ERASMUS UNIVERSITY ROTTERDAM
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Master Thesis Financial Economics

The index effect: A profit opportunity for the ordinary investor?

An empirical study of price, volume, and liquidity effects for index revisions.

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Abstract

This thesis empirically examines the price, volume and liquidity effect concerning index revisions on six European indices. The inclusion effects include permanently positive price, volume, and liquidity effects while the exclusion effects include permanently negative price and liquidity effects, but no significant change in trading volume is documented compared to the estimation period. Investors are willing to trade excluded stocks, even though higher total trading costs are involved. The inclusion and exclusion effects support both the Imperfect Substitute Hypothesis and the Liquidity Hypothesis.

Table of contents

Introduction

Prior research has found that stocks that are included in or excluded from an index are prone to price changes, the index effect. The selection methodology used by index providers ought to be based on objective criteria and an inclusion should, therefore, not signal favorable information to investors. Another possibility could be the increased popularity of index investing. With a change of indices, index funds need to rebalance their portfolio while trying to keep the tracking error to a minimum. This may create a profit opportunity for arbitrageurs knowing that funds need to rebalance, resulting in temporary heightened prices. Whether any of the existing theories explain the effect depends on the characteristics of the index effect.

Most of the existing research regarding the index effect has been done on S&P 500 index (Shleifer, 1986; Harris & Gurel, 1986; Jain, 1987; Beneish & Whaley, 1996, 2002). Shleifer (1986) and Jain (1987) find significant abnormal returns following inclusions to the S&P 500 index and do not find any reversal effect, which is consistent with downward sloping demand curves. However, Jain also performs tests on supplementary indices by the S&P 500, which serve as a control group as funds do not replicate them and does not find statistically different abnormal returns as those obtained from the S&P 500 inclusions. Harris and Gurel (1986) do find a return reversal following index inclusion. They find temporary elevated levels of demand when index funds need to rebalance their portfolios. Although there is no full reversal of prices, they cannot reject complete reversal of the abnormal returns during the event period. Kaul, Mehrotra and Morck (2000) research the index effect on the Toronto Stock Exchange by testing the abnormal returns and the excess turnover. Cumulative abnormal returns remain significantly positive for at least seven weeks while excess turnover diminishes within the first two weeks. The result supports downward sloping demand curves.

In contrast to the United States market, less research on the index effect exists on the European market. Doeswijk (2005) anticipates which stocks will benefit from the index revision of the AEX and investigates their performance. His research not only embraces the inclusions and exclusions, but all potential winners and losers from the revision. Doeswijk finds outperformance of winners and temporary price pressure around the revision day and also documents significant returns pre-announcement, which indicates an accurate prediction of the revision changes by investors. Blomstrand and Säfstrand (2010) investigate the index effect on the EURO STOXX 50 and OMXS30. The results imply that only the larger exchange exhibits a temporary effect as it has more close substitutes and more elastic demand curves.

This paper will consider the Efficient Market Hypothesis, Price Pressure Hypothesis, Imperfect Substitute Hypothesis and Liquidity Hypothesis. To determine which of these hypotheses dominates, an examination is made what an index revision does to the slope and position of the demand curve. A downward sloping demand curves will nullify the possibility of efficient markets. A shift in the demand curve indicates a new equilibrium in favor of both the Imperfect Substitute Hypothesis and Liquidity Hypothesis. The price, volume, and liquidity effects concerning index revisions of six European stock exchanges are documented.

Several effects are hypothesized before conducting the research. First, it is expected to document positive price effects for inclusions and negative price effects for exclusions after announcement. In the short term, trading volume and liquidity will increase for both inclusions and exclusions. These effects will remain positive for inclusions while the volume and liquidity effects will be negative for exclusions in the long term. Furthermore, it is expected that index fund size will have a positive effect on trading volumes around effective date.

However, the results show that already before announcement of an inclusion an appreciation of the stock price exist. Investors are able to predict the index revisions based on the transparent, publicly available, selection procedures of the index providers. Investors with a selection bias will rebalance their portfolio accordingly. The increased volume predominantly caused by index funds on the day preceding effective date will not significantly change prices. The bid/ask spreads show that the immense demand on this day will decrease liquidity and increase trading costs. The reversal tests show that the appreciation during the period before announcement will not reverse in the weeks after the composition changes become effective. The results show that the inclusion effects include permanently higher prices, volume, and liquidity, which are in favor of both the Imperfect Substitute Hypothesis and the Liquidity Hypothesis. The exclusion effects include permanently lower prices and lower liquidity, but no real change in volume. Again, these effects provide evidence in favor of the Imperfect Substitute Hypothesis and the Liquidity Hypothesis.

The paper will be outlined as followed. Section 1 reviews the existing literature on index revisions. It will touch upon earlier research on the United States market as well as the European market. Section 2 discusses the research methodology, after which, the data will be described in Section 3. Section 4 will review the theoretical framework and state several hypotheses. The price effects, and changes in volume and bid/ask spread are discussed in Section 5. A discussion and limitations will be addressed in Section 6 and Section 7, respectively. Section 8 concludes the study.

1. Literature review

A fundamental basis of many economic theories is formed by the assumption that capital markets are efficient. In an ideal situation, the market perfectly signals the allocation of capital by the accurate pricing of assets. The paper by Fama (1970) is part of the main literature that proposes the existence of efficient capital markets. It evaluates both the existing theoretical and empirical frameworks of efficient capital markets. This is a market in which a security's price always fully reflect all available information at that time, which translates into a perfectly elastic, horizontal, demand curve. Furthermore, any discrepancies in the price will be arbitraged away in seconds and demand will only shift with newly available information. The efficient market hypothesis has three forms. The weak form is based on historical price returns. The semi-strong form includes all publicly available information. And lastly, the strong form incorporates all information, both publicly and privately available. Fama (1970) concludes the presence of efficient capital markets although not in the strong form, which should merely serve as a control state.

Scholes (1972) is an early author to investigate the slope of the demand curve by using secondary distributions. Scholes finds positive price reactions to large block purchases and negative price reactions to large block sales. However, the author finds that the price impact mainly depends on the identity of the seller, thereby, indicating unfavorable information. Mickelson and Partch (1985) also document the stock price effects of secondary distributions and find evidence in favor of downward sloping demand curves. Large number of shares could not be sold at the prevailing market price. In accordance with Scholes (1972), they find a larger price impact for notable sellers and for larger block sales, also indicating unfavorable information. As opposed to secondary distributions, index revisions should be free of any new information. In line with this theory, an index revision event should not include a price effect as this does not reveal any new information and a prediction error, a deviation in returns compared to the estimation period, should not be produced during this event. With other words, the demand curve is horizontal in an information-free event as index revisions ought to be. Any statistically significant permanent prediction error present in such an event implies a different slope of the demand curve and a violation of the efficient market theorem and depending on the situation and dimension of the effect can be explained by hypotheses found in other literature.

