The relationship between stock performance and their inclusion to or exclusion from the MSCI or S&P 500

An event study for listed firms in Europe and US

Master thesis

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Contents

Management Summary

In recent years indexing has grown enormously, with passive investments reaching all time highs, both in terms of Assets Under Management (AUM) and percentage of the underlying market. This raises the question what happen to stock prices of companies added to or deleted from indices. Existing literature generally finds positive abnormal returns around inclusions but is mainly focused on the US in the period before 2000. The research also did not include all aspects impacting stock performance. That is why I conduct an event study on US and EU indices until 2016 and also research the impact of liquidity, market size and differences between US indices on stock price performance. I found that inclusions in an index generally earns positive abnormal returns. This price effect is permanent for the pre-2006 sample whilst it is mostly temporary for the samples spanning over the 2006-2016 time period. There is also a difference in stock performance depending on the index, where investors tracking the S&P show little anticipation on the rebalancing compared to the high anticipation on the rebalancing for the MSCI. I found that market size positively impacts stock performance meaning that firms with higher market capitalization earn higher abnormal returns when added to an index. Liquidity also impacts stock performance but the impact depends on the liquidity measure used. The research overall suggest the existence of a price pressure effect around index changes and hence it can be cost efficient for index tracking investors to rebalance at different times and not on the actual rebalance day of the index, taking into account the different aspects.

1 Introduction

Every day the S&P 500, MSCI Europe and other indices are used as benchmarks representing particular markets and relevant values for ETF's. Therefore indices are very important in the financial world as a lot of investors rely on them. The inclusion or exclusion of a company to or from such an index can therefore impose significant stock price reactions for the individual firm. This also has an impact on (institutional) investors investing passively into these indices and as a result on individuals savings, pension funds, interest rates etc. If there is a positive abnormal return before entry or after removal passive investors could leave money on the table by blindly following the index construction. This could be a sign that indexing is nearing its maximum size. Meaning that there are potentially too much passive investors and therefore an overreaction in the market takes place when a stock is added. Overreaction, a temporary deviation from the underlying fundamental value, could imply that there are not enough active investors setting a price. The graph in appendix 8.6 shows the massive growth of the assets under management of ETF's starting in 1995. This makes index rebalancing an interesting subject to research as most previous literature is old and inconclusive about the effects of in- and exclusion to the changes in stock prices. The timing regarding index rebalancing is also not properly researched and leaves a gap in current literature.

The different indices change the composition of their index to reflect changes in the underlying investment universe. The universe differs per index, for example the S&P 500 includes 500 of the largest firms traded on the American stock Exchange and the Russell 2000 includes 2000 small cap stocks. Index changes have multiple causes, for example a bankruptcy or a merger of a firm which is included in an index, changes in the number of shares outstanding or changes in the free float. The methodology underlying rebalancing in the index also differs between indices, and is discussed in depth in section 3. In this research the focus will be on additions and deletions of firms and not on mergers or defaults because the second has an impact on the individual firm and is not reflecting the effect I am researching.

When looking at previous literature (section 2) most papers conclude that a firm added to an index experiences positive abnormal returns (Elliot, Ness, Walker, & Warr, 2006), the opposite holds for a deletion. The different explanations are not conclusive about what causes this change in the stock price. Therefore I conduct an event study that tests the different hypothesis and by doing my own research come to conclusion about the stock price effect of firms added (deleted) to commonly used indices by passive investors/index followers.

2 Literature review

As stated in the introduction most previous literature concludes that a firm added to an index experiences positive abnormal returns on and after the announcement date (Elliott et al., 2006). When looking at the effect on stock prices for firms excluded from an index the literature is less precise and less conclusive. Chen et al. (2004) conclude that the negative effect on excluded firms is not permanent and that this is due to the investor awareness effect, which is discussed more in depth later. The event period used to calculate the abnormal returns differs among papers, Hegde and McDermott (2003) use a 3 month period following the event while Deininger et al. (2000) use a t $\pm$ 3 days period. The sample periods used in previous researches are mostly before the year 2000 and it is therefore interesting to research the periods after 2000 as well and compare the results. Most research is based on the S&P 500 or other US indices, little is known about the stock price reaction for European firms. Only Vespro (2006) and Oberndorfer et al. (2013) have investigated European markets. For this reason the MSCI Europe index is also included in this paper.

Regarding the cause for the abnormal returns different theories are proposed by papers, which can be categorized into 5 different hypotheses. The first hypothesis is proposed by Scholes (1972) and Kraus and Stoll (1972) and is called *'The price pressure hypothesis'* which discusses the change in a stock price due to a large stock sale or purchase without a change in the publicly available information. This can be explained by the fact that a small investor can not influence the share price on its own, but a buyer or seller of a big block of shares can (Bildik and Gülay, 2008). This means that the supply curve for a stock is less than perfectly price elastic. Kraus and Stoll (1972) describe this effect as a distribution effect due to short-run liquidity constraints which is caused by the increased demand. This is what happens when a firm is added or deleted from an index because fund managers try to rebalance their portfolio accordingly to the index and therefore an increase in demand for the respective stocks arises. The core of this hypothesis is that the effect is temporary and the price effect is not permanent. Elliott et al. (2006) & Harris and Gurel (1986) confirm this finding by checking for post-inclusion returns and find a negative abnormal return which cancels out the earlier gained positive effect. Elliott et al. (2006), Vespro (2006) and Lamoureux and Wansley (1987) found evidence supporting this hypothesis regarding inclusions/exclusions although results for inclusion were more significant.

