irrespective of their size, all firms react in a similar manner. Kumar (2005) finds no abnormal volumes or significant changes in liquidity around the Nifty revisions and no price effects for the Jr. Nifty index. Li and Sadeghi (2009) examine the price and liquidity effects in the Chinese market and find an asymmetric stock price increase for the additions compared to a price decrease for the deletions.

Chan and Howard (2002), Pullen and Gannon (2007) and Pinfold and Qiu (2008) study the index effects in Australia. Chan and Howard (2002) examine the Australian All Ordinaries Index (AOI) and find that the results for the open-ended indices are consistent with those for the closed-end indices, with the price and trading volume effects around the change date. Pullen and Gannon (2007) study the stock price and volume effects of the announcement of changes to the S&P/ASX 200 and the four supplementary indices and find evidence supporting the price pressure hypothesis. Conversely to the main S&P/ASX 200 index, the supplementary indices do not experience any price or trading volume effects. Pinfold and Qiu (2008) find no abnormal returns for the S&P/ASX 100 changes after adjusting for trading costs and document only weak effects for the S&P/ASX 300. The authors believe that the trading volume effects are absent because the institutions are allowed to conduct transactions outside the market. In New Zealand, Li, Pinfold and Elayan (2000) find no effects for changes in NZSE 10 and abnormal (negative) returns only for stocks deleted from NZSE 40.

European indices

FTSE 100 is the most widely researched European index. Hamill et al. (2005) look at the index in 1984-2000 and find superior performance for the additions prior to entry only, while the deleted stocks continue to produce worse results even after exiting the index. Investigating the long-term price effects of the FTSE 100 revisions, Mazouz and Saadouni (2007) find strong evidence for the price pressure hypothesis as the price decrease for the deletions and price increase for the additions start already before the announcement and reverse completely within two weeks from the revision date. Fernandes and Mergulhao (2011) find that for FTSE 100 the anticipatory trading effects explain about 40% and 23% of the cumulative abnormal returns for the added and deleted stocks, respectively, which is most probably explained by the downward-sloping demand curve hypothesis. The authors create a trading strategy based on the estimates of the probability of an addition or a deletion and find significant wealth effects for both types of events. Mase (2007) distinguishes between the firms that are newly added to FTSE 100 and those that have been constituents previously, but does not find any significant difference, concluding that the increased investor awareness or monitoring cannot account for the full extent of the observed effects. Brealey (2000) finds that while the stocks added to the FTSE All-Share and FTSE 100 indices experience positive abnormal returns during the 11-day period immediately surrounding the announcement, the effect is insignificant both economically and statistically.

Vespro (2006) looks at the price and volume effects of changes in the French CAC40 and SBF 120 indices, in addition to those of FTSE 100. She finds evidence supporting the price pressure hypothesis associated with the rebalancing of the index funds, but weak or no evidence in support of the imperfect substitution, liquidity and information hypotheses. Deininger et al. (2000) investigate the index change effects of the German stock indices DAX and MDAX and conclude with some support for the imperfect substitutes hypothesis. The price effects are found to be permanent and asymmetric with a greater absolute effect for additions; similarly, the additions experience larger abnormal trading volume than the deletions do. Monroy Anton et al. (2012) investigate the Spanish stock index IBEX 35 in 2005-2009 with the aim to see if the financial crisis has changed the trends. While the additions tend to get positive and the deletions negative abnormal returns, the effects are balanced out by the returns on the rest of the stocks in the market. .

Bildik and Gülay (2006) investigate the ISE-100 and ISE-30 indices of the Istanbul stock exchange during 1995-2000. They find positive abnormal returns for the inclusions and negative for the exclusions until the effective date, and significantly increased trading volume. After the effective date, the prices of both the added and deleted stocks decline. They conclude with support for the information cost and liquidity hypotheses.

Bechmann (2004) investigates the Danish blue-chip index KFX and finds on average 16% negative abnormal return for the deleted stocks during the 6 months preceding the deletion. The added stocks experience on average 5% abnormal return during the same period, but no significant change in the trading volume. Bechmann explains the effects with the imperfect substitutes and information cost hypotheses. The index effects of the Swedish stock market indices have been investigated by Andelius, Skrutkowski (2008) and Blomstrand and Säfstrand (2010). Andelius and Skrutskowski find mildly negative impact on the stock prices on the change day for the Swedish stocks added to both the Swedish and the foreign indices, while the announcement day effect is statistically insignificant. Blomstrand and Säfstrand compare the index effects of OMXS 30 and EURO STOXX 50 and conclude that while both of the indices exhibit abnormal returns and abnormal trading volumes in the short term, only OMXS 30 changes have permanent effect on the corresponding stocks. They reason that the inclusion to OMXS 30 introduces the stock to a larger base of potential investors and the smaller size of the market signifies having less perfect substitutes.

Euronext European indices

The region that this thesis plans to investigate, the Euronext indices in Europe, has found little coverage by previous research. Gregoriou (2011) investigates the liquidity effects corresponding to the revisions of the CAC40 index in 1997 to 2001 and finds evidence of a long-term increase in the liquidity of the added stocks and a decrease for the deleted stocks due to the lower and higher asymmetric information costs of transacting. He adds that the changes in the direct costs of trading are not the main reason for the change in liquidity as the investors demand smaller risk premium for investing in a stock that has more available information. Doeswijk (2005) examines the Dutch AEX index and finds evidence of a temporary price pressure for both the additions and the deletions, suggesting the prevalence of the attention and price pressure hypotheses.

Cerqueira Barros (2009) finds evidence of significant herding among mutual funds for the stocks added to or deleted from the Portuguese index PSI20. The activity, concentrated to the month of the revision, might reflect the behaviour of the active versus the passive funds whereas the latter will trade very close to the effective date but the prior can be expected to conduct the trades further from the effective day. Duque and Madeira (2005) find price reaction on both the announcement and effective date for the PSI20 revisions, while the effective day often sees a price decrease, indicating potential overreaction upon the announcement. A positive abnormal trading volume is observed for both the additions and the deletions, with some persistency after the event. Duque and Madeira (2005) also find that the investors do not wait until the effective day for rebalancing the portfolios. The authors conclude with support for the price pressure hypothesis.

To conclude, the majority of the previous works on the index effects report positive abnormal returns for the index inclusions and negative abnormal returns for the index exclusions at the announcement as well as the effective date. Changes in the trading volume are also often observed in connection with the index revisions. Yet, the researchers have set forth a variety of different explanations for the effects, with no one explanation prevailing.

5. Data and methodology

5.1. Data description

The corporate action and composition change history is available on the Euronext website for the AEX, BEL20 and N100 indices. We identified the changes in CAC40 through comparing the monthly historic compositions of the index which was also available through the Euronext website. To uncover the changes in PSI20, we collected and compared the event lists used in the previous event studies of the Portuguese stock market by Duque and Madeira (2005), Pereira and Cutelo (2010) and Cerqueira Barros (2009); further, we identified the most recent changes in the index via announcements in the Factiva database.

Based on the previously listed sources, we identified altogether 393 index inclusions and exclusions for the 5 indices over the period 2000-2011 (Table 3). After removing the events that are unsuitable due to corporate actions (such as merger, takeover or delisting) and unavailability of the data, our final sample consists of 252 events for 150 companies. A higher proportion of the events was left out of the sample for the exclusions compared to the inclusions because many of the index exclusions were due to a delisting or takeover.

Table 3. Number of identified events by indices. Source: made by authors.

	Total sample	N100	AEX	BEL20	CAC40	PSI20
Inclusions:						
Identified events	189	98	24	12	29	26
Unsuitable events	44	22	2	3	9	8
% of identified	23%	22%	8%	25%	31%	31%
Final sample	**145**	**76**	**22**	**9**	**20**	**18**
Exclusions:						
Identified events	194	97	26	13	32	26
Unsuitable events	87	41	13	5	19	9
% of identified	45%	42%	50%	38%	59%	35%
Final sample	**107**	**56**	**13**	**8**	**13**	**17**

The number of events in different parts of the analysis may deviate from these figures due to data availability issues. For example, the post-event data is limited for some observations, which is why those events must be excluded when estimating the abnormal returns.

The announcement and the effective change days have been verified by cross checking the events with the corresponding announcements issued by Euronext. The announcement day is either the day of the publication of the news or the next trading day depending on whether the announcement was issued before or after the market close for each event. In general, Euronext reports the index revision notices after the market closes making this adjustment necessary. The duration between AD and ED varies greatly across the events - from a few days in some cases to 2 months in others. Currently, Euronext rules state that the decision of the revision should be announced at least 2 weeks before the effective day (NYSE Euronext, 2011a, 2011b, 2011c, 2012b, 2012c) which leaves at least 10 trading days between AD and ED. The adjusted prices for all the stocks as well as the corresponding market indices and the market capitalisations and the trading volume for the stocks were retrieved from Datastream.

Following, we present some of the characteristics in the sample and briefly discuss the size, the betas, and the industry composition of the sample. Table 4 presents the average market capitalisation of the companies added to or deleted from the indices. We will use this average size in a comparison later in the paper and will refer to PSI20 and BEL20 as the small indices because they have the smallest market capitalisations for the stocks at the event; CAC40 and N100 are referred to as the large indices. AEX is excluded from the size comparison as the average size of both its additions and deletions is in the middle of the other two groups and not clearly attributable to either of the categories.

Table 4. Average market capitalisation on effective change day.
Market capitalisation is presented in thousands of EUR, N denotes the number of observations in the respective sample. (*) The average market capitalisation for the exclusions from PSI20 excludes one major outlier.
Source: made by authors based on market capitalisation data retrieved from Datastream.

	Total sample	N100	AEX	BEL20	CAC40	PSI20
Inclusions						
Mcap	6 543	7 153	4 842	3 128	13 199	359
N	145	76	22	9	20	18
Exclusions						
Mcap	2 286	2 628	1 508	503	4 932	354*
N	107	56	13	8	13	17

The betas for our sample are on average below 1 (Table 5). It seems that the inclusions to and the exclusions from the PSI20 index are the most weakly correlated with the respective market index movements among the 5 indices while the CAC40 companies follow the market rather precisely as the beta is close to 1.

Table 5. Average betas of companies with respective markets.
Source: made by authors using data retrieved from Datastream.

Index	Total sample	N100	AEX	BEL20	CAC40	PSI20
Pre revision beta over [AD-150;AD-30]						
Inclusions	0.74	0.66	0.96	0.70	1.07	0.46
Exclusions	0.90	1.04	0.78	1.10	0.91	0.43
Total	0.81	0.82	0.89	0.90	1.00	0.45
Post revision beta over [ED+30;ED+150]						
Inclusions	0.79	0.71	1.04	0.70	0.94	0.71
Exclusions	0.88	1.02	0.89	0.82	0.99	0.33
Total	0.83	0.84	0.98	0.76	0.96	0.53

The industry composition of the sample is varying between the indices and the type of the event (Appendix 3). Overall, the events are related most to the Industrials (53 events), the Financials (52) and the Consumer services (44) companies. There are most inclusions of the Industrials (35) and the Financials (33) but most exclusions of the Consumer services (25) firms. Index-wise, most of the N100 events are the inclusions or the exclusions of the Financial (21) or the Industrial (20) companies. The inclusions to AEX are mostly the Industrials (6), but the inclusions to BEL20 are mostly the Financial companies (4) and most of the exclusions from CAC40 are operating in the Consumer services sector (7). The events for all the other subgroups are more evenly divided between the industries.

Since the events for some indices are clustered to one or two larger industries, it is possible that the specific industry characteristics are partly driving the index effects. This is a matter which is not addressed in this paper, however, it is an interesting topic for future research.

5.2. Returns methodology

The most commonly used method for studying the index effects has been the standard event study methodology advocated by Fama et al. (1969). This consists of two steps: first, estimating the „normal" returns based on a certain model such as the market model or constant mean return model; second, calculating the abnormal returns (hereafter: AR) as the difference between the previously estimated „normal" returns and the observed returns and the respective t-statistics. Next, the abnormal returns are aggregated over the chosen event windows into cumulative abnormal returns (hereafter: CAR) measure.