Shleifer (1986) and Harris & Gurel (1986) investigate price reactions to index revisions of the S&P 500 in a similar setup. Both papers find positive abnormal returns after inclusion

announcements and are increasing throughout the sample, for which they argue that the growing of index funds are the main contributors. Subsequently, the heightened levels of the daily trading volumes near the effective date prove the rebalancing of these index funds. Due to the temporary nature of the volume effect, the evidence is consistent with downward sloping demand curves. The slope predicts that a stock's increased demand after inclusion will result in, at least temporary, higher prices. Further research on price reversals could clarify if the price pressures are consistent with the Price Pressure Hypothesis or the Imperfect Substitute Hypothesis. The first predicts heightened prices due to a temporary higher trading volume by investors after which the prices return to their original levels. The latter predicts a permanent increase in the price of a stock as securities that are exchanged into and from the indices are not perfect substitutes, and therefore, demand is not perfectly elastic. Although both event studies on the S&P 500 of Shleifer (1986) and Harris & Gurel (1986) were performed using the same sample period, the authors come to different conclusions. Shleifer (1986) finds evidence in favor of the Imperfect Substitutes Hypothesis through significant heightened volumes and no price reversals in the period after index revision implying the slow rebalancing of portfolios by index funds. Harris & Gurel (1986) support the price pressure hypothesis by finding systematic price reversals, although not a complete reversal. A possible explanation could be a permanently increased liquidity due to more scrutiny from investors and analysts.

Amihud and Mendelson (1986) investigate the liquidity of a stock around an index revision. They argue that an investor can either wait to trade at favorable prices or trade immediately at the prevailing bid or ask price. In the latter case, the investor will buy at a premium or sell at a concession. The measure of illiquidity is the sum of the premium and the concession, which is the spread between the bid and the ask quotes. An index inclusion will increase attention from investors and analysts, which decreases information asymmetry and improves liquidity of a stock. As a result, bid/ask spreads narrow. The same path of reasoning vice versa holds for exclusions. The Liquidity Hypothesis predicts that a widening bid/ask spread will increase expected stock returns at a diminishing rate. Thus, a less liquid stock should compensate the investor with higher expected returns, which translate to lower prices. The liquidity effect, as specified by Amihud and Mendelson (1986), should result in permanently elevated prices for index inclusions. Green and Jame (2011) study the trade response of index funds to the predicted price effects coming from S&P 500 index revisions. Index funds face the tradeoff between higher expected returns and the increased costs of a higher tracking error. The authors find that index funds trade away from the effective date based on the characteristics of the fund. The strategic trading around the effective day is also

positively related to the size of the index funds. Large index funds are more plausible to trade away from the effective date as the demand more liquidity for rebalancing their portfolios.

Jain (1987) argues that the index revision event may not be entirely free of information by using the supplementary indices of the S&P 500 as a benchmark. The expectation is that the price effect should not exist in these indices as these are not followed by index funds. However, the supplementary indices experience similar abnormal returns as the main index, hence, there may be informational content in a revision event of the S&P 500. Therefore, a specific index revision event is empirically examined by Kaul, Mehrotra & Morck (2000). This event is interesting as the revision was due to a redefinition of the public float, which caused new weightings of the included stocks. The event should not possess any information for four reasons. First, the announcement occurred several months before the revision, and should, therefore, be fully anticipated for in the prices. Second, the new weightings were publicly available. Third, as the redefinition was already in use by the Ontario Securities Commission, there are no regulatory effects. Fourth, the event did not include any new constituents to the index, so the certification of stock quality is also ruled out. The authors find economically significant outperformance during the event week, along with unusually high trading volume, which is consistent with the portfolio rebalancing of index funds. There appears to be no price reversal during the period after the event week even though trading volume reverts to normal levels.

Doeswijk (2005) investigates all stocks that will benefit from an AEX index revision event and finds that those stocks with a positive weight change will outperform. In addition, the paper documents an outperformance of stocks before the announcement date, which indicates the correct prediction of index composition changes. Similarly, Algra (2016), who also examines the AEX index, finds an abnormal return of 1.15 percent in the five days before the announcement and concludes that investors are able to predict which stocks are eligible for promotion to an index.

The literature in this section discusses four hypotheses, which are Efficient Market Hypothesis, Price Pressure Hypothesis, Imperfect Substitute Hypothesis and Liquidity Hypothesis. The Efficient Market Hypothesis predicts a horizontal, perfectly elastic, demand curve. Thus, an index revision event, under the condition that it possesses no information, should have no price effect. The Price Pressure Hypothesis predicts elevated prices and volumes around effective date, which should return to normal levels. The Price Pressure Hypothesis is consistent with a downward sloping demand curve and the long-term equilibrium is not changed. Furthermore, the Imperfect Substitute Hypothesis is consistent with a

downward sloping demand curve and assumes that the stock which replaces the other are not close substitutes. In order to meet the demand, the demand curve shifts outwards with a new equilibrium. The change in trading volume depends on the trading behavior of the investor. Although, the Liquidity Hypothesis also shifts the demand curve, but can be differentiated from the Imperfect Substitute Hypothesis in that it explicitly specifies a permanent increase in liquidity for inclusions and a decrease in liquidity for exclusions.

2. Research methodology

A paper by MacKinlay (1997) describes the use of an event study in an economical and financial context and summarizes the previous literature on the subject. Using stock market data of a firm, an event study is a simple methodology tool for measuring the impact of an event on the performance of that firm in terms of market value. The comprehension of the mechanism is simple as the effect of the event is documented as the discrepancy between the expected returns and the actual returns. The expected returns are calculated using the regression coefficients during a period before the event with the assumption that the development of the stock price would have been constant without the interference of an event. An index revision perfectly fits the description of such event. In accordance with Shleifer (1986), the event study that will be used is pioneered by Fama, Fisher, Jensen, and Roll (1969) as implemented by Ruback (1982). As trading days are not continuous, the data is nonsynchronous, and the measured returns of the securities are first-order serial dependent. This limitation will be addressed in Section 7. The following simple market model as specified by Ruback (1982) is used:

$$\tilde{r}_{nt} = \alpha_n + \beta_n \tilde{r}_{mt} + \tilde{\varepsilon}_{nt} \quad (1)$$

where

$\tilde{r}_{nt}$ = rate of return of a security n over day t

$\tilde{r}_{mt}$ = rate of return of a value weighted market portfolio over day t

$\beta_n = \frac{cov(\tilde{r}_{nt}, \tilde{r}_{mt})}{var(\tilde{r}_{mt})}$

$\alpha_n = E(\tilde{r}_n) - \beta_n E(\tilde{r}_m)$

$\tilde{\varepsilon}_{nt}$ = disturbance term of security n on day t and $E(\tilde{\varepsilon}_{nt}) = 0$

During the research of Ruback (1982), the announcement and effective date coincided, and Ruback uses two estimation windows to intercept potential risk shifts. As current index revision events have the announcement and effective dates on different moments, it would be subjective to decide which regression coefficients should be used during the period between announcement and effective date. Therefore, this event study will consist of only two blocks, an event window and one estimation period before the event window that will start 150 trading days before the effective date and end 50 trading days before the effective date. The event window is specified as the period that begins a number of 20 trading days before the announcement date and ends a number of 30 trading days after the effective date. Subsequently,

the expected return during the event period will be calculated using the estimated coefficients obtained from the Ordinary Least Squares (OLS) regressions in the estimation period. The coefficients during the event period are deliberately left out to avoid estimation bias. The average prediction error (APE) can be calculated for all τ in the event window using Equation 2.

$$APE_{\tau} = \frac{1}{N}\sum_{n=1}^{N}\left[\tilde{r}_{n\tau} - \left(\hat{\alpha}_n + \hat{\beta}_n \tilde{r}_{m\tau}\right)\right] \quad (2)$$