Kraus and Stoll (1972) also proposed *'The imperfect substitutes hypothesis'* or reformulated by Shleifer (1986) as downward-sloping demand curve to be a good explanation for the stock price change. This hypothesis proposes that the stocks added to the index are no longer good substitutes for stocks which are not added to the index. This means that there is a difference in firm value perceived by investors, solely based on the index inclusion. Therefore the price increase will be permanent assuming that the imperfect substitutes hypothesis holds and the firm remains in the index (Kraus and Stoll, 1972). Beneish and Whaley (1996), Lynch and Mendenhall (1996), Kaul et al. (2000), Blume and Edelen (2002) and Wurgler and Zhuravskaya (2002) support the imperfect substitutes hypothesis. This is the hypothesis which is supported the most by previous literature.

Another explanation for the stock price effect is proposed by Amihud and Mendelson (1986) who proposed the *'liquidity hypothesis'*. This hypothesis states that stocks added to an index should become less expensive for individual investors to trade due to increased liquidity (Bildik and Gülay, 2008). This can be partly explained by the price pressure effect as trading volume increases drastically following the announcement (Madhavan and Ming, 2002) and the opposite holds for exclusion. Therefore liquidity increases and the transaction costs (bid-ask spread) are reduced, the increase in liquidity is found to be permanent for additions but the price pressure is not, as explained before. The liquidity hypothesis is supported by Hegde and McDermott (2003) who found significant results in a 90 days post event study. The liquidity hypothesis is related to the *'Attention awareness hypothesis'* and is based on the shadow cost principle of Merton (1987). Merton (1987) investigated the relationship between the demanded rate of return and investor recognition. By the inclusion of a firm in an index investors became more aware of the optimal subset of stocks to track (an index) and therefore demanded a smaller premium for non systematic risk. And the increase in liquidity also reduced the time spent searching for information about a specific stock because more information was publicly available, therefore reducing the trading cost. Following these two arguments the rate of return demanded by investors is reduced, and the price of the stock should be higher. This hypothesis is supported by Bildik and Gülay (2008), Elliott et al. (2006) and Chen et al. (2004).

The final hypothesis proposed by previous literature is the *'Information signaling hypothesis'* proposed by Jain (1987) which attributes the stock price change of a firm to information embedded in the signaling of an inclusion/exclusion. To be relevant to market participants, the information must be previously unavailable (Lamoureux and Wansley, 1987). Meaning that when a firm is included it needs to signal something about the future prospects, this is confirmed when looking at the requirements that the S&P 500 index Committee uses to choose a company. The Committee filters companies based on liquidity, profitability, ownership structure and market power, so when a firm is added to the index it suggests to investors that it is financial stable and therefore triggers a stock price increase (Madhavan and Ming, 2002). The index methodology is discussed in depth in section 3 where the methodology of the MSCI and S&P is outlined and important differences are highlighted. This methodology is used by Madhavan and Ming (2002) to explain the stock price change and show that trading between the announcement date and the actual implementation can cut cost dramatically. Dhillon and Johnson (1991) used both stock and option data to show that bond and call options for additions increase on the announcement date and not on the effective date. The value of put options decreased and the stock price did not reverse back to pre-announcement levels, supporting the information signaling hypothesis. This opens up opportunities for arbitrage investors who buy (long) a firm expected to be included and sell (short) a firm expected to be excluded. But not all papers report the same findings regarding this hypothesis, Lamoureux and Wansley (1987) find that the inclusion of a firm in the index is an information free event and changes in the index are only made to reflect the broader market the index wants to represent. This makes sense because there are no changes in the financial structure or any other part of the firm, the only changed factor is the inclusion/deletion in an index. So following the efficient market theory the stock price should remain the same.

The EMH (Efficient market hypothesis) is closely related to the information signaling hypothesis and is more of a supportive theory, it states that one price is consistent within a given information set. So the price increase coming from the price pressure effect is observed by non-informed investors as a change in the information set (Lamoureux and Wansley, 1987). Then the consequence is that after the inclusion/exclusion the price reverts back because investors realize it was not a change in the information set (information signaling hypothesis). This is especially found in the 1976-1989 period because only investors subscribed to the notification service received notice of a change in the index prior to the actual change (Jain, 1987). There is also another finding related to the information signaling hypothesis, which is argued by Brealey

(2000) who focuses more on the benchmark function of index funds. Most large index funds are used as a benchmark for other funds therefore the other funds track the index. Which makes those funds reluctant to buy stocks that are not included in the index. Especially more risk-averse managers perceive those stocks as risky and are only willing to hold them when a higher expected return is offered.