In this paper we used a panel regression with dummy variables for the event window instead of the standard model. If the events investigated were independently and identically distributed (i.i.d.) then the two models would be equivalent and produce exactly the same results and the choice of the model would depend on personal preferences. However, the standard event study methodology is designed only for the events that are i.i.d. whereas the regression with dummy variables does not require such strong assumption to be made regarding the distribution of the events which is why it is chosen in this paper. For the index effects the i.i.d. assumption clearly does not hold since the inclusions to or the exclusions from an index are clustered around certain dates as stipulated by the index rules. Further, this has clear implications for the standard errors of the coefficients and consequently to the significance of the results. For the standard event study methodology the i.i.d. assumption infers assuming independent variances for the abnormal returns (AR), i.e. a covariance of zero which can easily lead to underestimating the variance and overstating the significance of CAR. The dummy variable event study method is thus more appropriate for the index revisions where the events often tend to be interrelated and to some point predictable.

In order to estimate the normal and abnormal returns for the stocks we used the post-event estimation window with a length of 120 days [ED+30;ED+150]. The post-estimation window was chosen instead of the pre-estimation window similarly to Bechmann (2004), Edmister et al. (1994) and Chung and Kryzanowski (1998) because during the period before the change the additions are expected to overperform and the deletions to underperform the market, given that there is a potential selection bias in choosing the additions and the deletions. This means that the pre-event estimation window would capture these effects that do not adequately represent the normal returns (Bechmann, 2004).

The use of dummy variables in the event study methodology was first introduced by Karafiath (1988). The method has been successfully applied by Masse et al. (2000) for investigating the price effects on the Canadian stock market and Mazouz and Saadouni (2007) and Fernandes and Mergulhao (2011) for researching the price effects of the FTSE100 revisions, among other authors. With this approach, CAR is estimated with the following regression:

$$R_{jt} = \alpha_j + \beta_j * R_{mt} + \gamma D_{jt} + \varepsilon_{jt} \qquad (1)$$

where

R_{jt} = return to security j at time t

α_j = the intercept

β_j = the slope or measure of the systematic risk

R_{mt} = return to the market at time t

γ = the excess return for securities on average per day during the event window; later referred to as AAR (the average abnormal return)

D = dummy equal to one on each day of the event window and zero otherwise

ε_{jt} = residual for security j on observation at time t

The regression was run with the data of the stock returns and the market for the estimation window and the event window. The setup of the regression is such that the dummy only captures the effect of the event while otherwise the regression is equivalent to the market model. The standard errors for the regressions are adjusted for clustering by events.

The regression was run separately for the inclusions and the exclusions and using different event windows whereas the effective day (ED) of the inclusion or the exclusion was the event day.

The event windows analysed with the method were as follows (graphically depicted in Appendix 4):

- The run-up window [ED-5;ED-1]
- The event window [ED;ED+1]
- The short post-event window [ED+2;ED+5]
- The long post-event window [ED+6;ED+30]
- The short complete event window [ED-5;ED+5]
- The long complete event window [ED-5;ED+30]

We use the longer post-event window and the long complete event window in order to see whether the effects witnessed around the effective day, if any, are persistent over time or will reverse.

The standard errors and t-statistics for significance were reported by the statistical analysis software Stata for the average day during the event period indicated with the dummy D (i.e. the average abnormal return AAR). The cumulative effects were calculated as follows:

$$CAR_N = N * AAR$$

where the AAR is the average abnormal return for a day in the event window consisting of N days (coefficient γ from regression (1)). The significance for CAR does not change compared to AAR as the t-statistic for CAR is calculated as:

$$t = \frac{N * AAR}{N * se(AAR)}$$

5.3. Volumes methodology

Due to the highly skewed distribution of the volume data which is caused by the occasional extreme observations unrelated to the events under investigation, we use the logarithmic adjustment for the trading volumes in our analysis. The logarithm is taken from the daily trading volume plus 1 in order to avoid negative values. We estimate the presence of the abnormal trading volume by computing the mean volume ratio (MVR) over the event period as in Andelius and Skrutkowski (2008):

$$VR_{it} = \frac{\log(1 + V_{it})}{\log(1 + V_i)} \qquad (2)$$

$$MVR_t = \frac{1}{N} * \sum_{i=0}^{N} VR_{it} \qquad (3)$$

Where V_{it} is the trading volume (number of shares traded) of stock i during the event day t, V_i is the average trading volume of the stock over the estimation period of 120 trading days (150 days before AD to 30 days before AD), and N is the number of days in the event period.

The volume ratio (VR) measures the trading volume on each event relative to the average trading volume over the estimation period; the mean volume ratio (MVR) is the average VR over the respective event period. If there is no abnormal trading activity then the volume ratios (VR on each day as well as MVR over the whole event) equal one. We use the two-tailed unequal variance t-test to verify whether the ratios are statistically different from unity.

We investigate the index inclusions and exclusions around the effective change day (ED) of the index revision by using the following event windows:

- The run-up window [ED-5;ED-1]
- The event window [ED;ED+1]
- The short post-event window [ED+2;ED+5]
- The long post-event window [ED+6;ED+30]
- The short complete event window [ED-5;ED+5]
- The long complete event window [ED-5;ED+30]

The event windows are graphically depicted in Appendix 4. The long post-event window and the long complete event window are used to check for the persistence of the volume effects. If the volume ratios are significantly different from 1 also over these longer event windows, we consider the changes in volume to be permanent.

6. Expected results

We have established various hypotheses regarding the effects that we expect to see based on the theoretical background, previous literature and the characteristics of the specific markets.

H1: The included stocks experience significant positive abnormal returns around the event.

Regardless of which theoretical explanation prevails, vast majority of the previous research has proven that the index inclusion boosts the stock price. Either because of the increased demand and awareness, the hidden informational content or the reduced trading costs, the inclusions exhibit abnormal price increase around the event.

H2: The excluded stocks experience significant negative abnormal returns around the event; the price reaction is weaker compared to the inclusions.

4 out of the 5 theoretical explanations predict a negative price reaction for stocks that are excluded from the indices which is supported by the majority of the empirical research. The one explanation contradicting the negative abnormal returns is the investor awareness hypothesis. This is important in the Euronext markets due to the relatively smaller size of the companies in 3 out of the 5 indices investigated which benefit more from the index inclusion as it brings wider international awareness. Several of the explanations may account for the price effects in this case which is why we believe that the overall impact on the price of the excluded stocks will still be negative but of smaller magnitude in absolute value than for the inclusions because when a stock is removed from an index, the investors remain aware of it.

H3: The abnormal returns disappear in the long run.

Based on the amount of the previous research supporting (fully or at least partially) the Price Pressure Hypothesis (PPH) (Appendix 2), we expect to further verify PPH in the Euronext markets. The rebalancing activities of the index tracking investors create significant price pressure around the event and push the share prices temporarily away from their fair value – the higher demand for the included stocks results in positive abnormal returns and the increased supply of the excluded stocks causes negative abnormal returns, both of which will reverse shortly after the event as the prices return to their fair market value.

H4: The trading volume increases around the event for both the inclusions and the exclusions.

For the same reasons as mentioned before, we expect to see higher trading activity for both the inclusions and the exclusions as the investors rebalance their portfolios. The bulk of the trading is expected to take place a few days around the effective change day as the index tracking investors aim to minimise the tracking error.

H5: The trading volumes return to the historic levels in the longer term after the event.
Consistently with the reversing price effects and the Price Pressure Hypothesis, we expect the trading volumes to move back to the historic levels in the longer term after the event because the portfolio rebalancing of the index tracking institutional investors is likely the main factor behind the increased trading activity around the index revisions. After those investors have bought the stocks that are added to the respective index and sold the shares that are excluded from the index, the trading levels move back to the historic levels.

7. Empirical results

7.1. Returns

Inclusions

Graphs of the cumulative abnormal returns are presented in Appendix 5. Graphs 3 and 5 in the appendix depict the development of CARs for the inclusions over the short and long complete event windows, respectively. The eyeball test indicates an upward trend for the inclusions to most indices during [ED-5;ED+5] whereas the prices clearly reverse for most index inclusions during [ED-5;ED+30]. Statistical analysis is performed to discuss the significance of the results over various event windows (Table 6). Similar statistical tests are also performed for the daily ARs but the results are not reported here.

The regressions using the effective day of the index reconstitution as the event day show that the stocks to be included in any of the Euronext indices researched here experience significant positive abnormal returns during the 5 trading days prior to the event, whereas the effect is the largest for the stocks added to BEL20 (+7.57% CAR) and the smallest for the stocks added to Euronext 100 (+1.21%). This can potentially be so because the stocks added to BEL20 are more likely to be those of the small companies, introducing the company thus to a significantly wider circle of investors, whereas the companies entering Euronext 100 can be of quite significant size and already included in their smaller country indices and are thus already more likely to be under the attention of investors. This hypothesis is also supported by the fact that the CARs for the smaller indices (BEL20, PSI20 and AEX) are higher than the CARs for the larger indices (CAC40 and N100). The daily analysis of the returns shows that the effect is mainly concentrated to the period ED-3 to ED-1, where the inclusions to each index have as minimum 1 significant AR. Further, applying the main regression around the announcement day (the graphs presented in Appendix 6 and the test results in Appendix 7) shows that for the total announcement window [AD-5, AD+5] only PSI20 and AEX, i.e. two of the three smaller indices, exhibit significant abnormal returns with +6.29% CAR and +5.84% CAR, respectively, demonstrating even stronger effect for the small stocks as both the run-up to the effective inclusion and the announcement window create significant positive CARs for the smaller indices whereas the larger indices see the effects only right before the inclusion and no significant effects at the announcement.

Table 6. Cumulative abnormal returns around the effective day.

The table presents the results of the multiple regression with dummy variables for the event windows (regression 1 under the methodology). The effective day is the event day, and the dummies equal 1 for each day in the corresponding event window and 0 otherwise. Each intersection of an event window and an index represents a separate regression run (only 1 event window was included in a regression at a time). The regression reported Average Abnormal Return for a day in the event window; the CAR and the standard error reported here are obtained by multiplying the regression AAR and the corresponding standard error with the number of days in the specific event window. The regression uses the post-event period (i.e. the base case) for estimating the "normal" returns.

The significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
Period	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared
Inclusions												
N	138		71		22		9		18		18	
[ED-5;ED-1]	2.45% ***	0.237	1.21% **	0.208	4.55% **	0.287	7.57% ***	0.312	2.35% **	0.272	3.08% *	0.201
	(0.000)		(0.024)		(0.001)		(0.000)		(0.011)		(0.076)	
[ED;ED+1]	-0.70% ***	0.238	-0.01%	0.205	-1.35%	0.290	0.08%	0.321	-2.61% ***	0.275	-0.70%	0.210
	(0.005)		(0.978)		(0.111)		(0.917)		(0.000)		(0.316)	
[ED+2;ED+5]	-0.07%	0.235	0.05%	0.203	-0.01%	0.289	-1.33%	0.308	0.00%	0.271	-0.22%	0.202
	(0.863)		(0.924)		(0.990)		(0.382)		(0.997)		(0.870)	
[ED+6;ED+30]	0.56%	0.241	1.60%	0.201	-0.91%	0.311	-1.88%	0.273	-0.74%	0.285	1.09%	0.197
	(0.583)		(0.251)		(0.796)		(0.593)		(0.758)		(0.567)	
[ED-5;ED+5]	1.69% **	0.231	1.26%	0.203	3.19%	0.287	6.19% **	0.287	-0.25%	0.268	2.14%	0.185
	(0.011)		(0.124)		(0.108)		(0.017)		(0.863)		(0.362)	
[ED-5;ED+30]	2.25% *	0.234	2.86% *	0.197	2.25%	0.308	4.26%	0.244	-0.99%	0.281	3.25%	0.173
	(0.080)		(0.092)		(0.598)		(0.351)		(0.738)		(0.299)	
Exclusions												
N	99		51		13		8		11		16	
[ED-5;ED-1]	-2.06% ***	0.182	-2.62% ***	0.209	-3.83% *	0.151	-1.73%	0.089	0.67%	0.300	-1.12%	0.049
	(0.005)		(0.003)		(0.068)		(0.758)		(0.587)		(0.247)	
[ED;ED+1]	0.06%	0.182	-0.06%	0.207	-1.06%	0.143	1.15%	0.098	2.30% ***	0.303	-0.78%	0.051
	(0.903)		(0.934)		(0.450)		(0.417)		(0.001)		(0.263)	
[ED+2;ED+5]	0.28%	0.184	0.50%	0.207	2.37%	0.153	-2.06%	0.104	-0.60%	0.304	-0.17%	0.050
	(0.667)		(0.586)		(0.411)		(0.317)		(0.524)		(0.864)	
[ED+6;ED+30]	3.11% *	0.183	6.76% ***	0.212	0.44%	0.136	-11.95% *	0.095	0.76%	0.303	4.40% *	0.048
	(0.067)		(0.008)		(0.939)		(0.093)		(0.784)		(0.070)	
[ED-5;ED+5]	-1.73%	0.184	-2.21%	0.212	-2.49%	0.149	-2.60%	0.095	2.38%	0.298	-2.07%	0.051
	(0.120)		(0.145)		(0.526)		(0.677)		(0.198)		(0.190)	
[ED-5;ED+30]	1.33%	0.185	4.50%	0.217	-2.13%	0.139	-14.57%	0.093	3.13%	0.298	2.29%	0.048
	(0.530)		(0.148)		(0.765)		(0.142)		(0.392)		(0.454)	

Upon the inclusion taking effect at [ED;ED+1], the stocks added to CAC40 experience significant price reversal with -2.61% (p-value 0.000), with statistically significant ARs of -1.47% and -1.13% during the respective days. Although this behaviour is anomalous and completely the opposite to what is expected, we see that at the announcement window [AD;AD+1] the CAC40 inclusions experienced +2.43% CAR (significant at 1% level) which then reversed at the effective day. While the price effects of the index inclusion on the effective day and the following day are insignificant for the remaining indices, this is highly likely to be because the index funds decided to rebalance their portfolios directly prior to the actual inclusion and not wait until the actual change day. The PSI20 additions experienced on average -0.51% negative AR at ED+1.