Ultimately, the cumulative average prediction error (CAPE) will give an indication of the abnormal return development of the stock over the event window using varying intervals. CAPE is specified in Equation 3 as the cumulative abnormal return over period τ_1 till τ_2.

$$CAPE_{\tau_1,\tau_2} = \sum_{n=1}^{N} APE_{\tau} \quad (3)$$

The CAPE will be calculated over different intervals to illustrate the total holding period return an investor would obtain by getting a long position at τ_1 and closing the position at τ_2 for an index composition change. Subsequently to knowing the price effect, it is essential to know if prices will eventually return to initial levels. In accordance with Kaul, Mehrotra & Morck (2000), a complete reversal test will be executed in order to examine during which interval, if any, return reversal exists.

$$CAPE_{t_3-T,j} = \alpha + \theta CAPE_{t_1-t_2,j} + \epsilon_{t_1-T,j} \quad (4)$$

A complete reversal exists when $CAPE_{t_3-T,j} = -CAPE_{t_1-t_2,j}$, where $CAPE_{t_1-t_2,j}$ is the cumulative average prediction error in the period during the initial period, and $CAPE_{t_3-T,j}$ is the cumulative average prediction error in the period after either announcement or effective date and day T following the effective date. A significant delta coefficient of a minus entity confirms complete reversal, and thereby, a temporary effect of heightened prices. In addition, the significance of a delta coefficient equal to zero will test partial price reversal.

Furthermore, volume will be tested similar to Beneish and Whaley (1996). Abnormal trading volume is defined as the daily trading volume divided by the average trading volume. The period that is used to determine the average trading volume is based on the length of the estimation window of 100 trading days, which starts 150 trading days and ends 50 trading days

before the effective date. The abnormal volume is defined as the stock's daily trading volume divided by the average trading volume of the stock during the estimation period, after which the ratio is zero mean adjusted. The interpretation is as follows: abnormal volume equals zero if there is no change in trading volume in comparison to the estimation period. If abnormal volume equals 0.5, the trading is 1.5 times higher in that specified period than during the estimation period.

Finally, quoted bid/ask prices are used to calculate the abnormal quoted bid/ask spreads over different intervals in the event window, which will be called the liquidity ratio. The methodology is similar to the volume ratio. The liquidity ratio is defined as the stock's daily bid/ask spread divided by the average daily bid/ask spread of the stock during the 100 trading days of the estimation period. A ratio below one indicates that the bid/ask spread are smaller in the specified period than during the estimation period, indicating an improved liquidity.

3. Data

The characteristics of six indices in the sample are stated first after which the gathering and cleaning of the data will be discussed. The characteristics of the indices entail the requirements and motives of each index for a stock's inclusion or exclusion. In addition, the predictability of the composition changes will be discussed.

Index methodology

The four indices AEX, PSI 20, CAC 40 and BEL 20 are part of the Euronext N.V., and therefore, have similar characteristics and selection procedures. Each index is independently supervised by a Steering Committee and responsible for "monitoring the selection of constituents for the index and ensuring that the index offers a reliable and representative view of the market" (Euronext, 2018). The AEX, PSI, CAC and BEL indices consist of free-float capitalization-weighted blue-chip companies, and each weighting is capped at 15 percent, except for the PSI index as its weighting is capped at 12 percent. The annual review determines the free float and the final weights of the constituents. The date of the review differs among the indices with it generally being in March for AEX, PSI and BEL and September for the CAC. In addition to the annual review, the AEX and CAC also have quarterly reviews in June, December, and March or September.

Table 1: Summary statistics of each index.

	Number of constituents	Market capitalization (in billion USD)	Total index fund size (in billion USD)	Average number of trading days between AD and ED
AEX	25	872	0.759	15
PSI	20	33	/	12
FTSE	100	2105	19.006	10
DAX	40	1245	12.442	13
CAC	40	1310	4.062	9
BEL	20	136	/	18

Then, the Financial Times Stock Exchange, FTSE in short, is also a free-float market capitalization-weighted index consisting of 100 UK-listed blue-chip companies (FTSE Russel, 2022). Due to the sheer size of the index no weight cap rule is necessary in contrast to the indices managed by Euronext N.V. Review events are held four times, annually in June and

quarterly in September, December, and March. Lastly, the DAX index includes the 40 largest German blue-chip companies, based on order book turnover or market capitalization. Since 2021, the number of constituents increased from 30 to 40 and quarterly reviews in March, June, September, and December were introduced as opposed to twice a year (Deutsche Börse, 2021).

Predictability of index composition changes

The index providers rank all stocks based on market capitalization, which continues beyond the number of stocks included into the specific index. Euronext N.V. has a "buffer zone" for their indices which are comprised of the stocks that are not included by default (Euronext, 2018). For instance, the buffer zone regarding the AEX consists of four stocks with ranking positions 24 till 27. As the two already included stocks have the preference over the other two, it is possible that positions 26 and 27 are included in the AEX rather than 24 and 25. The FTSE and DAX maintain similar measures. These firms on the reserve list will more likely enter the index during a revision event, and therefore, the composition changes can be prediction to a certain degree. It should be noted that there may be sector requirements for a replacement to preserve that the index remains a representative view of the market. Unfortunately, no data on reserve lists is available in order to quantify the rate of inclusion of firms on these lists. In addition, the selection methodology of all index providers is based on objective and publicly available set of rules, which makes it possible for investors to predict changes in the composition.

Index funds

Indices can be tracked by Exchange Traded Funds (ETFs), which are type of pooled investment securities. ETFs mimic a particular index by managing a portfolio of the stocks included in that index with their respective weights, which is also known as passive index investing. An ETF offers investors the opportunity to gain exposure to that index without needing to buy and sell each individual stock by their corresponding weight change during every index revision. As transaction costs are distributed over the whole fund and the managing fee is generally small, an ETF is an inexpensive tool for investors to gain exposure to a particular market. Often, most bigger indices will have one or more ETFs that tracks the index and Table 1 summarizes the aggregated fund size of index funds per index. The two indices PSI and BEL are not replicated by index funds. Lynch and Mendenhall (1997) argue that a majority of the index funds rebalance their portfolios the day preceding the effective date in order to minimize tracking

error. Therefore, the expectation is that index funds will have a significant effect on the results during the event window and it may have noticeable implications for an index without an ETF.

Data description

The effective dates of index revisions are gathered from the Refinitiv Eikon database, which results in an initial sample with a total of 966 inclusions and 736 exclusions starting in the year 2000. Unfortunately, no available database is able to deliver the dates of announcement. To minimize this problem, each announcement date for every stock in a revision event is individually searched for. Dates could be found separately in news articles through various websites and languages. The number of stocks in the initial sample decreases drastically after matching with the available announcement dates. Price data of each stock is downloaded from Refinitiv Eikon as the total return index, which assumes that all cash distributions, like dividends and interests, are reinvested into the stock. Furthermore, bid/ask prices and trading volume are also available on Refinitiv Eikon, and any negative prices and volumes are corrected accordingly. Unfortunately, bid/ask prices and volume data are not available for all inclusions and exclusions in the already limited sample size. During the tests on this data, the sample will be split in two groups based on whether the index is followed by an index fund. Index revision events in 2022 are excluded from the final sample as the price and volume data to complete the remaining trading days in the event window would not be available. Further cleaning the sample on mergers, acquisitions, liquidations, and bankruptcies decreases the sample to a total of 295 inclusions and 275 exclusions.