The last aspect is the cost for investors caused by the rebalancing of equity indices. This is important because the large price movements of the stocks added to the indices can induce a lot of costs for investors, which is researched by Madhavan and Ming (2002). These costs are called hidden cost and Madhavan and Ming (2002) show that by adopting a specific trading strategy these cost can be reduced. Implying that there is a sort of arbitrage opportunity for traders when trading in advance of the rebalancing date by going long in expected additions and short in expected deletions. This is called the S and P Game proposed by Beneish and Whaley (1996), they find that the overnight return is 3.1% after the announcement and another 4.1% on the effective date. So the implications for investment managers who rebalance their portfolio near the actual index revision are that they pay a high liquidity premium (7.2%) by not trading ahead of the rebalancing, so they leave money on the table for their clients/firm. Lynch and Mendenhall (1996) report similar results, they also report trading volume to be 30% above average after the announcement. They attribute this increased volume to the use of arbitrage instruments by traders but this can also be explained by the rebalancing effect of big funds.

3 Methodology underlying index rebalancing

While I investigate price effects of index inclusions and exclusions into and from the S&P 500 and the MSCI Europe/USA index, it is also important to look at the differences in the construction methodology between the S&P and MSCI indices. Especially the rebalancing criteria are important because they affect the predictability and timing of rebalances. Hence the construction methodology potentially impacts the price reaction to the announcement and implementation of these rebalances. The most important aspects of the methodology are shown in Table 1.

Table 1: S&P 500 and MSCI Methodology summary

Criteria	S&P 500	MSCI
Minimum Market cap	∼$5.3bn	$209 million, adjusted annually
Liquidity requirements	Adequate liquidity and price	>20% 3-month Turnover rate
Public float	>50% exceptions allowed	>50%
Domicile	U.S. companies	Listed equity securities
Financial viability	Recent quarter earnings >0	Needs to satisfy the continuity rules
Announcement period	5 days ahead	14 days ahead
Timing of rebalancing	Ad-hoc	Semi-annual and quarterly

The main differences between the two indices occur in the way the criteria are described and the timing of the rebalancing. The S&P 500 is less transparent, hence less predictable, about rebalancing and the requirements needed for a firm to be considered. The list with requirements for additions and deletions in the S&P 500 is opaque therefore making it relatively hard to predict a potential inclusion candidate. In the S&P U.S. Indices Methodology (Feb 2016) report from S&P their methodology is described and they use 8 requirements for additions and 2 requirements for deletions. I will state the requirements that are not described in Table 1 here and discuss them briefly. Sector Classification is defined as 'Adequate contribution to sector balance maintenance, as measured by a comparison of each GICS (Global Industry Classification Standard) sector's weight in an index with its weight in the market'. This definition does not explain which value is seen as 'adequate' by the S&P Committee because no absolute number is reported. Another requirement regards the IPO treatment and states that IPO's should be seasoned for six to 12 months before being considered. The last requirement is that the firm can only be considered when it is listed on the major US indices (NYSE, NASDAQ etc). The deletion requirements are straight forward as a firm is deleted when it is involved in a merger/bankruptcy or if a firm violates one of the addition requirements.

The MSCI offers an index based on transparent and objective rules and follows a step by step guide when it rebalances. The MSCI uses 6 general defined steps for every index with every step divided in to more requirements, thus making the MSCI indices bound to a lot of rules regarding additions/deletions. The first step for the MSCI is to define the equity universe and classify the eligible equity securities in the appropriate country. After that MSCI screens the individual eligible securities on size, free float, liquidity, foreign inclusion and length of trading. The securities are then ranked on market capitalization and checked for some additional rules regarding financial stability. The securities are then classified for the appropriate MSCI indices and implemented on the rebalancing date. MSCI constructs every index following these 6 general steps but adds specific requirements for some indices. For example the MSCI US equity index has 2 additional requirements: an additional liquidity measurement and firms need to be US based. I will briefly discuss the other general requirements which are not included in Table 1 as these differ from the S&P. The equity universe is widespread as all listed equity securities can be added to an MSCI index. MSCI also uses an GICS sector measurement, but reports 3 additional absolute rules for the GICS measurement. And the same goes for the other requirements which are more in depth and absolute compared to the S&P guidelines.

Table 1 shows the main criteria used for rebalancing, the differences are for some criteria comprehensive. When looking at the market capitalization it is stated that for the S&P it needs to be at least US$ 5.3 billion. This is not a hard requirement meaning that under certain market conditions there can be exceptions. This is, compared to the hard requirement of $209 million that the MSCI uses, a big difference. Additionally the minimum market capitalization for the MSCI is adjusted annually and based on the global equity universe. Mainly the soft requirements of the S&P make it harder for traders to predict which firms are going to be added/deleted. The same goes for the liquidity requirements of the S&P as it has not defined what it considers as adequate. This trend is seen in all other requirements the S&P reports in its methodology publications. Because of this trend discussing the rest of the reported requirements adds no value to this paper.

Looking at the timing, the S&P is not rebalanced according to a schedule and the index is only rebalanced when necessary. The main goal of the S&P is to include the 500 biggest listed US firms and therefore a scheduled rebalancing is not in line with this goal. This is a good attitude but hard for investors to act on. The fact that the S&P does not rebalance according to a schedule makes the changes in the S&P unpredictable and spontaneous, this is also the main difference with the MSCI methodology. Due to the transparent rules and guidelines of the MSCI it is easier to predict which firm will be added/deleted and at what moment. This transparent way of rebalancing makes it easier for traders to trade before the announcement and therefore drive up the price for institutional investors. I expect that this makes the MSCI additions more sensitive than the S&P for a run up in price (pre-announcement). The event study in section 5 will check whether this is true and whether this result is robust.