None of the stocks added to any of the Euronext European indices experience a significant price change following the inclusion, neither short-term [ED+2;ED+5] or medium-term [ED+6;ED+30], which indicates no direct reversal.

Looking at the short complete event window of [ED-5;ED+5] we see that only the inclusion to BEL20 has permanent effect for a stock which will earn +6.19% CAR that is significant at the 5% level. The total sample results also indicate significant positive CAR for the stocks added to the Euronext European indices; however, given that the inclusions to 4 out of the 5 indices tend to produce no price effects and the effect for the total sample is economically small with only 1.69% for the entire 11-day window, this has no important implications for our results. In the long complete event window [ED-5;ED+30] only the additions to N100 produce statistically significant results with +2.86% CAR (p-value 0.092), even though the Graph 5 in Appendix 5 would indicate higher permanent price level for each index except for CAC40. Yet, the effect is economically minuscule if considering that the less than 3% CAR was earned over 36-day period. All in all, it seems that nearly all the statistically significant effects prior to the effective inclusion and/or upon the inclusion will reverse within the next 5 to 30 days, with the only exception for N100 where the effects seem to persist to a small extent. Thus, based on the price effects alone we could hypothesize that for the N100 additions the imperfect substitutes hypothesis, the information content hypothesis, the liquidity hypothesis or the investor awareness hypothesis could be the potential solutions whereas for the rest of the indices the price pressure hypothesis seems to be the most plausible explanation based on the results presented till this point.

Exclusions

Turning to the effects of the exclusion of a stock from the Euronext European indices, we see a negative development in the CAR for most of the indices (Graphs 4 and 6, Appendix 5). The table 6 shows that for the build-up window [ED-5;ED-1] the stocks to be excluded from N100 and AEX experience significant price decline (-2.62% CAR at the 1% significance level and -3.83% CAR at the 10% significance level, respectively), whereas there is no effect for the stocks to be excluded from BEL20, CAC40 and PSI20. While the total sample exclusions experience an average CAR of -2.06% (p-value 0.005) over the build-up period, we believe the effect to be driven by the two previously mentioned indices.

At the day of the effective exclusion and the day immediately following the exclusion, the stocks excluded from the CAC40 index experience significant positive abnormal return of +2.30% (significant at 1% level) instead of the commonly expected negative or insignificant effect. This clearly constitutes an anomaly in the index effects literature. The positive CAR cannot be explained with the price reversal either since there has not been any significant price drop for the stocks to be excluded from CAC40 neither around the announcement day nor preceding the effective day. The actual exclusion of the stocks from any other index [ED;ED+1] has no effect on the prices of these stocks.

Looking at the post-exclusion period, in the short post-event window [ED+2;ED+5] there is no significant price effect for any of the indices, whereas in the longer post-exclusion window of [ED+6,ED+30] the effects are very mixed. At that period, the exclusions from AEX and CAC40 have no price effects while the exclusions from the BEL20 index experience a significant negative abnormal return of -11.95% during the 25-day period, implying that the exclusion from BEL20 index has a significantly negative effect for the stocks listed on Euronext Brussels. This could be explained by the small size of the market that is not very attractive for many larger investors who prefer to invest in better known stocks that are included in the index; however, that does not address the issue why the effects would be so grave for the BEL20 constituents and not for the constituents of the other small Euronext indices. Conversely, the exclusions from Euronext 100 and PSI 100 experience significant positive abnormal returns of +6.76% (significant at the 1% level) and +4.40% (significant at the 1% level), respectively. This is completely the opposite of what could be expected since the exclusion as such should be either neutral or a negative signal about the company and not make it more attractive to the investors. What is more noteworthy is that this positive CAR cannot be explained by the reversal of the previous abnormal price increases since the stocks excluded from PSI20 did not experience any abnormal return neither around the announcement date nor between the announcement date and the effective date. While part of the positive CAR for the stocks excluded from N100 can be explained by the reversal of the previous negative CAR during the pre-exclusion period, the magnitude of the positive CAR is more than twice of the previous negative CAR, showing that there is some other source for this effect which cannot currently be explained.

Looking at the complete event windows for the effective exclusion, for both the short and the long complete event windows [ED-5, ED+5] and [ED-5, ED+30] there are no significant return effects for any of the Euronext European indices, although the graphs 4 and 6 in Appendix 5 indicate negative CARs ranging near -2% for all the indices except for

CAC40 around the short event window and significant drop to -15% cumulative abnormal return for BEL20 during the long complete event window. This implies that despite some daily price fluctuations, the exclusion from the Euronext European indices has either temporary or no effects, without any consistent pattern on the timing of those effects within the event windows themselves either.

To briefly summarise, we see that the investors tend to actively buy the stocks during the week before the actual inclusion to the index whereas there are no abnormal prices following the effective inclusion of a stock to any of the Euronext indices. Conversely, the investors either do not aggressively sell the removals prior to the effective exclusion for most of the indices or the activity does not create significant pressure on prices. Surprisingly, while there appears to be no significant abnormal returns for the excluded stocks in the week after the exclusion, the longer-term effects are very mixed and for N100 and PSI20 indices actually include significantly positive abnormal returns in excess of the prior negative returns. For the complete event windows we see no significant effects for the excluded stocks, which means that any price declines experienced previously reverse within the next 5 trading days already.

7.2. Volumes

When taking a first look at the graphs of the daily average volume ratios around the effective change day, we see clear peaks in the volume ratios one day before ED both for the inclusions and the exclusions (Graphs 9-12, Appendix 8). It is very probable that this indicates the rebalancing activities of the index tracking investors who wish to minimise their tracking error by adjusting their portfolios on the last possible minute. N100 is the only index which' inclusions and exclusions do not experience notable changes in the trading volume while PSI20 inclusions and BEL20 exclusions show a volume increase over the entire week before ED. The ratios seem to reverse rather fast and trend slightly downwards for the exclusions from all the indices but remain volatile and above one for the inclusions to the 5 indices even 30 days after ED. The same graphs around the announcement day depict a clear peak in trading volumes at AD only for the inclusions to a couple of the indices (Graphs 13 and 14, Appendix 9) indicating lower reaction at the announcement of the revisions. However, the graphs themselves do not allow us to make any conclusive inferences; thus, statistical analysis has to be undertaken to reveal the significance of the effects. The results of the t-tests for the event windows are presented in the Table 7 below; the statistics for the daily average volume ratios are presented in Appendix 10.

Table 7. Mean volume ratios (MVR) over the event windows around the effective change day.
The p-value of two-sided t-tests checking whether the samples equal 1 are in the parentheses under MVRs. The number of observations (N) is accompanied by the percentage of how many observations in the sub-sample are larger than 1. Significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR
	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)
Panel I: Inclusions												
[ED-5;ED-1]	141	1.07 ***	75	0.99	22	1.09 ***	8	1.18 **	18	1.11 ***	18	1.29 ***
	(60%)	(0.000)	(36%)	(0.592)	(95%)	(0.000)	(88%)	(0.015)	(94%)	(0.000)	(72%)	(0.008)
[ED;ED+1]	141	1.06 ***	75	1.00	22	1.12 ***	8	1.14 **	18	1.10 ***	18	1.14 **
	(66%)	(0.000)	(51%)	(0.866)	(95%)	(0.000)	(88%)	(0.028)	(89%)	(0.001)	(61%)	(0.033)
[ED+2;ED+5]	141	1.04 ***	75	1.02	22	1.05 ***	8	1.07	18	1.05 *	18	1.14 *
	(63%)	(0.001)	(55%)	(0.274)	(82%)	(0.003)	(88%)	(0.104)	(67%)	(0.083)	(61%)	(0.051)
[ED+6;ED+30]	141	1.03 **	75	1.02	22	1.06 ***	8	1.05	18	1.03	18	1.04
	(64%)	(0.017)	(61%)	(0.223)	(82%)	(0.001)	(75%)	(0.237)	(67%)	(0.353)	(44%)	(0.599)
[ED-5;ED+5]	141	1.06 ***	75	1.00	22	1.08 ***	8	1.13 **	18	1.09 ***	18	1.19 ***
	(66%)	(0.000)	(49%)	(0.806)	(95%)	(0.000)	(88%)	(0.021)	(89%)	(0.003)	(67%)	(0.009)
[ED-5;ED+30]	141	1.04 ***	75	1.02	22	1.07 ***	8	1.08 *	18	1.05 *	18	1.08
	(65%)	(0.001)	(59%)	(0.304)	(86%)	(0.000)	(88%)	(0.098)	(72%)	(0.082)	(50%)	(0.208)
Panel II: Exclusions												
[ED-5;ED-1]	107	1.09 ***	56	1.01	13	1.10 ***	8	1.53	13	1.09 ***	17	1.13
	(67%)	(0.010)	(55%)	(0.495)	(92%)	(0.010)	(88%)	(0.196)	(100%)	(0.000)	(53%)	(0.192)
[ED;ED+1]	107	1.05 **	56	1.04 *	13	1.11 ***	8	1.27 *	13	1.04 **	17	0.98
	(67%)	(0.029)	(64%)	(0.093)	(92%)	(0.001)	(75%)	(0.099)	(69%)	(0.028)	(53%)	(0.828)
[ED+2;ED+5]	107	1.03	56	1.05 ***	13	1.01	8	1.06	13	0.97	17	0.99
	(60%)	(0.109)	(70%)	(0.001)	(54%)	(0.582)	(63%)	(0.341)	(31%)	(0.229)	(53%)	(0.930)
[ED+6;ED+30]	107	1.00	56	1.04 ***	13	0.98	8	0.99	13	0.96 **	17	0.91
	(48%)	(0.970)	(64%)	(0.009)	(31%)	(0.326)	(25%)	(0.768)	(23%)	(0.011)	(35%)	(0.262)
[ED-5;ED+5]	107	1.06 ***	56	1.03 **	13	1.07 ***	8	1.31	13	1.04 **	17	1.05
	(66%)	(0.007)	(61%)	(0.024)	(85%)	(0.010)	(75%)	(0.172)	(85%)	(0.019)	(53%)	(0.581)
[ED-5;ED+30]	107	1.02	56	1.04 ***	13	1.01	8	1.09	13	0.99	17	0.95
	(53%)	(0.231)	(64%)	(0.007)	(38%)	(0.667)	(50%)	(0.265)	(38%)	(0.247)	(41%)	(0.536)

Inclusions

The volume effects around the effective day are not significant for N100 inclusions over any of the event windows while the inclusion effects are notable for all 4 local indices. The inclusions to AEX exhibit strong and permanent increase in the trading volume around the event with the highest MVRs over the run-up window [ED-5;ED-1] (1.09, 95% of observations above 1) and the event window [ED;ED+1] (1.12, 95% > 1). The high volume ratios persist also in the longer term for the AEX inclusions as the MVR over the long post-event window [ED+6;ED+30] is 1.06 (82% > 1). The inclusions to the other 3 country indices show a significant increase in the trading volume especially over the run-up window with the MVR ranging from 1.11 to 1.29. The volume ratios remain high and significant for the BEL20, CAC40 and PSI20 inclusions also over the event window [ED;ED+1] ranging from 1.10 to 1.14. The increased trading activity is sustained over the short post-event window [ED+2;ED+5] for the CAC40 and PSI20 inclusions, but the trading returns to the historic levels a week after the event. Meanwhile, the reversal to the historic trading levels is the fastest for the BEL20 inclusions as indicated by the insignificant MVR over the short post-event window [ED+2;ED+5]. It is evident that the volume effects are larger in magnitude for the indices with smaller size of the included companies – BEL20 and PSI20. The difference is especially notable over the run-up window when the MVR is 1.18 (88% > 1) and 1.29 (72% > 1) for BEL20 and PSI20, respectively, compared to 1.09 (95% > 1) and 1.11 (94% > 1) for AEX and CAC40.