Table 2 in the Appendix summarizes the total inclusions and exclusions per index in the initial and final sample for which price data is available. The number of observations for the FTSE index account for approximately half of the observations included in the final sample, such that, the remaining observations are spread over the other indices.

4. Theoretical framework and hypotheses

This section summarizes the implications of the different hypotheses introduced in the literature review of Section 1. Subsequently, the expected findings of the study will be discussed, and several hypotheses are stated.

Theoretical framework

On the condition that an index event is free of information, the Efficient Market Hypothesis assumes that an index revision should have no price effect as the demand curve is horizontal and perfectly elastic. The Price Pressure Hypothesis expects temporary price pressures due to the increased trading around the revision dates. The demand curve will slope donw and there will be no new equilibrium. The Imperfect Substitute Hypothesis predicts permanently different prices as the exchanged stocks are no perfect substitutes. The downward sloping demand curve will lead to a new equilibrium. Often, trading volumes are used as a proxy for liquidity. The Imperfect Substitute Hypothesis does expect a short-term increase in volume due to portfolio rebalancing but does not specify a permanent change in liquidity, which is dependent upon the behavior of the investors. Lastly, the Liquidity Hypothesis assumes that a higher liquidity is part of a higher index. A stock in such index is constituent of a larger investment universe, which should mean higher liquidity and lower total trading costs. Lower trading costs induces a higher price. This hypothesis is also consistent with downward sloping demand curve and expects permanently higher (lower) prices and liquidity for inclusions (exclusions).

Expected findings

Several expectations are made before conducting the research. First, it is expected that the announcement of an inclusion will induce an appreciation of the stock price due to the increased demand. Investors with a selection bias will rebalance their portfolio accordingly. In addition, arbitrageurs will step in knowing that index funds need to rebalance their portfolios close to the effective date. Presence of index funds will be positively related to trading volumes around effective date. The part of the price appreciation induced by arbitrageurs and the portfolio rebalancing of index funds is expected to reverse in the weeks after the composition changes become effective. Furthermore, no full price reversal and permanently higher prices can be explained by the slightly higher trading volumes and narrowed bid/ask spreads for inclusions, which will remain for the entire event window. Second, the stock price of exclusions will

depreciate upon announcement of the composition changes. Again, investors with a selection bias will rebalance their portfolios. The demand of the arbitrageurs will not outweigh the supply by private investors and the demand will, therefore, not cause positive price pressures. The trades around effective date by index funds will further depreciate stock prices. Partial reversal of prices will happen after the portfolio rebalancing of index funds has finished. However, permanently lower prices will be caused by permanently lower trading volume and liquidity. Based on the hypothesized results, it is expected that an ordinary investor is able to capitalize on the price pressures between announcement and effective date. The ordinary investor is defined as an investor with a daily occupation other than scrutinizing equity markets. The expectations are formulated in six hypotheses as followed.

Hypothesis 1: *In the short term, index revisions will lead to positive price effects for inclusions with negative price effects for exclusions.*

Hypothesis 2: *In the long term, there is partial reversal of price effects with the overall permanent effect remaining positive for inclusions and negative for exclusions.*

Hypothesis 3: *In the short term, inclusions will experience positive volume and liquidity effects while exclusions will experience positive volume and negative liquidity effects.*

Hypothesis 4: *In the long term, inclusions will experience positive volume and liquidity effects and exclusions will experience negative volume and liquidity effects.*

Hypothesis 5: *Volume effects around index revisions are more evident with the presence of index funds.*

Hypothesis 6: *Index revisions are a viable profit opportunity for the ordinary investor.*

5. Results

This section examines the results of various tests that have been performed based on the literature and the methodology discussed in previous sections. First, the cumulative average prediction error per index over various key intervals will be discussed, which will make it possible to conclude if price pressures exist before or following announcement of stock inclusions and exclusions. In addition, these results will be checked by testing on the reversal of prices in the period following the initial period of returns. Abnormal trading volume and bid/ask spreads are documented, and its implications are discussed. The sample is split in two groups based on whether or not the index is followed by index funds to give insight in the causality of index funds on volume and liquidity effects.

Table 3: Cumulative Average Prediction Error for index revisions

	ALL	AEX	PSI	FTSE	DAX	CAC	BEL
3.1 Inclusions							
AD-20 till AD	**.027*** **	**-.017**	**.039**	**.052*** **	**.021**	**-.015**	**-.014**
	(.006)	(.02)	(.025)	(.008)	(.016)	(.012)	(.026)
AD till AD+1	.002	.006	.036***	-.002	-.011**	.009***	-.005
	(.002)	(.005)	(.01)	(.002)	(.005)	(.003)	(.005)
AD till ED	**-.007**	**.021**	**.077*** **	**-.013** **	**-.054*** **	**-.008**	**-.026**
	(.005)	(.014)	(.026)	(.006)	(.014)	(.008)	(.017)
ED till ED+1	-.004*	0	-.022***	-.003	.006	-.015**	.005
	(.002)	(.006)	(.008)	(.003)	(.006)	(.006)	(.004)
ED till ED+7	-.015***	-.013	-.032**	-.01*	-.02*	-.027***	-.012
	(.004)	(.01)	(.013)	(.005)	(.011)	(.009)	(.014)
ED till ED +30	**-.045*** **	**-.024**	**-.077*** **	**-.039*** **	**-.061** **	**-.064*** **	**-.039**
	(.007)	(.024)	(.017)	(.01)	(.028)	(.022)	(.026)
3.2 Exclusions							
AD-20 till AD	**-.025*** **	**.041**	**-.03***	**-.066*** **	**.043**	**.009**	**.085** **
	(.009)	(.034)	(.017)	(.012)	(.034)	(.02)	(.03)
AD till AD+1	-.003	-.017***	-.032***	.007***	.005	-.012**	-.013**
	(.003)	(.005)	(.007)	(.003)	(.009)	(.005)	(.006)
AD till ED	**.01**	**-.038**	**-.071*** **	**.022** **	**.084** **	**.007**	**.044**
	(.007)	(.023)	(.021)	(.009)	(.039)	(.014)	(.036)
ED till ED+1	-.001	-.013	.001	.001	.01	.003	-.016**
	(.003)	(.007)	(.012)	(.004)	(.027)	(.004)	(.007)
ED till ED+7	.005	.001	.02	.004	.002	.003	-.001
	(.005)	(.014)	(.019)	(.006)	(.034)	(.007)	(.016)
ED till ED+30	**.053*** **	**.033**	**.024**	**.05*** **	**.202**	**.043***	**.05**
	(.016)	(.031)	(.027)	(.015)	(.2)	(.025)	(.049)