The announcement methodology of the MSCI is the opposite of the S&P because the MSCI rebalances every quarter (Feb, May, Aug and Nov) and this is announced every year in January. The press releases are freely available on the website of the MSCI and therefore accessible for everyone. So transparency on guidelines and methodology are the main driver of the discrepancy between the S&P and MSCI index. The gap between the announcement day and effective rebalancing day is bigger for the MSCI while the MSCI uses a 14 trading day gap and the S&P a 5 trading day gap. These facts combined make the MSCI more predictable and should therefore see a bigger price run up pre-announcement compared to the S&P. This creates hidden cost for indices following the MSCI or S&P closely because they are paying a higher price for the added stocks. Especially when the trading is done on the effective day and not on the announcement day or even earlier.

4 Methodology and Data collection

The data collection process for the S&P and MSCI indices is not the same and therefore I discuss them separately. First I discuss the data collection process for the S&P and after that I discuss the MSCI data process. Then the methodology underlying this paper is explained in combination with how the collected data is used.

The index constituents for the S&P are downloaded from the Compustat database which is part of the WRDS (Wharton Research Database services) database. The Compustat database contains data on additions and deletions from 1974 until now, giving a total of 1680 individual observations. I first clear the dataset from firms that are in the S&P from the start and have not left the S&P (73 firms). These firms have no measurable event of addition or deletion and are therefore deleted. Then I delete the observations which are caused by a merger or bankruptcy (712 firms). These observations are deleted because a merger or bankruptcy disrupts the actual stock price reaction that I want to research. Then another 98 observations are deleted due to a lack of daily return data. For the remaining 797 observations I downloaded the daily return data from Bloomberg & Datastream. Firms with less than 250 trading days (80 firms) of return data around the inclusion/exclusion are deleted because they are not useful for longer term measurements. 717 observations remain, 501 additions and 216 deletions. Some firms are both added to and deleted from the index and are therefore included as both addition and deletion. So the 717 observations are in the end based on 668 firms. I found a big flaw in the CRSP data because the reported event dates were not correct and therefore I checked all observations by hand. Especially the data from pre-1990 included a lot of errors with some reported dates not even existing or dates that occur in the weekends (when the market is closed). I checked these flawed dates by searching online in old newspapers for relevant information regarding the rebalancing of that specific observation. This by hand checking gives me one of the clearest data sets and therefore should be better than previous literature where some used the default data set from CRSP. I also needed the daily return data for the S&P index to use for my benchmark which I downloaded from CRSP. I use this return data in the calculation of the expected returns. Additional firm specific data such as market capitalization and sector information is also downloaded from CRSP. This data is also checked by hand but no big flaws were found.

The MSCI data on additions and deletions is provided by Northern Trust Asset Management (NTAM). NTAM is part of the Northern Trust Corporation and provides a broad range of investment management and related services. The data provided only goes back to 2006 as Northern Trust was not able to provide data on the period pre-2006. The data contains all the additions and deletions over all developed MSCI indices. As I only research the MSCI EU and MSCI USA, I delete the additions and deletions which did not affect the MSCI EU or MSCI USA index. The data is then edited the same way as the S&P sample, so additions and deletions caused by mergers or bankruptcy's are removed (121 observations). Then I delete another 92 observations due to a lack of daily return data. In the end this gives 247 additions and 305 deletions for the MSCI EU. For the MSCI USA I have 371 additions and 180 deletions. The same problem occurred regarding flawed event dates so this data is also hand checked. The daily return data for the remaining additions and deletions are gathered from datastream. The daily return data for the MSCI EU and MSCI USA index as a whole are also from datastream.

As methodology for my research I use an event study because the inclusion to or exclusion from an index is an event which has an effect on the stock price. Therefore the rebalancing moments of the index serve as event dates and the stock returns are the performance measures for these events. The reason that I use rebalancing moments as event dates is because the announcement date is a fixed amount of days before the rebalancing (see section 4.1) which makes it easy to see the potential announcement effect, which is shown in section 5.4. I start the event study by using the full sample which spans over the time period 1974-2016 for the S&P and over the time period 2006-2016 for the MSCI indices. The only split I make is between additions and deletions because deletions are not expected to show the same effect as additions, see section 2. After that I split the S&P sample in two different time periods to reveal potential time effects. I only do this for the S&P sample as the MSCI sample already has a short time period and splitting it up will give very small samples. I use the following time periods for the S&P: 1974-2006 and 2006-2016. I use 2006 as a split date because the MSCI sample spans over the 2006-2016 period and therefore it will make the comparison easier and will make it possible to show if there are any differences between the indices regarding price effects. The results from these different time periods are then linked to the hypotheses from Section 2.