When looking at the daily volume ratios for the index inclusions (Appendix 10), MVRis the highest on the day before the index revisions become effective [ED-1] over the 11 days around the event. This provides support to the presumption that many investors leave the rebalancing of their portfolios to the last minute in order to minimize the tracking error with the respective index. On that day, MVR jumps to 1.51 (100% > 1) for BEL20; the respective figures for the rest of the indices are 1.22 (95% > 1) for AEX, 1.34 (100% > 1) for CAC40 and 1.21 (92% > 1) for PSI20. With regards to the announcement day, there is a small anticipatory increase in trading for N100 inclusions (MVR 1.03 over [AD-5;AD-1]) while the CAC40 inclusions react at the announcement (MVR 1.07 over [AD;AD+1]); the PSI20 inclusions exhibit a strong reaction at the announcement (MVR 1.38) but the trading volume is already higher than the historic one before the event (MVR 1.15) and remains so also afterwards (MVR 1.13) (Appendix 11).

Exclusions

The exclusion effects around the effective change day are weaker and less pronounced compared to the inclusion effects (Table 7). It is still evident that the largest and the most significant changes in the trading volume concentrate on [ED-1] and [ED], but the results for the individual indices are varying. Contrary to the inclusion effects, the N100 exclusions see a slight increase in trading volumes after ED ([ED;ED+1] and [ED+2;ED+5]) as the MVR is 1.04-1.05 and persists even 30 days after the event. Given this, we can infer that the trading behaviour regarding the regional N100 index cannot be explained by the rebalancing activities of the index trackers. It may be that the investors holding N100 stocks delay with selling the excluded stocks as the trading volume increases the most 3-4 days after the event (Appendix 10).

The volume reaction to the exclusions from the smaller indices (BEL20 and PSI20) is practically insignificant due to the higher variance in the daily ratios. The BEL20 exclusions experience significantly higher trading volume only on the effective change day [ED] when the MVR is 1.34 (88% > 1) and PSI20 on the day before [ED-1] with an MVR as high as 1.33 (92% > 1). The highest MVR of 2.01 is evident for BEL20 exclusions on the day before the effective change day, however it remains statistically insignificant (Appendix 10). The volume over the event window [ED;ED+1] remains significantly higher (MVR 1.27, 75% >

1) for the BEL20 exclusions while no effects can be considered to exist for the PSI20 exclusions.

Among the larger indices, the AEX exclusions display increased trading volume before and at ED when the MVR is 1.10-1.11, however, the volumes return to normal quickly after the revision takes effect. The CAC40 exclusions follow the same trend before and at ED, but the MVR drops below one as soon as the event is over. The stocks excluded from CAC40 continue with the lower trading volumes even 30 days after the change as the MVR for the long post-event window [ED+6;ED+30] is 0.96 and significant. The volume ratios are below 1 over the long post-event window also for the other country indices; this could indicate lower demand for the excluded stocks after the index revision becomes effective, though it cannot be confirmed as the ratios are statistically insignificant. The announcement day effects for the exclusions from the Euronext indices are also weaker than AD effects for the inclusions. In fact, the volume reaction is practically non-existent with a slight increase in the trading volume before the event [AD-5;AD-1] only for the N100 exclusions and at the event [AD;AD+1] for the CAC40 exclusions (Appendix 11).

Overall, we observe an asymmetric volume effect between the inclusions and the exclusions around the effective change day. For the country indices, the effects are stronger and persist over the short post-event window for the inclusions while the volume ratios reverse right after the event and may even drop below the historical levels in the longer term for the exclusions. This indicates that the stocks included to an index benefit from it and the exclusion from an index may have a negative impact on the stock's trading volume. We see an unexpected trend on the regional level as the N100 inclusions depict no notable changes in the trading volumes and the exclusions from N100, contrarily, show persistently higher trading volume levels even 30 days after the event. Additionally, we observe differences between the indices with larger and smaller constituent companies – the volume ratios tend to be larger for the smaller indices.

7.3. Robustness

Robustness checks for return analysis results

For the robustness checks, we conducted the analysis of the returns using the pre-event estimation instead of the post-event estimation for computing the normal returns over the event window. Furthermore, we performed the analysis using the standard event study methodology.

When changing the estimation window from post-event to pre-event estimation (see Appendix 12) we see that many of the previously found patterns remain but a few anomalies appear. The significant run-up to the inclusion during [ED-5;ED-1] becomes insignificant for 3 out of the 5 indices. During the event window [ED;ED+1] the CARs for N100, AEX and CAC40 become significantly negative, which is unexpected in terms of the direction of the effect, especially so because with the pre-event estimation the additions to N100 and CAC40 did not experience any prior significant positive abnormal returns that could be reversing. Further, the CAC40 inclusions become significantly negative over the complete event windows and the N100 inclusion price effects become insignificant over the same windows.

As for the effective removals of the stocks from the indices, the patterns using the pre-event and the post-event estimation windows are fairly similar with only a few differences: the BEL20 inclusion effects over the long post-event window lose their significance and the N100 inclusions effects become significant and positive, the latter constituting another anomaly.

In order to test the robustness of our methodology, analysis of the base case scenario was performed using the standard methodology with the market model defined below:

$$r_{it} = \alpha_i + \beta_i * r_{mt} + \varepsilon_{it}$$

The untabulated results (available upon request) from using the standard event study methodology demonstrate that the CARs are similar in terms of magnitude with the two methods both for the stocks that are included to and excluded from the Euronext European indices. While some variation in the CARs still exists, there is no clear trend of one method producing consistently higher CARs than the other.

However, for several occasions, using the standard methodology results in significant CARs for several event windows which are either insignificant or less pronounced when using the multiple regression with the dummy variables. For example, the BEL20 inclusions now experience statistically significant -2.02% CAR during [ED+2;ED+5] and PSI20 inclusions experience significant (at the 10% level) CAR of +2.22% over the short complete event window [ED-5;ED+5], both of which are statistically insignificant with our base case methodology.

By the same token, the short post-event window for the AEX exclusions and the long complete event window for the N100 exclusions are statistically significant at the 10% level (with +2.80% and +4.16% respective CARs). These observations lend support to our premise that the standard methodology with the i.i.d. assumption underestimates the correlation between the events and consequently the respective variances, resulting in what appear to be more statistically significant results, using exactly the same data.

Robustness checks for trading volume analysis results

We used different estimation windows for the normal trading volumes and the unadjusted data to check the robustness of our results regarding the trading volumes.

Since the results may be sensitive to the choice of the estimation period, we have conducted the analysis of the trading volumes using, in addition to the base case of [AD-150;AD-30], the following 3 estimation windows: [AD-100;AD-30], [AD-70;AD-30] and [AD-50;AD-10]. The graphs of the daily average volume ratios do not have any striking differences with our base case when using the different estimation windows. Statistically, however, the choice of the estimation window does have an impact on the significance of the volume effects, but the results are not presented in this paper (available upon request).

Though the volume effects for N100 inclusions are insignificant in our base case, they are significant when using shorter estimation periods but the trend is not what is expected. The trading volume for N100 inclusions decreases (MVR is less than 1) significantly before and at the effective day compared to the historic levels. The exclusions from N100 do not exhibit large differences with the varying estimation window. The results are also equivalent with the base case when using differing estimation windows for the volume behaviour regarding the CAC40 and AEX inclusions and exclusions as well as the inclusions to PSI20 and BEL20. However, the exclusions from PSI20 reveal a positive price effect over the run-up window [ED-5;ED-1] with the 2 shortest estimation windows and the exclusions from BEL20 exhibit persistently lower trading volume (MVR<1) over the long post-event window [ED+6;ED+30] when using [AD-100;AD-30] or [AD-70;AD-30] as the estimation window. This shows that there may be a trade-off between estimating accurately the normal trading volume for the inclusions and the exclusions. A longer estimation window further away from the event may be more accurate for one type while a shorter window closer to the event day may be more applicable for the other. Overall, the choice of the estimation window does not change our main conclusions regarding the volume effects.

Additionally, we performed the analysis for the volumes using the unadjusted (raw) trading volume data to see how the logarithmic adjustment impacts the significance of the results. The average VR graphs (Appendix 13) in the case of using the raw data have a notably wider scale on the axis as the ratios sometimes even exceed 9. The peaks at the day before the effective day are more pronounced, however, there are no peaks in the volume ratios at the announcement day. The larger variance of the ratios and the occasional high peaks mean that a few extreme events for some of the indices have affected the overall results to a large extent and all the other movements are less notable on the graphs simply because the scale is wider. When using the raw trading volume data, the significance of the results does not change as much as to impact our overarching conclusions regarding the volume effects. Yet, the major outliers in the raw dataset distort the results among the individual indices and event windows.

8. Discussion

8.1. Posed hypotheses

Overall, the stocks included to the Euronext European indices experience positive abnormal returns around the event date, specifically during the run-up window before the actual inclusion. This supports our Hypothesis 1 that the included stocks experience a significant positive abnormal return around the effective inclusion.

For the exclusions, the stocks excluded from 2 out of the 5 (N100, AEX) investigated indices show significant negative abnormal returns prior to the exclusion. While the stocks excluded from the 2 other indices (BEL20, PSI20) experience negative abnormal returns, the effects are statistically insignificant. Surprisingly, the exclusions from CAC40 see a positive abnormal return at the event window [ED;ED+1] which is contrary to the expectation. Further, comparing the price effects at exclusion with the price effects at inclusion, we see no clear pattern: for N100, the exclusion effect is in fact stronger; for the other 4 indices the inclusion effects are of greater magnitude than the exclusion effects (should there be any at all). Thus, our Hypothesis 2 is fully supported for AEX, partly supported for N100, BEL20 and PSI20 and rejected for CAC40. Consequently, no generalisations can be made regarding the entire set of the Euronext European indices.

To investigate the behaviour of abnormal returns in the long run, we look at the returns over the long complete event window [ED-5;ED+30]. For the inclusions, the CAR remains significant only for the stocks added to N100; for all the other indices, the included stocks experience a price reversal, although we cannot pinpoint exactly in which period they disappear. Hypothesis 3 for the inclusions is partly supported by the data. The price impact from the exclusions does not persist for the stocks removed from any of the investigated indices over the long complete event window, although surprisingly for 3 out of the 5 indices the excluded stocks experience significant abnormal returns over the long post-event window [ED+6;ED+30]. Thus, while many stocks experience abnormal returns during the 30 days following the effective exclusion, over the total event window the effects are nil and Hypothesis 3 is supported for the index exclusions.

The trading volume for the inclusions increases significantly for AEX, BEL20, CAC40 and PSI20 around the event (before and at the event for all; for 3 out of the 4 also during the immediate post-event window). There are no volume effects for the N100 inclusions. The volume effects for the exclusions are notably more mixed: the PSI20 deletions experience no abnormal trading volume, the AEX and CAC40 deletions see an increased trading over the run-up and event windows, the BEL20 deletions only at the event and the N100 deletions at the event and during the short post-event window. Thus, Hypothesis 4 is partly supported by the data and more so for the inclusions than exclusions.

The higher-than-historic trading volume is persistent over the long post-event window [ED+6;ED+30] only for the AEX inclusions but reverts to pre-inclusion levels for the rest of the indices. As for the exclusions, the effects are controversial. The N100 exclusions experience a sustained increase in trading volume while the CAC40 exclusions see a significant drop in trading volume. Although the exclusions from the remaining indices experience lower-than-historic trading volumes during the long post-event window (MVR<1), the effects are statistically insignificant. Overall, Hypothesis 5 finds reasonable support, being rejected only for the AEX inclusions and the CAC40 exclusions.