Index inclusion

As documented by Shleifer (1986) and many others, the expected result would be a positive abnormal return for stocks during an initial period before the effective date. Two parts of this initial period are of interest, which is the period before announcement of inclusion and the period between the announcement and effective date. A positive abnormal return for index inclusions and similarly a negative abnormal return for exclusions. In accordance with the Price Pressure Hypothesis, the prices would return to initial levels in some period following the effective date. In line with the Imperfect Substitute Hypothesis and the Liquidity hypothesis, the stocks would experience permanently elevated prices after the stock's inclusion in an index (Shleifer, 1986; Amihud & Mendelson, 1986). Opposing the research on the AEX of Algra (2016) and Doeswijk (2005), no price effect is found in the days preceding the announcement day for the Dutch index, which also holds for the CAC and BEL index. The research of Algra (2016) differs from this research of the AEX in length of the sample which starts in 1983 rather than 2000. In addition, the research of Doeswijk (2006) includes all stocks that may benefit from a revision as opposed to only including the exchanged stocks. These differences in research data and methodology could clarify the different results obtained for the AEX index. For the aggregated sample, a significant positive cumulative abnormal return of 2.7 percent is documented before announcement date. The individual indices PSI, FTSE and DAX experience a positive cumulative abnormal return during the days prior to announcement, of which only the FTSE has a statistically significant cumulative return of 5.2 percent. As the FTSE makes up the largest part of the sample, the pre-announcement price effect of the aggregated sample may be largely present due to this index. Hence, half of the results in Table 3.1 do not suggest such pre-announcement price effect. A possible explanation for the outperformance of the FTSE during this interval might be the fact that this index is under a more attention by investors relative to the other smaller indices. The scrutiny of these investors on the selection methodology of the index provider can result in a more accurate prediction of index revisions. While looking at the cumulative average prediction error as illustrated in Table 3.1, the negative return subsequent to the announcement of the FTSE after a significant positive return of 5.2 percent could be characterized as a price effect of temporary nature. In accordance with Blomstrand & Säfstrand (2010) who investigate the index effect on the EURO STOXX 50 and OMXS 30, a possible explanation is that a larger index like the FTSE has more close substitutes, and thereby, more elastic demand. Similarly for the Portuguese index PSI, there is an initial positive cumulative return of 7.7 percent during the period between announcement

and effective date for index additions, accompanied with an approximately equal negative return in the period 30 days following the effective date. Furthermore, the prices for the whole sample return to normal levels within the first 30 trading days after inclusion. The heightened prices in the initial period and subsequently returning prices suggest that the price effect for the whole sample, the PSI and FTSE index revisions is temporary.

The index revisions of the other four individual indices do not experience a price effect as described in the literature. For the AEX and BEL indices, no statistically significant prediction error is documented in the sample during the period during the entire event window. The price effect of the DAX and CAC is counterintuitive and therefore opposes the hypothesis that index additions and deletions will experience positive and negative abnormal returns, respectively. The counterintuitive effect of these indices does raise the question if the effect may be influenced by some dominant events in the sample. Considering the Global Financial Crisis as such event and eliminating it would skew the sample upwards as the would still include the market recovery, thereby, biasing the sample. Same line of reasoning holds for the Covid pandemic during recent years. Nonetheless, filtering on such unique events still delivers the same results and the price effect related to index revisions may be overruled by some other unknown effects. Another reason why the events mentioned above probably did not influence the results to that extent is that these events had a worldwide impact and would have affected all indices. For these two indices in contrast to the other indices, a negative return is documented for additions and a similar mirrored image for deletions. The documented effect could be attributed to the fact that the results are based a smaller number of observations for these indices.

The index revision events of the whole sample, the PSI and FTSE indices experience initial positive returns followed by a period of negative return, which is in accordance with the literature by Harris & Gurel (1986). However, a return reversal test on stock level is required to conclude if the effect is indeed temporary.

Index exclusion

With regard to stocks removed from an index, a similar effect appears for the whole sample and the FTSE index as a significant negative return of 2.5 and 6.6 percent, respectively, is documented in the period before announcement. Unlike PSI additions, the pre-announcement returns of the PSI deletions are statistically significant. The CAC index documents positive prediction errors of 8.5 percent in the period before announcement, after which no negative

abnormal returns are documented. Overall positive cumulative abnormal returns for exclusions over the entire event window are contrary to the expectation and the existing literature.

The four indices AEX, PSI, CAC and BEL experience a significant negative return on the day of announcement, which may be due to the selection bias of investors. Such investors will merely invest in stocks that are included in a particular index and rebalance the portfolio accordingly. The timing of rebalancing is less sensitive for such investors than for index funds, which historically have the objective to minimize their tracking error (Beneish & Whaley, 1996; Lynch & Mendenhall, 1997). The prediction errors between announcement and effective dates in Table 3.2 document similar effects as in Table 3.1 besides that the PSI does seem to experience a permanent price effect rather than temporary price pressures. No price reversal is documented in the period following the exclusion from the index. The price effect concerning stock removal from the FTSE is similar to the effect associating with their additions. Again, a statistically significant prediction error of 6.4 percent during the 20 working days before announcement suggest the scrutiny of investors by accurately predicting what stocks are leaving the index. The significant negative prediction error pre-announcement is followed by a positive return of similar magnitude after announcement. As mentioned earlier, further tests are necessary to confirm the persistency of the prices on the stock level.

Based on the results in previous sections, price effects as described in literature are documented for PSI, FTSE as well as the whole sample. The documented effects of the other indices are not statistically informative due to the limited number of observations, and therefore, lack statistical power. Additionally, it must be noted that the sample concerning the PSI index also has a fewer number of observations and the documented effects have to be interpreted with caution.

Reversal tests

The reversal tests are based upon the methodology used by Kaul, Mehrotra & Morck (2000), which test if the cumulative average prediction error between announcement and effective date is equal to the minus entity of the cumulative average prediction error between effective date and a specified week thereafter. A modified version of that test will be applied here so that also the first interval is variable, depending on the results documented in Table 3. The Price Pressure Hypothesis expects a significant delta coefficient of the minus entity for the full reversal of prices. The Imperfect Substitute Hypothesis and the Liquidity Hypothesis predict a permanent change in the price level due to a shift in the demand curve and thus the

reversal test would not return any significant negative coefficients. The index revisions for all indices are considered here for two different time intervals and the results are documented in Table 4.

Table 4: $CAPE_{t_3-T,j} = \alpha + \theta CAPE_{t_1-t_2,j} + \epsilon_{t_1-T,j}$ where θ = -1 in case of complete reversal of price pressure.

Dependent		$CAPE_{AD,30} = \theta CAPE_{-20,AD}$			$CAPE_{ED,30} = \theta CAPE_{AD,ED}$		
Variable		θ	θ = -1	θ = 0	θ	θ = -1	θ = 0
			p-values			*p-values*	
Whole	+	.4559166	0.000	0.000	.1484281	0.000	0.092
	-	.4712762	0.000	0.004	.9053312	0.000	0.000
AEX	+	.2101475	0.000	0.455	.3910405	0.000	0.188
	-	.7279253	0.000	0.001	.3984572	0.000	0.110
PSI	+	.5873963	0.000	0.050	.1537216	0.000	0.295
	-	.3722657	0.000	0.250	-.4331375	0.027	0.085
FTSE	+	.555214	0.000	0.000	-.0611375	0.000	0.648
	-	.332378	0.000	0.031	.715841	0.000	0.000
DAX	+	.5041718	0.000	0.188	1.136942	0.000	0.001
	-	1.505012	0.332	0.556	4.021596	0.000	0.000
CAC	+	.3688607	0.000	0.324	.2833198	0.014	0.567
	-	.7251965	0.000	0.021	.5840079	0.000	0.075
BEL	+	.6332925	0.000	0.005	.0206427	0.007	0.953
	-	.2698575	0.108	0.723	.8741692	0.000	0.002