In my event study I compare the actual returns of a firm with the expected returns predicted based on the market return. This is measured during the event window and estimated during the estimation window. The estimation window is the time period before the actual event (event window) in which it is assumed that the firm behaved as 'normal'. The estimation window in which the expected return is predicted is set at 200 trading days before the event with a gap between the event and estimation window of 30 days. I use this gap to counter potential confounding effects. The estimation window is shifted relative to the event window meaning that when the event window is widened the estimation window is shifted to keep the 30 day gap between estimation and event. Observations which do not comply with the 200 trading day estimation window requirement are dropped, otherwise the estimation results are less exact and statistical significance will suffer. The expected return calculation is based on the CAPM model, which predicts the β for every individual firm during the estimation window by regressing the returns of the observations on the market return. The regression is done without an intercept (α) because the estimation window of 200 trading days is to short to predict a reliable α. Then by using the 3 month T-bill rate for the S&P & MSCI USA and the 3 month Euribor rate for the

MSCI Europe as risk free rates the expected return can be derived following the formula:

$$R_{it} - R_f = \beta_i(R_{mt} - R_f) + \epsilon_{it}$$

This formula is widely used in event studies and the CAPM model seems a good benchmark estimate for the expected returns (Kothari and Warner, 2004). The expected return is then used to calculate the abnormal returns of the individual firms. The abnormal return is the actual return of the firm minus the predicted return during the event period. The abnormal return as a formula is:

$$AR_{it} = R_{it} - E(R_{it})$$

Where AR_{it} is the abnormal return of an individual company, R_{it} is the actual return of the company and $E(R)_{it}$ is the expected return for the individual company. The abnormal return is calculated on every event day in the event period for every individual firm to make it comparable across the sample. To calculate the Cumulative Abnormal Return (CAR) I summarize the abnormal return over the event window for every firm. The cumulative abnormal return formula is therefore:

$$CAR_i = \sum_{t=T1}^{T2} AR_{it}$$

The event window is the period where the abnormal returns are measured before and after the event, so a 4 day event window means a period ranging from T-4 to T+4 where T is the event date. The event window is varied between 4, 14 and 60 trading days for the S&P and MSCI sample. The 4 trading days period is chosen because of the 4 trading days period between announcement and rebalancing that the S&P applies. This event window should therefore capture the announcement price effect for the S&P which is expected to be higher than the MSCI in this period, because the MSCI applies a larger period between announcement and rebalancing which is discussed more in depth in Section 4.1. The 14 days window is therefore chosen to capture this larger gap of the MSCI and to show the price effect over a longer period. The 60 trading days event window is used to show the long term price effect, to reveal potential pre-announcement/post rebalancing effects.

To test the liquidity hypothesis I use the Amihud Illiquidity ratio (2002), this ratio measures the price impact associated with one million dollars of trading volume. This ratio is widely used in empirical literature and a very convenient way to measure liquidity as it only uses the absolute return and dollar volume of traded shares. A higher value for the Amihud measure shows more illiquidity on that day, which can be caused by higher dollar volume or a lower absolute return as follows from the formula:

$$ILLIQ_{it} = \frac{|R_{it}|}{V_{it}}$$

The $|R_{it}|$ is the absolute return of firm i on day t, V_{it} is the dollar volume of the traded shares of firm i on day t. The Amihud measure is scaled by the market value of the individual firm after this to account for size effects and time effects, this is especially important for the S&P sample as this sample spans over a large time period. The Amihud measured is calculated over the whole sample and after that I take the median of the Amihud measure over the estimation window for every firm to derive one Amihud value for each firm. After this I perform a cross-sectional regression by regressing the 14 day CAR on the median Amihud measure to see what and if there is a liquidity effect on the CAR. The regression is defined as:

$$CAR_i = \alpha_i + \beta_i * ILLIQ_i + \epsilon_i$$

As an additional measure I also use the turnover measure which is essentially the denominator of the Amihud measure. The turnover measure is the dollar volume divided by the market value of the individual firm so it is already scaled to account for the time and size effects. I use the turnover measure to check for potential endogeneity errors occurring in the Amihud measure as the left side and right side of the equation are based on the returns of the firm. The signs of the regression results should be the opposite of each other as the Amihud ratio shows illiquidity and the turnover ratio shows liquidity. An additional t-test is done on the median of the Amihud measure in the estimation window compared to the event window Amihud measure. I expect to find a positive t-stat which indicates that the liquidity is higher in the event period compared to the estimation period as most index trackers buy additional stocks in the event window.

To show potential differences between 'small' and 'large' firms an additional section is made which discusses the size effects. The size effects are shown by regressing scaled market caps on two groups named as 'large' and 'small'. The small group contains the 50% smallest firms based on the market cap, the large group contains the rest of the observations. The scaling of the market values of the firms is done by creating a scaling factor and using this scaling factor to derive the 'current' market values. The scaling factor is defined as 1 for the current market value of the index and by dividing the current market value of the index with the historic market values I get the scaling factors. Then I multiply the market values of the firms with this scaling factor. As an additional measurement I also regress the market size on the CAR to show the economic impact of the market size. The regression in formula form is shown below.

$$CAR_i = \alpha + \beta * Marketsize_i + \epsilon_i$$

The last analysis includes some statistical adjustments to account for event clustering and cross-sectional heteroskedasticity. The event clustering is corrected for using the crude dependence adjustment (Brown and Warner, 1980). By using this adjustment the standard deviation is calculated over the estimation period and not over the actual event window. Then this standard deviation is used to calculate the t-stat and show potential changes in the significance levels. It is expected that the standard deviation is higher when adjusted for event clustering. The cross-sectional heteroskedasticity is countered by standardizing the returns using the volatility in the estimation period and then using these returns for calculations of the t-stat. This counters a potential increase in variance during the event period. The adjustment is proposed by Boehmer et al. (1991) and is expected to show higher standard deviations and therefore the t-stat will be lower.