8.2. Theoretical explanations

To link the results to the theoretical explanations listed before, we look at each index individually to identify what is the most prevalent explanation for that specific market. The table summarizing which explanations the inclusions and exclusions of each index support is presented in Appendix 14. To begin with, the **inclusions to Euronext 100** index give **partial support to the Information Cost** (ICH), **Imperfect Substitutes** (ISH) **and Investor Awareness Hypotheses** (IAH), based on the price reaction: there are evident positive price effects (H1 holds) which do not reverse in the long run (H3 rejected). However, the trading volume does not increase significantly though ISH and ICH predict otherwise. **The exclusions from N100**, however, fully **support the Price Pressure Hypothesis** as there is a temporary negative price effect around the exclusion (H2 and H3 hold) as well as temporarily higher trading volume around the event date (H4 and H5 hold).

No clear explanation prevails for the **inclusions** to the Dutch **AEX index**. While the stocks experience significant positive abnormal returns around the event date (H1 holds) which reverse in the longer term (H3 supported), the trading volume increases significantly near the effective date (H4 holds) and does not reverse (H5 rejected). From the prevalent 5 explanations, no one can count for these effects as the Price Pressure Hypothesis (PPH) would predict the trading volumes to fall to the pre-event levels in the long run and the Liquidity Hypothesis (LH) would predict no price reversal. For the stocks **excluded** from the **AEX index, PPH holds** as the abnormal returns around the effective date are significantly negative (H2 holds) but reverse in the long run (H3 holds), and the stocks experience significantly higher trading volume around the event (H4 holds) which reverses during the following 30 trading days (H5 holds).

The **stocks included to BEL20** experience significant but reversing positive abnormal returns and volumes (H1, H3, H4, H5 hold), the combination of which supports the **Price Pressure Hypothesis**. However, **none** of the 5 presented potential explanations fit well with the **BEL20 exclusion** effects since there are no negative abnormal returns (H2 rejected, H3 not applicable) although the stocks exhibit significantly higher trading volume around the event which reverses in the long run (H4 and H5 hold).

For the **inclusions to and exclusions from** the **CAC40** index, **no explanation clearly prevails**. While the additions to CAC40 experience significant positive abnormal returns prior to the inclusion, on the narrow event window [ED;ED+1] the stocks see significant negative abnormal returns (H1 only partly supported), whereas the excluded stocks unexpectedly experience positive significant CARs (H2 rejected). Over the complete event window, no significant price effects are observed for either the inclusions or exclusions (H3 holds). The trading volume increases significantly around the event both for the included and excluded stocks but reverses to the pre-event levels for the inclusions and below the pre-event levels for the exclusions (H5 partly supported).

The stocks **included** to **PSI20** provide support for the **Price Pressure Hypothesis** as inclusions have reversing significant positive CARs (H1, H3 hold) and a temporary increase in trading volumes (H4 and H5 hold). For the **exclusions,** there are **no price or volume effects**, thus supporting the Efficient Market Hypothesis.

8.3. Implications

All in all, the analysis shows that no one explanation prevails not only across all indices, but not even across the inclusions and exclusions of the same index. However, the Price Pressure Hypothesis finds the strongest support from our results which we believe to be caused by the index funds as they are the only investors with a clear need to rebalance their portfolios around the reconstitution whereas the other investors can wait longer until the prices reverse.

Part of the pressure could also be caused by the arbitrageurs who are hoping to benefit from the expected price movements, further pushing the prices to overreact. However, the demand from the arbitrageurs is likely to occur at the announcement when they form their expectations regarding how the prices will react and establish their positions accordingly.

While the analysis of the announcement day effects revealed some impact for certain indices, it is clearly not as prevalent as the reaction around the actual reconstitution and the announcement effects were found to reverse already before the effective day. We consider this as proof against the applicability of the Information Content Hypothesis for the investigated markets because if ICH would hold, the effects from revealing additional information would be permanent and rather immediate at the announcement.

Looking at the magnitude of the effects between different indices, the cumulative abnormal returns for the inclusions during the run-up window indicate that the smaller companies in terms of market capitalisation may in fact experience a larger price impact than their counterparts with higher market value. The effects are even more visible when comparing the trading volume effects of smaller and larger stocks (taking as indication BEL20 and PSI20 as the indices with relatively small and N100 and CAC40 as the indices with large-market value inclusions and exclusions) over multiple event windows. While testing for the difference between the results remains out of the scope of this paper, we believe this to be an important observation that would merit further research.

The results presented in this paper have implications for two large stakeholder groups. First, our findings are not very good news to the arbitrageurs. The rather wide volatility and extent of most of the results between the different indices and types of events demonstrates that the events as such are not risk-free arbitrage opportunities because the prices move in unexpected directions for several indices (for example, the significant positive CARs at event window for the CAC40 exclusions). Thus, the investigated Euronext European indices do not provide clear arbitrage opportunities or relatively safe revision-related investment strategies because the size and often even the direction of the price reaction cannot be forecasted with certainty.

Second, the investors may benefit from the information revealed in this research. For investors who prefer to invest in the index stocks or whose mandates stipulate them to do so should avoid rebalancing their portfolios close to the effective date of the event in order to avoid buying the stocks too expensive or selling them too cheap. Delaying these transactions would decrease the costs as the prices are expected to reverse in a few weeks after the event. This would be a good strategy also for the index funds; avoiding the costs related to the rebalancing around the event would result in higher returns. However, it is unlikely that the index fund managers would do so because their aim is to minimise the tracking error with the index, based on which they are also compensated. Thus, they are willing to suffer higher costs.

8.4. Limitations

There are several factors that may have affected the obtained results. The period under investigation (2000-2011) includes also the crisis years, which hit the financial markets hard; the companies that were included to or excluded from an index at that period may not exhibit the same characteristics they would in normal times. It is possible that the turmoil on the markets affected the estimation of the relation between market return and normal return for the stock and consequently may have under- or overestimated the normal and consequently over- or underestimated the abnormal return.

While the overall sample is quite substantial for this type of study, looking at 5 separate indices divided the sample to rather small pieces, and the final sample sizes for BEL20 were below 10 for both the inclusions and exclusions. This is largely caused by the fact that for the majority of the research period the indices were rebalanced annually, creating a very limited pool of suitable events. While we do admit that the small sample size can create questions about the ability to make statistical inferences for a wider population of stocks, having a small sample is not uncommon for this type of studies which is why we do not consider the sample size to be a significant limitation to the work.

For the post-estimation window we used the period [ED+30;ED+150], which introduces potential survivorship bias. Since we required at least half of the estimation period's observations to be present for a company in order to be in the sample, the method excludes several non-survivors from the analysis. Consequently, some price effects may be over- or underestimated, however, we believe the impact is not substantial.

Our volume measure of daily number of stocks traded on event day in relation to the historic average trading volume of the same stock does not take into account the trading activity of the whole market. This may over- or underestimate the changes in trading volume for the individual stocks in case there is a general increase of trading in the respective market or a market-wide liquidity crunch. To ameliorate this, a market adjusted volume ratio could be used which incorporates the market volume at the event day and the historic market volume over the estimation period. Looking through the graphs of trading volumes for all the stocks included in the analysis revealed that there are, in general, no increasing or decreasing trends in the trading volumes for at least a year around the event. This indicates that the historic trading volume of the stock itself over the estimation period is a reliable measure of the normal trading volume during the event.

8.5. Suggestions for further research

While this thesis focuses specifically on the price and volume effects of index inclusions and exclusions, there are various related topics that merit further research. Here we bring out 4 of them. First, comparing the effects of a first-time inclusion and a repeat inclusion: i.e. are the inclusion effects the same for the stocks included to an index for the first time as for stocks that have been previously included in the same index as well. This would enable to investigate the Investor Awareness Hypothesis further and add to the research by Zhou (2011) whose results indicate a permanent price effect for first-time inclusions whereas only a temporary effect for repeat inclusions in the US. Thus, it would be interesting to investigate whether the effects also hold for the Euronext markets.

Second, it could be interesting to research the behaviour of various liquidity measures, such as the bid-ask spread, around the event. This would enable one to investigate the possible validity of the Liquidity Hypothesis and to better estimate the investor's benefits from holding the index stocks. Third, the price and volume effects for stocks included to or excluded from an index may differ across industries because firms in different industries vary with regards to betas and thus may have different sensitivity to such news. Examining the index effects by industries could also be used to investigate if and to what extent the price and volume effects uncovered in this paper are driven by the industry composition of the sample. Fourth, at various occasions we saw more pronounced effects in the prices and trading volumes for smaller companies (as measured by market capitalisation) than for larger companies. While testing for these differences remains outside the scope of this paper, it poses an interesting area for further research; more specifically, it would be interesting to know to which extent the index effects depend on the firm's size and whether the effects of an inclusion or exclusion differs within the same index.

9. Conclusion

This thesis researched the price and volume effects related to the index revisions on the Euronext indices N100, AEX, BEL20, CAC40 and PSI20. The sample of events included 145 inclusions to and 107 exclusions from the previously listed indices over the period 2000-2011. The abnormal returns were computed using the dummy variable approach to event study and the abnormal trading volume during the event was estimated with the Mean Volume Ratio analysis.

We find that the price and volume reaction to the index revision varies greatly across the 5 indices and also between the types of events – inclusions and exclusions. Overall, the Price Pressure Hypothesis finds the strongest support from the data being applicable to the stocks excluded from N100 and AEX as well as those included to BEL20 and PSI20. The CAC40 index is an outlier in the sense that the revealed effects are partly opposite to what was predicted – the positive CAR for inclusions pre-event is contrasted by a negative one as soon as the change comes into effect while, surprisingly, the exclusions exhibit a temporary positive price reaction. Regarding the volume, the trading activity increases temporarily for both types of events, but drops below the pre-event levels for the stocks excluded from CAC40.

The evidence depicting large differences between the various markets does not allow us to make generalisations regarding the theoretical explanations behind the index effects. It seems that no one explanation prevails because the reaction is largely index-specific and various factors affect the market behaviour simultaneously, often with opposing forces. Still, most commonly the inclusions to the indices exhibit temporary positive abnormal returns and higher trading volume especially just before the index changes become effective while the price and volume reaction to being excluded from the indices tends to remain insignificant.

The main implication of the analysis is that the price and volume effects are present for the Euronext European index revisions. The data strongly suggests that the index fund rebalancing activities are a major factor in driving the index effects around the effective day and there is no substantial informational content to the index revisions as the markets do not react notably to the announcement of the revisions.

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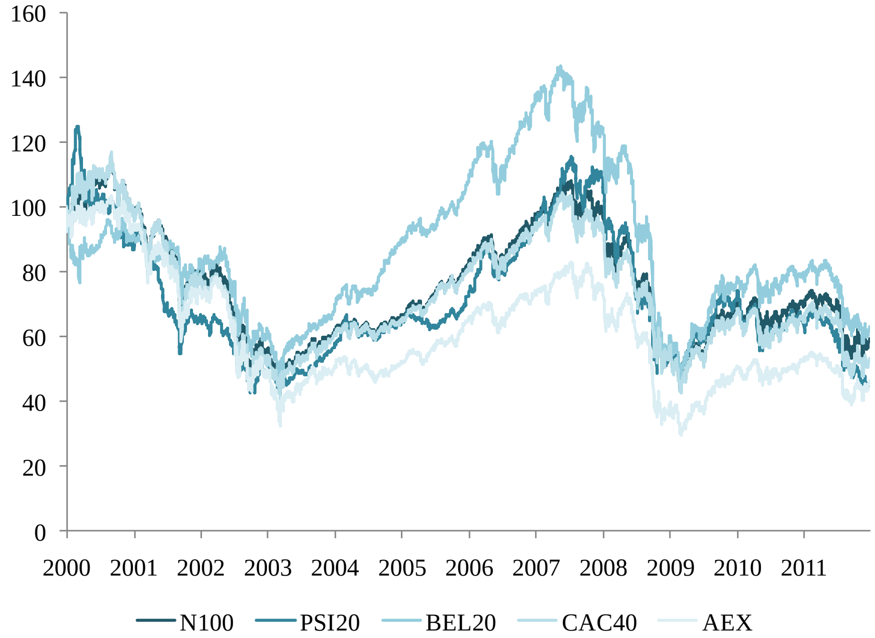
Appendix 1. Euronext European indices price development.

Graph 1. Price index development for N100, AEX, BEL20, CAC40 and PSI20.
Value at January 1, 2000 equals 100. Source: made by authors based on price index data from Datastream.



Appendix 2. Support for the theoretical explanations

Table 8. Support for the theoretical explanations from previous research. "X" denotes support for the explanation and "-" denotes evidence against the corresponding explanation. Source: made by authors based on previous literature.