The inclusion effect of the whole sample documents a positive pre-announcement return of 2.72 percent with a negative return of -4.52 percent during the first 30 days after the inclusion becomes effective. The reversal test delivers a significant coefficient of 0.46. The positive delta coefficient indicates that no return reversal exists on the stock level rather than the index level. For the PSI additions, the positive prediction error of 7.70 percent during the period between announcement and effective date will reverse in a period of 30 days after the effective date. A positive coefficient of 0.15 (t=1.08) cannot confirm any reversal between announcement and the remainder of the event window. According to Table 3, the FTSE index additions have a temporary positive return of 5.19 percent with an approximately equal negative return after announcement. However, the reversal test does deliver an insignificant

coefficient of -0.06 (t=-0.46), thus reversal does not exist on stock level for FTSE additions. It is expected that FTSE deletions exhibit a reversal effect of which the positive preannouncement returns of 6.36 percent will reverse during the announcement date till the remainder of the event window. The reversal test has a significant positive coefficient of 0.72 (t=5.29), which indicates there is no reversal of prices. According to Table 4, only PSI deletions has a negative coefficient of 0.43 that is significant on the 10 percent confidence level. Full price reversal can be rejected on the majority of subsamples as illustrated in Table 4. The subsamples, for which full reversal cannot be rejected, predominantly lack statistical power due to a limited sample size. To conclude, partial price reversal can be rejected for every subsample on at least five percent significance level.

Abnormal volume

Abnormal volume ratio is defined as the stock's daily trading volume divided by the average trading volume of the stock during the estimation period. Abnormal volume ratio equals zero if there is no change in trading volume in comparison to the estimation period. If the ratio equals 0.5, the trading is 1.5 times the normal trading volume during the specified period than in the estimation period. The expectation is that the number of trades during an index revision will rise above normal levels as investors will rebalance their portfolio in compliance with the changes of the revision. It is known that index funds must rebalance their portfolio accordingly, and only the timing of their trades may vary as the prevailing view is that most of the funds prefer to minimize tracking error (Green and Jame, 2011). Therefore, it is expected that the abnormal volume is highest on the day the index revision becomes effective. The sample documents an abnormal volume of only 0.90 on the effective date, so this is not the date that most rebalancing of the portfolio is executed. Indeed, Lynch & Mendenhall (1997) document the highest abnormal trading volume on the day preceding the effective date. The aggregated trading volume is 7.72 times the normal volume during the estimation period, which is calculated over the sample as a whole. The volume during the day preceding the effective date is the day with the highest average volume of the entire event window. In accordance with Lynch & Mendenhall (1997), indices that are more widely followed by index funds do seem to experience larger abnormal trading volumes. On the day preceding effective date, trading volume is 8.37 times the normal volume for tracked indices as opposed to 3.86 times for indices that are not followed by any exchange traded index fund. In the data sample, including all six indices, there is a strong positive correlation of 0.735

between abnormal volume on the day preceding the effective date and the aggregated size of exchange traded funds. It must be noted that this correlation figure does not include all privately held index funds, and therefore, it is not the true population correlation. Beneish & Whaley (1996) discuss the likelihood of a large amount of privately managed S&P 500 index funds. Therefore, the figure could be an underestimation for the total index fund size as it is plausible that European indices with larger exchange traded funds also have larger privately managed funds. Furthermore, it is thinkable that indices that are not replicated by index funds also have private funds for investors to gain exposure to that market.

Table 5: Abnormal volume is defined as the stock's daily trading volume divided by the average trading volume of the stock during the estimation period. Abnormal volume equals zero if there is no change in trading volume in comparison to the estimation period. If abnormal volume equals 0.5, the number of trades is 50 percent higher during the period than in the estimation period. The table differentiates between tracked indices (AEX, FTSE, CAC, DAX) and indices which are not tracked by an index fund (PSI and BEL). T-statistics in parentheses.

Period		Whole sample	Non-tracked indices	Tracked indices
-20, -11	+	0.615 *(3.01)*	0.494 *(4.39)*	0.637 *(2.65)*
	-	0.128 *(6.71)*	*-0.062 (-1.19)*	0.167 *(8.26)*
-10, -1	+	0.415 *(7.12)*	0.421 *(3.65)*	0.414 *(6.32)*
	-	0.300 *(10.80)*	-0.027 *(0.61)*	0.357 *(11.10)*
AD	+	0.656 *(3.09)*	0.414 *(1.77)*	0.699 *(2.84)*
	-	0.482 *(6.05)*	0.354 *(1.19)*	0.509 *(6.87)*
-1, AD, +1	+	0.788 *(6.52)*	*1.371 (3.48)*	0.684 *(5.53)*
	-	0.509 *(11.98)*	0.371 *(2.73)*	0.538 *(12.53)*
AD-ED	+	1.352 *(10.93)*	*1.652 (7.19)*	1.280 *(8.94)*
	-	0.770 *(16.59)*	0.232 *(3.30)*	*0.930 (16.60)*
ED - 1	+	7.715 *(6.82)*	*3.862 (5.14)*	*8.365 (6.38)*
	-	5.354 *(13.59)*	2.388 *(3.18)*	*5.90 (13.52)*
ED	+	0.900 *(8.21)*	*1.475 (3.38)*	0.797 *(7.81)*
	-	0.530 *(5.25)*	0.402 *(1.37)*	0.557 *(5.26)*
+1, +10	+	0.471 *(8.30)*	*1.179 (4.26)*	0.340 *(7.94)*
	-	0.151 *(4.20)*	0.357 *(1.99)*	0.106 *(5.33)*
+10, +20	+	0.330 *(10.18)*	0.351 *(4.54)*	0.326 *(9.15)*
	-	0.105 *(2.58)*	-0.223 *(-4.47)*	0.172 *(3.59)*
+20, +30	+	0.258 *(7.72)*	0.194 *(2.39)*	0.270 *(7.35)*
	-	0.015 *(0.58)*	0.040 *(0.29)*	0.010 *(0.69)*

As passive index funds generally follow a buy and hold strategy the part of heightened trading volume, induced by these funds, should only be temporary and should return to pre-event window levels, ceteris paribus. As documented in Table 5, the results are different for the abnormal trading volumes of inclusions and exclusions. The abnormal trading volume for stocks added to an index experience significant heightened levels before announcement, which increase during the days before effective date. The day before the changes become effective is the date where a maximum abnormal trading volume is reached, after which the volume decreases sharply. Although trading volume will fall, it will stay elevated by around 26 percent even during 20 till 30 trading days after effective date. Evidently, trading volume of a stock has increased permanently after a stock's inclusion to an index. A possible explanation is that the stock enters a broader investment universe after inclusion. A similar change in trading volume is documented for both tracked and non-tracked indices. Although, overall trading volume is higher for tracked indices. A more popular index will get more attention by investors and may induce fund providers to introduce a corresponding index fund. For the non-tracked indices, a more dispersed trading volume is documented during the intervals around effective date as shown in Figure 1. The more dispersed and lower peak than compared to the tracked indices shows slower rebalancing by private investors who can more easily trade further away from the effective date than index funds.