5 Results

5.1 S&P 500 rebalancing

In this section the results from the event study, with the rebalancing date as the event, are discussed and linked to the hypotheses formulated in section 2. First the additions to the S&P index are discussed and after that the deletions from the S&P sample. I will mainly refer to *The price pressure hypothesis* and *The imperfect substitutes hypothesis* as these two hypotheses explain the results of this event study best. It is possible that both hypothesis are rejected or both are supported as the hypotheses are not mutually exclusive. The other hypotheses are tested separately with different measurements, the information hypothesis with an announcement effect event study in section 5.4 and the liquidity hypothesis with the Amihud measure in section 5.5. Table 2 shows the Cumulative Abnormal Return (CAR) for the firms that were added to and deleted from the S&P 500 index for the time period 1974-2016. This sample is referred to as the full sample. Table 3 shows the results for the 2006-2016 time period. This sample is referred to as the late sample. Table 4 shows the results for the 1974-2006 time period. This sample is referred to as the early sample. The CARs in the tables represent different periods in the event period to show potential pre- or post-event price effects. The significance levels are denoted by asterisks. Appendix 8.1 to 8.3 shows the cumulative abnormal returns in a graph, which reflects more visually if the effect is temporary (Price pressure) or permanent (Imperfect substitutes) or both.

The 4 day event window for the full sample shows a significant positive CAR of 3.4% over the whole event period, which is in line with previous literature as Beneish and Whaley (1996),

Table 2: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the S&P 500 index for the full sample. The event period is the period in which the rebalancing (event) of the index happened with varies amount of trading days before and after the event denoted as K. The CAR is the average of the individual firm CARs over different periods in the event. The standard error is robust to account for heteroskedasticity. The t-stat is the result of the test statistic. N is the amount of firms included in the sample.

	Additions				Deletions			
	CAR				CAR			
Event period	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N
[-4, 4]	3.4%***	2.4%***	1.0%***	501	-8.47%***	-3.91%***	-4.56%**	216
	(8.80)	(9.93)	(3.10)		(-3.05)	(-3.60)	(-2.30)	
[-14, 14]	3.8%***	3.66%***	0.21%	501	-11.7%***	-6.26%***	-5.52%**	216
	(6.44)	(9.32)	(0.45)		(-3.48)	(-4.63)	(-2.09)	
[-60, 60]	3.0%**	4.77%***	-1.76%*	501	-16.3%***	-11.26%***	-5.19%	216
	(2.41)	(6.30)	(-1.76)		(-3.53)	(-4.75)	(-1.53)	

Significance levels : * : 10% ** : 5% *** : 1%

Table 3: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the S&P 500 index for the 2006-2016 time period. The 2006-2016 is a sub sample from the 1974-2016 time period. The event period is the period in which the rebalancing (event) of the index happened with varies amount of trading days before and after the event denoted as K. The CAR is the average of the individual firm CARs over different periods in the event. The standard error is robust to account for heteroskedasticity. The t-stat is the result of the test statistic. N is the amount of firms included in the sample.

	Additions				Deletions			
	CAR				CAR			
Event period	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N
[-4, 4]	1.85%***	0.95%***	0.90%**	166	-7.48%	-3.0%	-4.48%	33
	(3.51)	(2.76)	(2.21)		(-1.33)	(-0.87)	(-1.47)	
[-14, 14]	0.41%	2.41%***	-2.0%***	166	-5.0%	-5.68%	0.69%	33
	(0.45)	(4.05)	(-3.06)		(-0.82)	(-1.28)	(0.28)	
[-60, 60]	1.22%	6.17%***	-5.09%***	166	-18.32%*	-17.84%**	-0.53%	33
	(0.64)	(4.96)	(-3.30)		(-1.72)	(-1.99)	(-0.11)	

Significance levels : * : 10% ** : 5% *** : 1%

Table 4: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the S&P 500 index for the 1974-2006 sample. The event period is the period in which the rebalancing (event) of the index happened with varies amount of trading days before and after the event denoted as K. The CAR is the average of the individual firm CARs over different periods in the event. The standard error is robust to account for heteroskedasticity. The t-stat is the result of the test statistic. N is the amount of firms included in the sample.