Author(s)	Year	Index	Period	Price pressure	Imperfect substitutes	Liquidity	Investor awareness	Information content
Bechmann	2004	Danish KFX	1989-2001		X	X		
Becker-Blease and Paul	2010	S&P Small Cap S&P Mid Cap	1996-2003			X	X	
Beneish and Gardner	1995	Dow Jones Industrial Average				X		
Beneish and Whaley	1996	S&P 500	1986-1994	X		X		
Biktimirov et al	2004	Russell 2000	1991-2000	X				
Bildik and Gülay	2006	Istanbul ISE 100 & 30	1995-2000	-	-	X		
Blomstrand and Säftrand	2010	OMXS 30 & EURO STOXX 50	1996-2009	-	X		X	
Brooks et al	2004	S&P 500	1990-2002	-				X
Calafiore and Jackson	2008	Argentinian Merval index	1995-2007		X		X	
Cerqueira and Barros	2009	Portugese PSI 20	1997-2007	X				
Chakrabarti et al	2005	MSCI Standard Country Indices	1998-2001	X	X	X		
Chen et al	2004	S&P 500	1962-2000				X	
Chung and Kryzanowski	1998	Canadian TSE 300	1990-1994	X		X		
Deininger, Kaserer and Roos	2000	German DAX & MDAX	1988-1997	-	X	-		
Dhillon and Johnson	1991	S&P 500	1978-1988	-				X
Doeswijk	2005	Dutch AEX		X			X	
Duque and Madeira	2005	Portugese PSI 20	1996-2001	X		X		
Edmister et al	1996	S&P 500	1983-1989			X		
Elliot et al	2006	S&P 500	1993-2000	X	-	-	X	-
Fernandes and Mergulhao	2011	FTSE 100	1992-2010		X			
Goetzmann and Garry	1986	S&P 500	Nov 30, 1983					X
Gregoriou	2011	French CAC 40	1997-2001			X		
Gygax and Otchere	2010	S&P 500	1978-2006	X				X
Hacibedel and Bommel	2006	MSCI Emerging Markets Index	1996-2004				X	
Harris and Gurel	1986	S&P 500	1973-1983	X				
Hedge and McDermott	2002	S&P 500				X		
Hrazdil and Scott	2009	S&P 500	1987-1999					-
Jain	1987	S&P 500	1977-1983					X
Jog and Okomura	2003	Canadian TSE 300	1991-2000		X			
Kumar	2005	S&P CNX Nifty, Nifty Jr.	1996-2003	X				
Li and Sadeghi	2009	Chinese S&P/CITIC 300	2004-2007			X		X
Liu	2000	Nikkei 500	1991-1999		X			
Lynch and Mendenhall	1997	S&P 500	1990-1995	X	X			
Madhavan	2002	Russell indices	1996-2001	X		X		
Mase	2007	FTSE 100	1992-2005	X			-	
Masse et al	2000	Canadian TSE 300	1984-1994	X				
Mazouz and Saadouni	2007	FTSE 100	1984-2003	X				
Mohanty and Mishra	2005	S&P CNX Nifty	1996-2004	X				
Pullen and Gannon	2007	Australian S&P/ASX 200	2000-2002	X		-		-
Shankar and Miller	2006	S&P Small Cap	1995-2002	X				
Shleifer	1986	S&P 500	1966-1983		X			
Zhou	2011	S&P 500	1962-2008				X	
Vespro	2006	FTSE 100, CAC 40, SBF 120	1997-2001	X	-	-		-
Woolridge and Ghosh	1986	S&P 500	1977-1983	X		X		

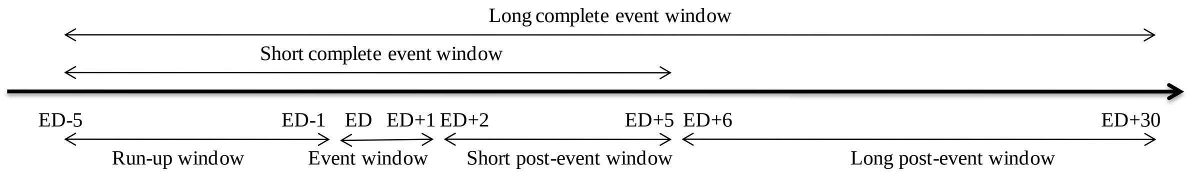
Appendix 3. Industry composition

Table 9. Industry composition of the sample. The numbers indicate how many observations in the sample belonged to each industry sector and index. The industry sectors are based on the widest industry classification by Euronext. Source: made by authors based on own analysis.

	Inclusions						Exclusions						Total sample					
Industry	**Total**	**N100**	**AEX**	**BEL**	**CAC**	**PSI**	**Total**	**N100**	**AEX**	**BEL**	**CAC**	**PSI**	**Total**	**N100**	**AEX**	**BEL**	**CAC**	**PSI**
Basic materials	14	5	1	2	2	4	11	3	1	2		5	25	8	2	4	2	9
Consumer goods	9	4	2	1	1	1	12	8	2		1	1	21	12	4	1	2	2
Consumer services	19	9	2	1	4	3	25	10	2	1	7	5	44	19	4	2	11	8
Financials	33	21	4	4	3	1	19	12	3		2	2	52	33	7	4	5	3
Healthcare	2			1	1		1			1			3	0	0	2	1	0
Industrials	35	20	6		5	4	18	12	2	2	2		53	32	8	2	7	4
Oil and gas	6	3	2		1		0						6	3	2	0	1	0
Technology	14	5	4			5	17	9	3	1		4	31	14	7	1	0	9
Telecommunications	6	4	1		1		3	2		1			9	6	1	1	1	0
Utilities	7	5			2		1				1		8	5	0	0	3	0
All industries	**145**	**76**	**22**	**9**	**20**	**18**	**107**	**56**	**13**	**8**	**13**	**17**	**252**	**132**	**35**	**17**	**33**	**35**

Appendix4. Event windows.

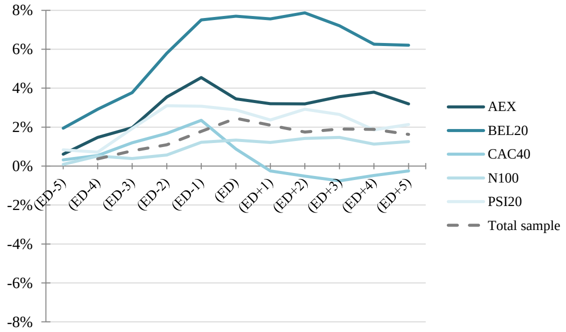
Graph 2. Event windows used in analysis. ED refers to the effective change day of the index revision – the event day. ED+1, ED+2 etc. indicate the day in relation to ED – 1 day after, 2 days after etc. Source: made by authors.



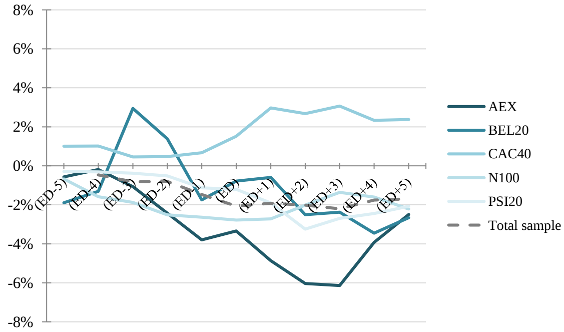
Appendix 5. Cumulative abnormal returns during the effective window

The abnormal returns are calculated similarly to dummy variable regression (1) whereas there is a separate dummy for each day in the event window (i.e. for the short complete event window there are 11 dummies in the regression and for the long complete event window there are 36 dummies). The regression is run separately for each event type and index combination as well as for all inclusions and all exclusions; the results are not presented in this paper due to space limitations.

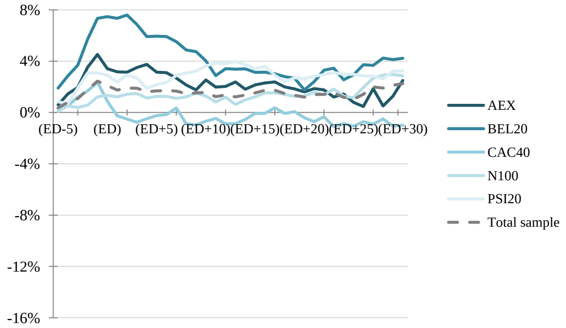
Graph 3. Cumulative abnormal returns for included stocks during the short complete event window.
Source: made by authors based on own analysis.



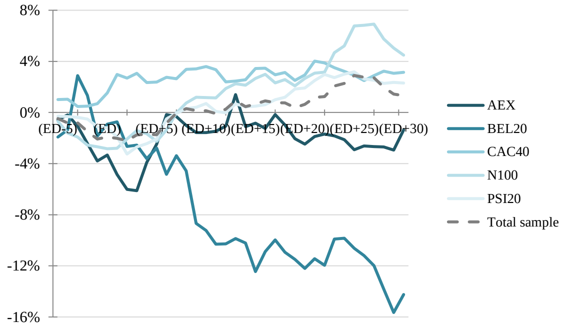
Graph 4. Cumulative abnormal returns for excluded stocks during the short complete event window
Source: made by authors based on own analysis.



Graph 5. Cumulative abnormal returns for included stocks during the long complete event window.
Source: made by authors based on own analysis.

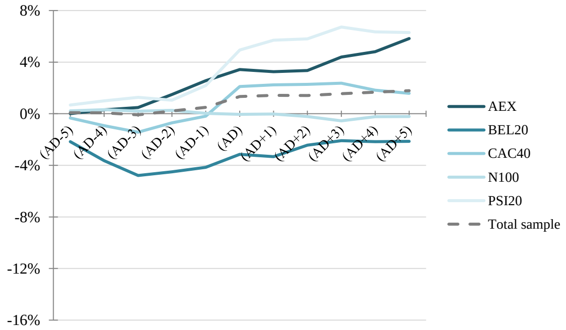


Graph 6. Cumulative abnormal returns for excluded stocks during the long complete event window.
Source: made by authors based on own analysis.

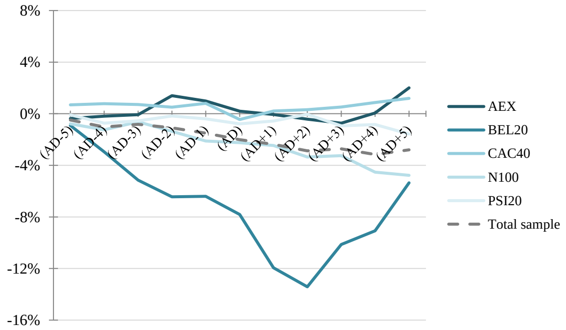


Appendix 6. Cumulative abnormal returns during the announcement window

Graph 7. Cumulative abnormal returns for included stocks.
Source: made by authors based on own analysis.



Graph 8. Cumulative abnormal returns for excluded stocks.
Source: made by authors based on own analysis.



Appendix 7. The regression results using Announcement Day (AD) as the event day

Table 10. Cumulative abnormal returns around the announcement day

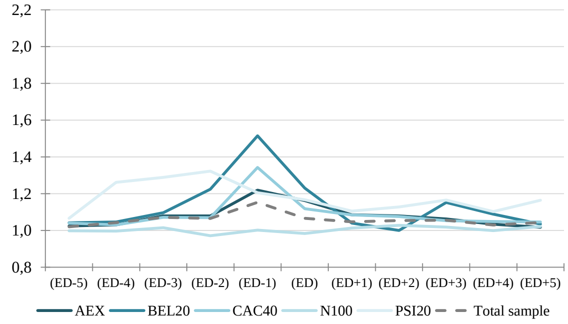
The table presents the results of the multiple regression with dummy variables for event windows (outlined in methodology). Effective day is the event day, and the dummies equal 1 for each day in the corresponding event window and 0 otherwise. Each intersection of event window and index represents a separate regression run (only 1 event window was included in a regression at a time). The regression reported Average Abnormal Return for a day in the event window; the CAR and standard error reported here are obtained by multiplying the regression AAR and corresponding standard error with the number of days in specific event window. The regression uses the post-event period (i.e. the base case) for estimating the "normal" returns.

Significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

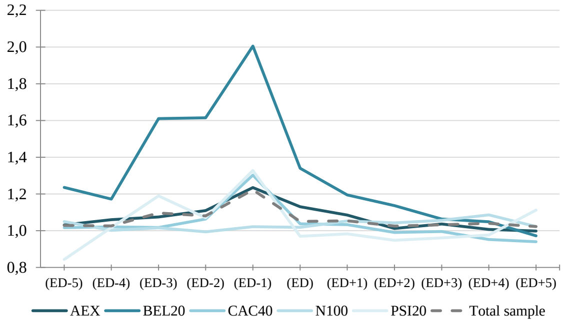
	Total sample		**N100**		**AEX**		**BEL 20**		**CAC 40**		**PSI 20**	
Period	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared
Inclusions												
N	138		71		22		9		18		18	
[AD-5;AD-1]	0.50%	0.235	0.03%	0.206	2.57% **	0.285	-4.15%	0.284	-0.19%	0.272	2.18% *	0.213
	(0.281)		(0.951)		(0.042)		(0.186)		(0.879)		(0.053)	
[AD;AD+1]	0.92% ***	0.238	-0.05%	0.206	0.69%	0.288	0.85%	0.320	2.43% ***	0.273	3.53% ***	0.220
	(0.000)		(0.851)		(0.411)		(0.253)		(0.001)		(0.000)	
[AD+2;AD+5]	0.36%	0.239	-0.20%	0.210	2.57%	0.288	1.21%	0.315	-0.66%	0.274	0.59%	0.210
	(0.363)		(0.735)		(0.010)		(0.316)		(0.511)		(0.604)	
[AD-5;AD+5]	1.78% ***	0.234	-0.21%	0.208	5.84% ***	0.285	-2.17%	0.272	1.58%	0.271	6.29% ***	0.206
	(0.009)		(0.806)		(0.002)		(0.542)		(0.390)		(0.001)	
Exclusions												
N	99		51		13		8		11		16	
[AD-5;AD-1]	-1.51% *	0.181	-2.11%	0.202	0.93%	0.154	-6.40% **	0.101	0.81%	0.306	-0.39%	0.048
	(0.070)		(0.138)		(0.599)		(0.030)		(0.403)		(0.644)	
[AD;AD+1]	-0.86% *	0.180	-0.35%	0.205	-1.04%	0.142	-5.55%	0.105	-0.60%	0.301	-0.17%	0.049
	(0.077)		(0.543)		(0.461)		(0.115)		(0.530)		(0.835)	
[AD+2;AD+5]	-0.43%	0.180	-2.31% ***	0.210	2.06%	0.139	6.58%	0.090	0.98%	0.302	-1.02%	0.049
	(0.563)		(0.010)		(0.395)		(0.209)		(0.395)		(0.233)	
[AD-5;AD+5]	-2.80% **	0.178	-4.78%	0.206	2.00%	0.140	-5.34%	0.085	1.20%	0.301	-1.57%	0.047
	(0.024)		(0.008)		(0.556)		(0.466)		(0.526)		(0.295)	

Appendix 8. Volume effects around the effective change day (ED)

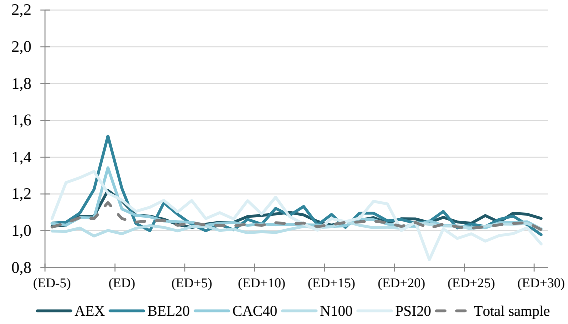
Graph 5. Average daily volume ratios for index inclusions over the short complete event window.
Source: made by authors based on own analysis.



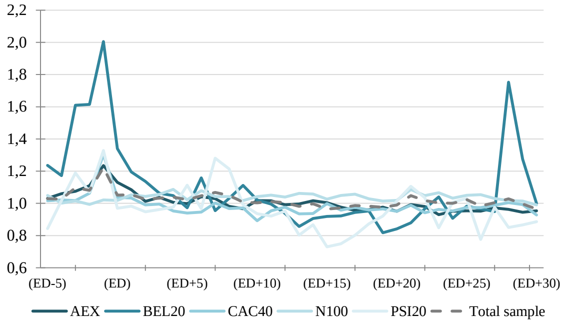
Graph 6. Average daily volume ratios for index exclusions over the short complete event window.
Source: made by authors based on own analysis.



Graph 7. Average daily volume ratios for index inclusions over the long complete event window.
Source: made by authors based on own analysis

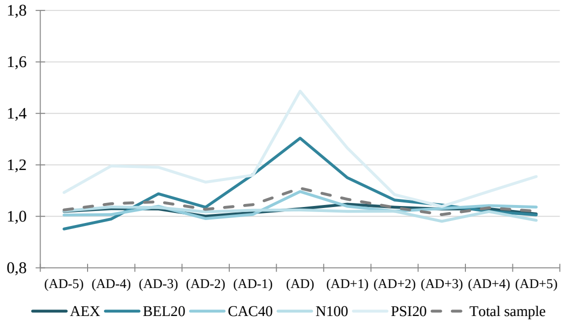


Graph 8. Average daily volume ratios for index exclusions over the long complete event window.
Source: made by authors based on own analysis.

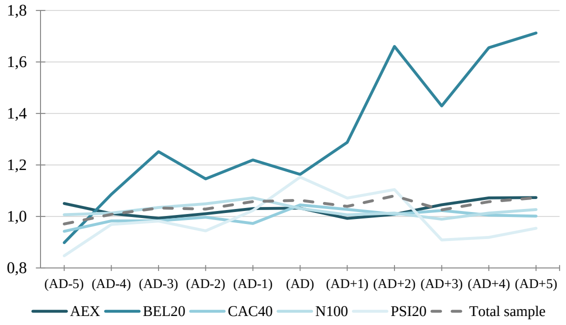


Appendix 9. Volume effects around the announcement day (AD)

Graph 9. Average volume ratio for inclusions.
Source: made by authors based on own analysis



Graph 10. Average volume ratio for inclusions.
Source: made by authors based on own analysis



Appendix 10. Significance of daily volume ratios around ED.

Table 11. Daily mean volume ratios (MVR) around the effective change day.

The p-value of two-sided t-tests checking whether the samples equal 1 are in the parentheses under MVRs. The number of observations (N) is accompanied by the percentage of how many observations in the sub-sample are larger than 1. Significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

Inclusions

	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR
	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)
ED-5	117	1.02	57	1.00	22	1.02	8	1.04	18	1.04	12	1.07
	(46%)	(0.247)	(40%)	(0.956)	(55%)	(0.110)	(63%)	(0.454)	(44%)	(0.218)	(50%)	(0.541)
ED-4	140	1.04 **	74	1.00	22	1.03	8	1.05	18	1.03	18	1.26 ***
	(49%)	(0.015)	(34%)	(0.851)	(64%)	(0.124)	(75%)	(0.354)	(56%)	(0.322)	(72%)	(0.007)
ED-3	139	1.07 ***	75	1.02	22	1.08 ***	8	1.10 **	16	1.07 ***	18	1.29 **
	(64%)	(0.001)	(51%)	(0.454)	(86%)	(0.000)	(75%)	(0.036)	(88%)	(0.009)	(67%)	(0.038)
ED-2	132	1.07 ***	67	0.97	22	1.08 ***	8	1.22 **	17	1.07 **	18	1.32 **
	(55%)	(0.008)	(34%)	(0.220)	(77%)	(0.001)	(88%)	(0.042)	(76%)	(0.035)	(67%)	(0.019)
ED-1	117	1.15 ***	56	1.00	22	1.22 ***	8	1.51 ***	18	1.34 ***	13	1.21 ***
	(76%)	(0.000)	(54%)	(0.934)	(95%)	(0.000)	(100%)	(0.006)	(100%)	(0.000)	(92%)	(0.006)
ED	141	1.07 ***	75	0.98	22	1.16 ***	8	1.23 *	18	1.12 ***	18	1.17 **
	(68%)	(0.000)	(48%)	(0.442)	(100%)	(0.000)	(88%)	(0.068)	(89%)	(0.000)	(83%)	(0.020)
ED+1	139	1.05 ***	73	1.01	22	1.09 ***	8	1.04	18	1.08 ***	18	1.11
	(65%)	(0.003)	(58%)	(0.525)	(77%)	(0.000)	(63%)	(0.549)	(89%)	(0.007)	(56%)	(0.177)
ED+2	139	1.05 ***	73	1.03 *	22	1.08 ***	8	1.00	18	1.08 **	18	1.13
	(67%)	(0.000)	(59%)	(0.073)	(86%)	(0.000)	(63%)	(0.997)	(78%)	(0.021)	(67%)	(0.128)
ED+3	141	1.06 ***	75	1.02	22	1.06 ***	8	1.15 ***	18	1.05 **	18	1.17 *
	(65%)	(0.001)	(56%)	(0.321)	(77%)	(0.001)	(88%)	(0.009)	(78%)	(0.027)	(61%)	(0.091)
ED+4	140	1.03	74	1.00	22	1.03 **	8	1.09	18	1.05	18	1.10
	(53%)	(0.101)	(45%)	(0.971)	(64%)	(0.030)	(63%)	(0.167)	(61%)	(0.237)	(61%)	(0.342)
ED+5	138	1.04 **	74	1.02	22	1.02	8	1.04	16	1.05	18	1.16
	(60%)	(0.011)	(58%)	(0.207)	(59%)	(0.394)	(88%)	(0.494)	(63%)	(0.191)	(56%)	(0.106)

Exclusions

	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR
	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)
ED-5	90	1.03	43	1.05 **	13	1.03	8	1.24	13	1.02	13	0.84
	(59%)	(0.302)	(65%)	(0.014)	(62%)	(0.328)	(63%)	(0.353)	(46%)	(0.623)	(46%)	(0.108)
ED-4	107	1.03	56	1.00	13	1.06	8	1.17	13	1.02	17	1.02
	(60%)	(0.265)	(57%)	(0.935)	(62%)	(0.292)	(75%)	(0.176)	(62%)	(0.194)	(59%)	(0.880)
ED-3	105	1.10 **	56	1.02	13	1.08	8	1.61	11	1.02	17	1.19
	(61%)	(0.044)	(55%)	(0.452)	(77%)	(0.112)	(75%)	(0.256)	(73%)	(0.318)	(53%)	(0.237)
ED-2	99	1.08 *	49	0.99	13	1.11 ***	8	1.61	12	1.06 ***	17	1.07
	(64%)	(0.071)	(49%)	(0.805)	(85%)	(0.002)	(88%)	(0.237)	(100%)	(0.001)	(53%)	(0.416)
ED-1	91	1.22 ***	44	1.02	13	1.23 ***	8	2.01	13	1.30 ***	13	1.33 ***
	(78%)	(0.000)	(59%)	(0.481)	(92%)	(0.000)	(100%)	(0.103)	(100%)	(0.000)	(92%)	(0.000)
ED	105	1.06 **	56	1.02	13	1.13 ***	8	1.34 *	12	1.04 *	16	1.03
	(66%)	(0.011)	(59%)	(0.356)	(77%)	(0.006)	(88%)	(0.076)	(83%)	(0.077)	(56%)	(0.756)
ED+1	105	1.05 *	54	1.05 *	13	1.08 ***	8	1.20	13	1.03 *	17	0.98
	(64%)	(0.062)	(63%)	(0.056)	(85%)	(0.005)	(63%)	(0.158)	(77%)	(0.051)	(41%)	(0.906)
ED+2	104	1.03	54	1.04 *	13	1.01	8	1.14	13	0.99	16	0.95
	(59%)	(0.298)	(65%)	(0.062)	(54%)	(0.668)	(50%)	(0.431)	(54%)	(0.614)	(50%)	(0.641)
ED+3	107	1.03	56	1.06 ***	13	1.04	8	1.06	13	1.00	17	0.96
	(58%)	(0.109)	(61%)	(0.005)	(54%)	(0.217)	(63%)	(0.120)	(54%)	(0.874)	(53%)	(0.710)
ED+4	106	1.04 *	55	1.09 ***	13	1.01	8	1.05	13	0.95 **	17	0.98
	(55%)	(0.091)	(73%)	(0.000)	(46%)	(0.832)	(50%)	(0.602)	(15%)	(0.011)	(35%)	(0.838)
ED+5	103	1.02	55	1.02	13	1.00	8	0.97	10	0.94	17	1.11
	(49%)	(0.358)	(53%)	(0.236)	(31%)	(0.950)	(50%)	(0.668)	(10%)	(0.102)	(71%)	(0.398)

Appendix 11. Mean volume ratios around the announcement day (AD).