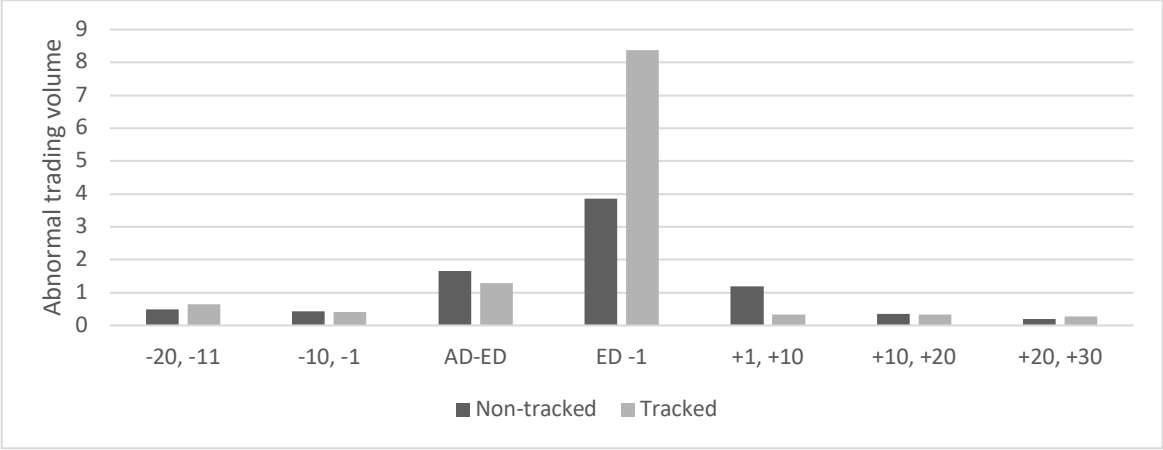

Figure 1: Abnormal trading volume for inclusions during event window.

The trading volume of index exclusions will experience a lower peak around effective date and will return to normal trading levels after 20 days following the effective date. It is probable that due to past inclusion investors are still aware of the stocks that leave the index, so the scrutiny of investors is still heightened. Therefore, the trading volume of exclusions does not decrease to levels lower than during the estimation period.

Quoted bid/ask spreads

According to Amihud & Mendelson (1986), higher demand and tighter supply should result in smaller bid/ask spreads. If a stock's index inclusion is a positive influence on overall demand, it should be paired with higher prices to induce investors to sell. A permanent increase in volume would be consistent with increased liquidity, and therefore, smaller bid/ask spreads (Beneish and Whaley, 1996).

Table 6: Abnormal quoted bid/ask spread is defined as the stock's daily bid/ask quote divided by the average daily bid/ask quotes of the stock during the 100 trading days of the estimation period. The table differentiates between tracked indices (AEX, FTSE, CAC, DAX) and indices which are not tracked by an index fund (PSI and BEL). T-statistics in parentheses.

Period		Whole sample	Non-tracked indices	Tracked indices
-20, -11	+	0.936 *(-4.46)*	0.863 *(-3.88)*	0.949 *(-3.23)*
	-	1.027 *(1.38)*	1.110 *(2.54)*	1.010 *(0.46)*
-10, -1	+	0.951 *(-3.54)*	0.921 *(-2.27)*	0.956 *(-2.90)*
	-	1.146 *(1.49)*	1.030 *(0.89)*	1.172 *(1.44)*
AD	+	0.893 *(-1.79)*	0.884 *(-0.76)*	0.897 *(-1.62)*
	-	1.030 *(0.60)*	0.838 *(-2.17)*	1.069 *(1.22)*
-1, AD, +1	+	0.887 *(-4.06)*	0.866 *(-1.92)*	0.891 *(-3.60)*
	-	1.395 *(1.10)*	0.975 *(-0.41)*	1.480 *(1.12)*
AD-ED	+	0.922 *(-4.92)*	0.820 *(-5.58)*	0.947 *(-2.94)*
	-	1.144 *(3.21)*	1.117 *(3.33)*	1.152 *(2.66)*
ED - 1	+	1.263 *(2.82)*	1.353 *(1.30)*	1.245 *(2.50)*
	-	1.485 *(4.56)*	1.794 *(3.33)*	1.424 *(3.62)*
ED	+	0.983 *(-0.30)*	0.862 *(-1.15)*	1.003 *(0.04)*
	-	1.549 *(4.87)*	1.681 *(2.73)*	1.518 *(4.13)*
+1, +10	+	0.886 *(-6.21)*	0.757 *(-7.61)*	0.909 *(-4.33)*
	-	1.433 *(12.76)*	1.636 *(8.53)*	1.389 *(10.24)*
+10, +20	+	0.812 *(-14.36)*	0.748 *(-8.67)*	0.823 *(-12.17)*
	-	1.333 *(12.84)*	1.548 *(7.26)*	1.287 *(10.67)*
+20, +30	+	0.817 *(-9.85)*	0.818 *(-1.84)*	0.816 *(-13.79)*
	-	1.367 *(10.80)*	1.546 *(7.23)*	1.331 *(8.72)*

If stock's index inclusion provides the stock with more liquidity, it will be confirmed by a smaller bid/ask spread in the event window compared to the estimation window. Therefore,

similar to the computation of the abnormal volume ratio, the change in bid/ask spreads is computed by the ratio of the daily bid/ask quote divided by the average daily bid/ask spread during the 100 trading days of the estimation period. A ratio below one denotes a smaller bid/ask spread during the interval in the event window than the estimation period. As smaller spreads mean more liquidity, a lower ratio does as well. The overall effect of index revisions on liquidity is consistent throughout Table 6 as the liquidity improves for index inclusions and decreases for exclusions. Smaller spreads for inclusions during the entirety of the event window suggest a permanent shift to higher liquidity. Only exception is the decreased liquidity on the day preceding effective date, which coincides with the sharply increased trading volume on that specific day. High demand and tighter supply should decrease bid/ask spreads. However, it appears that exceptionally high abnormal trading volumes will increase bid/ask spread and decrease liquidity, which holds for both inclusions and exclusions. In accordance with the decreased liquidity on this day, the Green and Jame (2011) find larger index funds want to trade further away from the effective date as the funds prefer higher liquidity.

A permanent decrease in bid/ask spreads for index inclusions and increased bid/ask spreads for exclusions show that a promotion to a higher index improves liquidity, vice versa for demotions. This permanent change in bid/ask spreads after index revision suggest a shift in the stocks' demand curve. Apparently, the heightened trading volume around effective date, probably mostly originating from index fund rebalancing, do not have a positive influence on liquidity. Index funds seem to only have a momentary effect on these spreads while rebalancing as bid/ask spreads are heightened for only a few days around the effective date.

Table 6 documents that inclusions have wider bid/ask spreads for the indices that are followed by index funds. Popular indices are under more scrutiny of investors and were expected to have a higher liquidity. In addition, as investors want to gain exposure to a particular market due to its popularity, it is likely that index funds want to enter this gap and provide that opportunity. As these passive funds only rebalance according to the weights of index composition changes, the part of the shares owned by funds will not be traded between new weightings as the funds follow a buy and hold strategy. This may outweigh the benefits of the popularity of tracked indices and may hamper the overall liquidity of the stocks within those indices. Hence, the popularity of indices is not positively related with the level of liquidity.