	Additions				**Deletions**			
	CAR				CAR			
Event period	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N
[-4, 4]	4.49%***	2.61%***	1.87%***	334	-8.65%***	-4.07%***	-4.58%**	183
	(9.13)	(8.62)	(4.23)		(-2.77)	(-3.62)	(-2.01)	
[-14, 14]	5.54%***	3.39%***	2.15%***	334	-12.9%***	-6.36%***	-6.64%**	183
	(7.03)	(6.63)	(3.65)		(-3.39)	(-4.58)	(-2.15)	
[-60, 60]	3.88%**	3.33%***	0.56%	334	-15.94%***	-10.07%***	-5.87%	183
	(2.44)	(3.41)	(0.47)		(-3.12)	(-4.39)	(-1.54)	

Significance levels : * : 10% ** : 5% *** : 1%

Lynch and Mendenhall (1996) and Kaul et al. (2000) found roughly the same results regarding S&P additions. This CAR shows a significant pre-event CAR of 2.4% and a significant post-event CAR of 1.0%, this supports the imperfect substitutes hypothesis as the effect remains positive after the event. Looking at the longer 60 trading days event window the CAR stays significantly positive at 3.0%, which supports the Imperfect substitutes hypothesis that there is a permanent positive effect for the full S&P sample. However the 14 day and 60 day post-event CARs show a small price pressure effect because the post-event CARs change from significant positive to insignificant negative, which supports the price pressure hypothesis that the price reverts back partially after the event. The graphs in appendix 8.2-8.3 show this small price pressure effect visually and support it, which means that the CAR on the event day is higher than the CAR at the end of the event period. A possible explanation for this is that the limited capacity of the market moves to absorb the increased order flow and this increases the price but decreases after the actual implementation. Most results are significant at the 99% confidence level except the post-event returns for the 14 days and 60 days event window.

Table 3 shows notable differences between the results from the full sample and the results from the late sample. The first difference is that the results for the late sample are statistically insignificant, except for the 4 day window. The CARs show that the way stock prices react to additions has changed over time because the CAR over the whole event period is much smaller compared to the full sample and the price effects are different. The difference in price effects is especially present in the post-event results with large negative price effects for the 14 (-2.0%) and 60 (-5.09%) days event windows which mostly cancel out the pre-event price effect. Therefore the price pressure hypothesis is supported and the imperfect substitutes can not be supported as the permanent effect is not statistically significant. This shows that no permanent price effect remains which can be explained by a potentially improved market liquidity. The liquidity hypothesis is tested more in depth in section 5.5.

Table 4 shows the results for the early sample which shows a lot of similarities with the full sample. The CARs over the full event period are the highest of the three samples which indicates that the effects of the full sample are mostly based on the period pre-2006. The post-event CARs show no negative signs which means that the price does not revert back after the actual implementation. This finding supports previous literature which is mostly based on the period pre-2000 and this shows the difference between the past and present. The imperfect substitutes hypothesis is therefore supported because all CARs over the full event period show a significant permanent positive effect. The price pressure hypothesis is rejected as the post-event CARs show no reversion. These findings suggest that pre-2006 an addition to the S&P was seen as an important signal about the financial situation of a firm and was valued more by investors. All findings are significant at the 99% confidence level except the post-event CAR for the 60 days event window.

The deletions share some of the patterns that are found for the additions of the full sample but there are also some main differences. First by looking at the full sample a significant negative CAR of -16.3% is found for the 60 day event period which is large but not unexpected as Masse et al. (2000) found similar results regarding deletions. For the full sample the post-event negative CAR is mainly caused by the negative abnormal return on the event day (-3.5%) and the day after (-2.2%), this is one of the reasons the result is insignificant. This confirms that there is no price pressure effect and the price pressure hypothesis is rejected. The graphs in appendix 8.1-8.3 confirm this finding as the graphs remain relatively stable after the rebalancing day. The imperfect substitutes hypothesis is supported as there is a significant permanent negative CAR over the 60 day event period of -16.3%. A similar pre-event effect, as the additions showed before, is found as the CAR for deletions is already negative (-11.26%) before the actual rebalancing is implemented. This can be caused by negative momentum of the firm and as a result the firm is excluded but this is out of the scope of this research. Most results for the full sample regarding deletions are significant at the 99% confidence level except the post-event results. This is caused by the large negative abnormal returns on the event day and the day after.

For the 2006-2016 period there is a great similarity between the additions and deletions as the results are mostly insignificant, which is mainly caused by the small sample size (N=33). Although the CAR values for the full event period are largely negative it can not be concluded that it is significantly different from 0%. The 60 days event window shows a negative CAR of -18.3% which is in the same range as the -16.3% from the full sample. This negative CAR is mainly based on the pre-event CAR which is -17.84% and significant at the 95% confidence level. The post-event CARs are not significantly different from 0% but this is mainly caused by the negative abnormal returns on the event day (-3.9%) and the day after (-2.8%) which is also found for the full sample. The graphs in appendix 8.1 to 8.3 support this finding as there is a price pressure effect because the price reverts back after the rebalancing date. This result is based on a wide confidence interval so it is not significantly supported. The imperfect substitutes hypothesis is statistically supported over the 60 days event window as there is a permanent negative price effect. So the main difference in results regarding the full sample and the late sample is that the price pressure is more present in the late sample.