Table 12. Mean volume ratios (MVR) over the event windows around the announcement day (AD).
The p-value of two-sided t-tests checking whether the samples equal 1 are in the parentheses under MVRs. The number of observations (N) is accompanied by the percentage of how many observations in the sub-sample are larger than 1. Significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR	N	MVR
	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)	(% >1)	(p-value)
Panel I: Inclusions												
[AD-5;AD-1]	141	1.04 ***	75	1.03 *	22	1.02	8	1.06	18	1.01	18	1.15 *
	(55%)	(0.005)	(57%)	(0.072)	(64%)	(0.299)	(50%)	(0.546)	(33%)	(0.705)	(56%)	(0.075)
[AD;AD+1]	141	1.09 ***	75	1.02	22	1.04	8	1.23	18	1.07 **	18	1.38 ***
	(64%)	(0.000)	(53%)	(0.289)	(77%)	(0.113)	(63%)	(0.155)	(72%)	(0.011)	(83%)	(0.001)
[AD+2;AD+5]	141	1.02	75	0.99	22	1.03	8	1.03	18	1.03	18	1.13 *
	(50%)	(0.107)	(39%)	(0.710)	(64%)	(0.193)	(50%)	(0.503)	(67%)	(0.148)	(61%)	(0.074)
[AD-5;AD+5]	141	1.05 ***	75	1.02	22	1.02	8	1.08	18	1.03	18	1.19 **
	(57%)	(0.002)	(51%)	(0.236)	(73%)	(0.170)	(63%)	(0.376)	(56%)	(0.222)	(61%)	(0.021)
Panel II: Exclusions												
[AD-5;AD-1]	107	1.02	56	1.04 ***	13	1.02	8	1.12	13	0.98 *	17	0.95
	(56%)	(0.237)	(64%)	(0.010)	(54%)	(0.348)	(63%)	(0.330)	(31%)	(0.088)	(47%)	(0.535)
[AD;AD+1]	107	1.05 **	56	1.02	13	1.02	8	1.23	13	1.04 **	17	1.11
	(61%)	(0.018)	(55%)	(0.291)	(62%)	(0.482)	(88%)	(0.288)	(62%)	(0.017)	(65%)	(0.155)
[AD+2;AD+5]	107	1.06	56	1.01	13	1.05	8	1.61	13	1.01	17	1.01
	(53%)	(0.220)	(55%)	(0.486)	(62%)	(0.141)	(63%)	(0.342)	(54%)	(0.357)	(35%)	(0.950)
[AD-5;AD+5]	107	1.04	56	1.02	13	1.03	8	1.32	13	1.00	17	1.00
	(58%)	(0.143)	(61%)	(0.067)	(62%)	(0.203)	(75%)	(0.334)	(54%)	(0.891)	(41%)	(0.985)

Appendix 12. Dummy regression results for abnormal returns, using pre-event estimation window for normal returns

Table 13. Cumulative abnormal returns around the effective day.

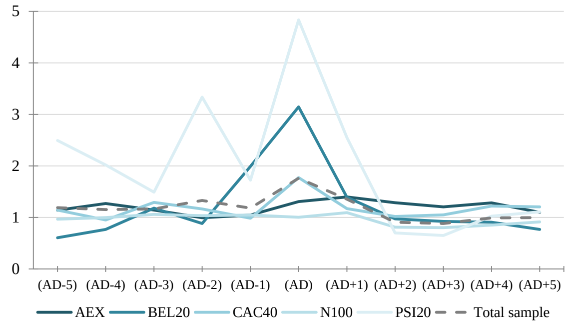
The table presents the results of the multiple regression with dummy variables for event windows (regression 1 under methodology). Effective day is the event day, and the dummies equal 1 for each day in the corresponding event window and 0 otherwise. Each intersection of event window and index represents a separate regression run (only 1 event window was included in a regression at a time). The regression reported Average Abnormal Return for a day in the event window; the CAR and standard error reported here are obtained by multiplying the regression AAR and corresponding standard error with the number of days in specific event window. The regression uses the pre-event period for estimating the “normal” returns.

Significance of the tests is denoted by *, ** and *** for 10%, 5% and 1% significance level, respectively.

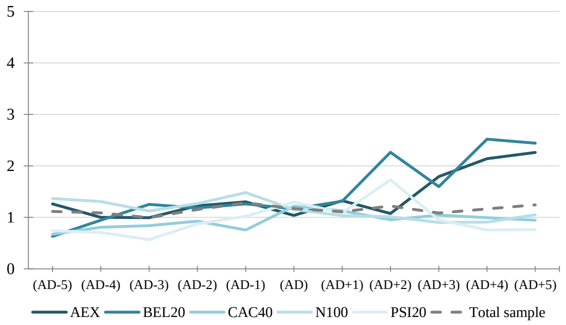
	Total sample		N100		AEX		BEL 20		CAC 40		PSI 20	
Period	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared	CAR (p-value)	R-squared
Inclusions												
N	131		69		22		7		17		16	
[ED-5;ED-1]	1.37% ***	0.144	0.23%	0.128	3.41% **	0.198	4.12% **	0.159	1.48%	0.265	2.54%	0.047
	(0.002)		(0.607)		(0.013)		(0.019)		(0.109)		(0.197)	
[ED;ED+1]	-1.09% ***	0.145	-0.52% *	0.126	-1.77% **	0.200	-0.52%	0.164	-2.95% ***	0.267	-0.78%	0.044
	(0.000)		(0.065)		(0.040)		(0.600)		(0.000)		(0.288)	
[ED+2;ED+5]	-0.71% *	0.144	-0.40%	0.124	-0.87%	0.199	-1.97%	0.159	-1.12%	0.268	-0.85%	0.045
	(0.069)		(0.431)		(0.357)		(0.254)		(0.115)		(0.568)	
[ED+6;ED+30]	-3.30% ***	0.163	-1.50%	0.137	-6.26% *	0.243	-5.02%	0.157	-4.09%	0.271	-4.28% *	0.048
	(0.002)		(0.292)		(0.073)		(0.181)		(0.101)		(0.065)	
[ED-5;ED+5]	-0.42%	0.145	-0.68%	0.128	0.78%	0.201	1.59%	0.151	-2.59% *	0.268	0.88%	0.045
	(0.527)		(0.375)		(0.692)		(0.577)		(0.075)		(0.741)	
[ED-5;ED+30]	-3.73% ***	0.163	-2.20%	0.139	-5.39%	0.244	-3.28%	0.145	-6.71% **	0.274	-3.40%	0.049
	(0.006)		(0.203)		(0.201)		(0.512)		(0.030)		(0.374)	
Exclusions												
N	107		55		13		8		14		17	
[ED-5;ED-1]	-1.25% *	0.202	-1.87% **	0.218	-2.73%	0.162	1.06%	0.207	1.13%	0.287	-1.23%	0.066
	(0.072)		(0.026)		(0.200)		(0.850)		(0.334)		(0.177)	
[ED;ED+1]	0.10%	0.202	-0.09%	0.216	-0.82%	0.158	2.27%	0.227	1.44% *	0.284	-0.81%	0.070
	(0.822)		(0.896)		(0.574)		(0.116)		(0.085)		(0.217)	
[ED+2;ED+5]	0.69%	0.203	0.80%	0.216	2.84%	0.164	-0.34%	0.230	-0.47%	0.291	-0.10%	0.066
	(0.274)		(0.366)		(0.319)		(0.869)		(0.627)		(0.920)	
[ED+6;ED+30]	6.21% ***	0.204	9.70% ***	0.225	4.02%	0.152	-0.97%	0.206	1.53%	0.307	3.60%	0.060
	(0.000)		(0.000)		(0.493)		(0.888)		(0.586)		(0.114)	
[ED-5;ED+5]	-0.46%	0.204	-1.18%	0.223	-0.69%	0.161	2.98%	0.208	2.10%	0.289	-2.14%	0.066
	(0.666)		(0.420)		(0.862)		(0.633)		(0.246)		(0.162)	
[ED-5;ED+30]	5.70% ***	0.207	8.48% ***	0.232	3.29%	0.153	1.97%	0.191	3.69%	0.308	1.38%	0.058
	(0.006)		(0.005)		(0.662)		(0.839)		(0.298)		(0.628)	

Appendix 13. Volume ratio graphs when using raw (unadjusted) data.

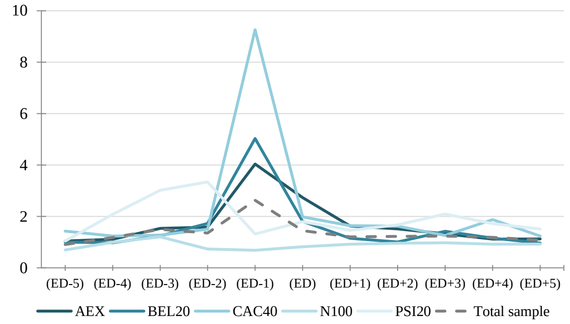
Graph 11. Average daily volume ratios for index inclusions around AD over the complete event window.
Source: made by authors based on own analysis.



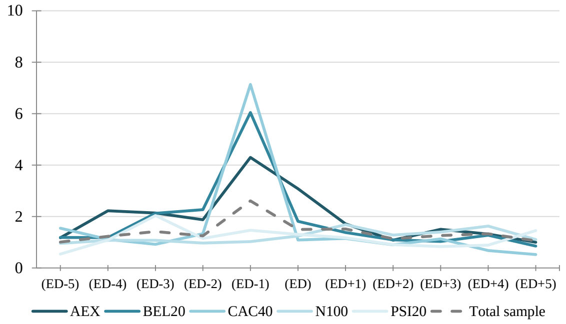
Graph 12. Average daily volume ratios for index exclusions around AD over the complete event window.
Source: made by authors based on own analysis.



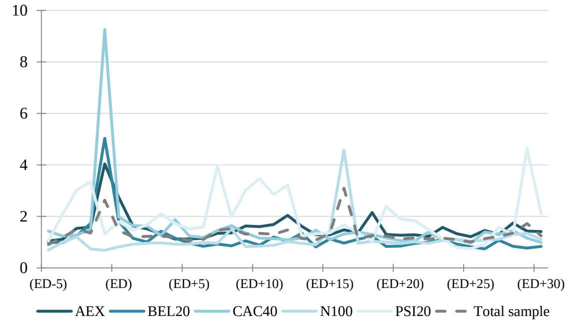
Graph 13. Average daily volume ratio for index inclusions around ED over the short complete event window.
Source: made by authors based on own analysis.



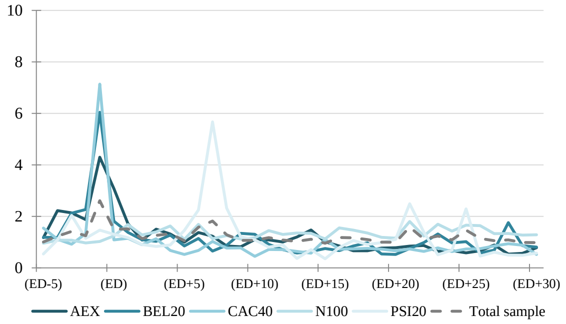
Graph 14. Average daily volume ratio for index exclusions around ED over the short complete event window.
Source: made by authors based on own analysis.



Graph 15. Average daily volume ratio for index inclusions around ED over the long complete event window.
Source: made by authors based on own analysis.



Graph 16. Average daily volume ratio for index exclusions around ED over the long complete event window.
Source: made by authors based on own analysis.



Appendix 14. Supported and rejected hypotheses by indices and event type

Table 14. Support for and evidence against the posed hypotheses. The table presents the support for our hypotheses. The "Good" are the results which are statistically significant and conform to our expectations, the "Bad" results are statistically significant but contrary to our expectations and the "Insignificant" results are statistically insignificant. The results with a slash represent the corresponding outcome for inclusions/exclusions. Source: made by authors based on own analysis.

Index	H1:	H2:	H3:	H4:	H5:
N100	Good	Good	Bad/Good	Insig./Good	Insig./Good
AEX	Good	Good	Good/Good	Good/Good	Bad/Good
BEL20	Good	Insignificant	Good/Insig.	Good/Good	Good/Good
CAC40	Good	Bad	Good/Good	Good/Good	Good/Bad*
PSI20	Good	Insignificant	Good/Insig.	Good/Insig.	Good/Insig.

** Volume not only reverses, but drops below historic levels*

H1: Included stocks experience significant positive abnormal returns around the event.
H2: Excluded stocks experience significant negative abnormal returns around the event; the price reaction is weaker compared to inclusions.
H3: Abnormal returns disappear in the long run.
H4: Trading volume increases around the event for both inclusions and exclusions.
H5: Trading volumes return to historic levels in the longer term after the event.