6. Discussion

Overall, this study documents positive and negative prediction errors in the period before effective date for inclusions and exclusion, respectively, which supports the first hypothesis. According to Table 3, a significant part of these returns is generated before announcement of the composition changes. The publicly available and transparent methodology used by index providers is a possible explanation for these results. The scrutiny of investors on these sets of rules will correctly predict the composition changes in advance of the announcement. A larger pre-announcement effect for the FTSE also supports the notion that a larger index is under more scrutiny by investors. Index funds do not influence the market at this time. Consequently, the reversal tests do not give statistically significant negative coefficients on the five percent confidence level, which contradict the subsequent returns in Table 3. The reversal of prices could not be confirmed in the reversal tests on stock level. Thus, the second hypothesis cannot be confirmed and the majority of the stock inclusions (exclusions) in the sample experience permanently heightened (lowered) prices as early as 20 trading days before announcement.

The results support the third hypothesis which predicts that, in the short term, inclusions will experience positive volume and liquidity effects while exclusions will experience positive volume and negative liquidity effects. Portfolio rebalancing will increase trading volumes for both inclusion and exclusions. Although, trading volume will mostly increase through buy-side pressures for inclusions and through sell-side pressures for exclusions. Table 6 supports the notion of increased liquidity for inclusions and decreased liquidity for exclusions. The fourth hypothesis differs from the third that long term volume effects of exclusions will decrease to below the levels during the estimation period. The results in Table 5 suggest that volumes will decrease to normal levels rather than below the level of the estimation period and the evidence is, therefore, not in favor of the fourth hypothesis. Furthermore, the volume effects around effective date are more evident for tracked indices than for indices without an index fund, which supports the fifth hypothesis. An ordinary investor could profit from an index revision if the price change between announcement and effective date are significant. Unfortunately, the significant prediction errors exist before announcement for which it is unfeasible that an ordinary investor is able to profit from an index revision without investing considerable time researching equity indices. Therefore, the sixth hypothesis can be rejected.

Evidently for inclusions, the permanently higher prices, higher volumes, and liquidity support both the Imperfect Substitute Hypothesis and the Liquidity Hypothesis. Exclusions document permanently lower prices and liquidity, but no significant change in volumes. These

results support the Imperfect Substitute Hypothesis. However, many studies use trading volumes as a proxy for liquidity of an index and in those studies the Liquidity Hypothesis states permanently lower trading volumes. This research adds to the existing literature by including both volumes and bid/ask spreads. As this study includes volumes and bid/ask spreads, it becomes evident that trading volumes are not a sufficient proxy for liquidity in all cases. The index exclusions in my sample experience no significant change in volumes in the long term while bid/ask spreads are significantly widened. It seems that the excluded stocks are still part of the investor's investment universe. Investors are still willing to trade the excluded stock while bearing the higher trading costs due to decreased liquidity as proxied by widened bid/ask spreads. Therefore, the results still support the Liquidity Hypothesis, even though no significant change in trading volume is documented in the long term.

7. Limitations

Investigating returns on a specific day can distort the real price effect as opposed to the effect originating from volume or bid/ask data. For example, the order book data on the day preceding revision date will capture all trading volume as the trades will only be executed when the market is open. However, the returns on this day may be distorted as the sample uses closing prices of each trading day for the calculation of the returns, and the price information between closing price and opening price of the next day will be lost since trading days are not continuous. The effect of nonsynchronous trading on actual returns will diminish when holding period increases. The documented returns on short intervals will, therefore, be less accurate than those on larger time intervals. Further research can circumvent this problem by using intraday price data rather than close-to-close prices. As discussed by Beneish and Whaley (1996), intraday data will make it possible to distinguish the part of the returns can be assigned to the price movement between market closing and opening of the next day.

The size of the sample of the individual indices will have several limitations. First, approximately half of the whole sample consists of observations of the FTSE index, such that the relatively small sample size of the remaining five indices may have consequences for the statistical power of the tests. For this study, it was sufficient to group the indices for the tests on volume and liquidity. Second, the counterintuitive effect for DAX and CAC may be caused by the limited number of observations of 30 and 32 for inclusions and 16 and 30 for exclusions, respectively. Therefore, the conclusion on the price effects is predominantly based on the effects resulting from the entire sample and the FTSE index. Another limitation of the sample is related to the amount of attention that a stock receives after inclusion or exclusion. For the stocks of which no announcement dates could be found, may receive less attention from investors as no news about the inclusion or exclusion was published. This would positively influence the results for inclusions and negatively for exclusions. It is thinkable that the stocks of which no press release or other news was published will experience more moderate price, volume, and liquidity effects.

8. Conclusion

This study investigates the index effect by documenting changes in prices, volumes, and bid/ask spread after announcement of an index revision by the index providers of six European indices. The effect for inclusions and exclusions support both the Imperfect Substitute Hypothesis and the Liquidity Hypothesis. The inclusion effects include a permanent increase in prices, volumes, and liquidity. I document a shift of the demand curve through permanent higher trading volumes and permanently improved liquidity. The exclusion effects have different implications as I document lower liquidity in combination with no significant change in trading volumes relative to the estimation period. In this case, trading volume has proven not to be a good proxy for liquidity. The excluded stocks remain part of the investor's investment universe after exclusion. Finally, index revisions are no viable profit opportunity for the ordinary investors as I find no statistically significant prediction errors between announcement and effective date.

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Appendix

Table 2: Results of sample cleaning

Initial sample	AEX	PSI	FTSE	DAX	CAC	BEL	total
+	111	100	475	95	116	69	966
-	86	91	376	56	75	52	736
Final sample							
+	35	22	153	30	32	23	295
-	31	27	151	16	30	20	275

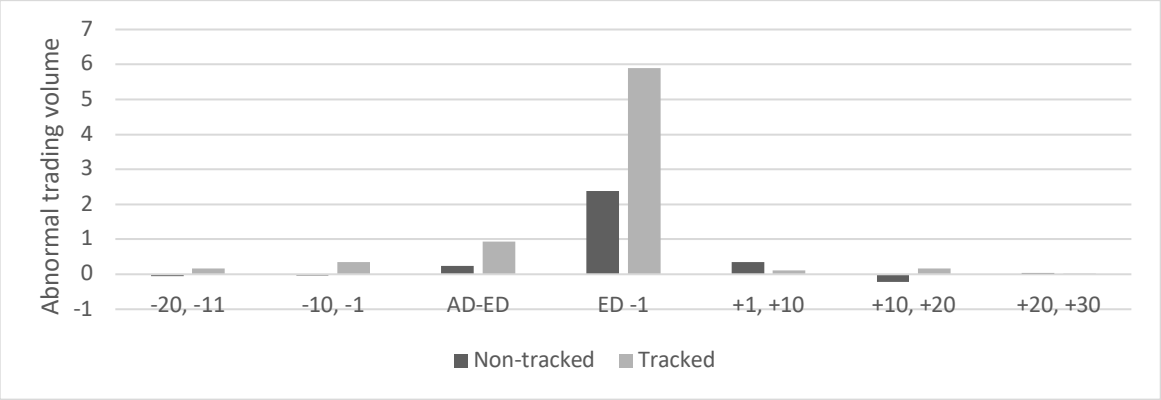

Figure 2: Abnormal trading volume for exclusions during event window.