The deletions in the early sample show a lot of resemblance with the deletions from the full sample. The negative post-event CAR is also mainly caused by the negative abnormal return on the event date (-3.4%) and the day after (-2.2%). Therefore the same conclusions can be drawn as for the full sample. With the price pressure hypothesis rejected and the imperfect substitutes hypothesis supported. The CARs from the early sample are similar compared to the full sample in terms of magnitude. This supports the finding that the full sample is mainly driven by the observations in the 1974-2006 period as is found for the additions in the previous segment.

5.2 MSCI Europe rebalancing

This section discusses the results of the event study for the MSCI Europe in the same manner as for the S&P 500. The only difference is that the MSCI Europe sample is not split as I only have data from 2006 till February 2016 for the MSCI Europe (see section 4). Table 5 shows the CARs for the MSCI Europe sample. It is important to notice that the comparison to the S&P index is made with the S&P 2006-2016 sample as this sample is in the same time period and time effects are thus ruled out. Appendix 8.1-8.3 contains all the CARs in graph format for the MSCI Europe which will be referred to more specific in further segments.

As stated in section 3 the main difference between the MSCI indices and the S&P index is the transparency regarding the index methodology. This transparency is reflected in the results for the MSCI Europe, as there is a very big run up in price especially for the 60 days event window. This run up in price starts ahead of the announcement and the actual rebalancing date suggesting anticipation by investors, section 5.4 checks whether this is caused by the announcement. Table 5 shows results suggesting that there is indeed a large run up in price

Table 5: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the MSCI Europe index which is part of the MSCI World index. The event period is the period in which the rebalancing (event) of the index happened with varies amount of trading days before and after the event denoted by K. The CAR is the average of the individual firm CARs over different periods in the event. The standard error is robust to account for heteroskedasticity. The t-stat is the result of the test statistic. N is the amount of firms included in the sample.

	Additions				**Deletions**			
	CAR				CAR			
Event period	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N	[-K, K] (t-stat)	[-K, -1] (t-stat)	[0, K] (t-stat)	N
[-4, 4]	1.68%***	0.98%***	0.70%***	247	-2.47%***	-0.89%**	-1.57%***	305
	(4.64)	(3.56)	(2.59)		(-3.69)	(-2.33)	(-2.89)	
[-14, 14]	1.61%**	2.74%***	-1.12%**	236	-7.62%***	-7.15%***	-0.47%	305
	(2.50)	(5.59)	(-2.36)		(-7.35)	(-9.28)	(-0.56)	
[-60, 60]	7.64%***	10.65%***	-3.25%***	232	-15.95%***	-17.31%***	2.28%	305
	(5.15)	(10.69)	(-3.06)		(-6.83)	(-9.27)	(1.38)	

Significance levels : * : 10% ** : 5% *** : 1%

pre-announcement as the pre-event CAR for the 14 days event window (announcement date till effective date) is 2.74% and the pre-event CAR for the 60 days event period is 10.65% which shows a price run up of around 8% pre-announcement. If the full event CARs of the 14 days S&P period (0.4%) and the 60 days period (1.2%) are compared to the full event CARs of the MSCI Europe, it is found that the price effect for the MSCI Europe is much larger and more significant. But this is not a fair comparison as the S&P maintains a 4 day gap between announcement and actual rebalancing. So the comparison between the 4 days full event CAR of the S&P (1.85%) and the 14 days full event CAR of the MSCI Europe (1.61%) is a better representation of the announcement effect. This shows that the effect for firms added to the MSCI Europe index is smaller over the period between announcement and the actual rebalancing. The more in depth analysis regarding announcement effects is discussed in section 5.4. Looking at the longer event period the full event CAR is much larger for the MSCI Europe compared to the late S&P sample as the CAR over the 60 days event period is 7.7% for the MSCI Europe compared to the 1.2% of the S&P. This finding shows that the additions to the MSCI Europe earn a higher abnormal return compared to the S&P sample. The post-event CARs for the 14 and 60 days event period is negative and significant which supports the price pressure effect for the MSCI Europe. The graphs in appendix 8.1-8.3 are also confirming a price pressure effect as the CAR on the actual rebalancing day is around 12% and ends at 7.64%. Still the permanent effect (Imperfect substitutes) dominates because a significant positive effect of 7.7% for additions is large. This might indicate that indexing in Europe still contains some new information and therefore the investors perceive an addition as a good signal. All results for the additions of the MSCI Europe are statistically significant at the 99% confidence level.

The deletions of the MSCI Europe index show more similarity with the S&P index as there is a large significant permanent effect of -15.95%. This confirms the imperfect substitutes effect again even though the sample is cleared for mergers and bankruptcy's. The price drop starts, same as the additions, ahead of the actual rebalancing, with a pre-event CAR of -17.31% over 60 days, potentially indicating that investors anticipate the deletion and sell their shares in advance. It could also indicate that the firm is performing poorly and that the deletion is a consequence of the bad performance compared to the market. But if this would be the case than the post rebalancing performance should continue the negative trend because the firm fundamentals do not change after the actual deletion. This is not found as the price pressure effect post-event is 2.28% positive, this shows the opposite effect as the firm performance is better than the market/benchmark after deletion. The findings do support the price pressure hypothesis as the price reverts back marginally after the event. The graphs in appendix 8.1-8.3 also confirm the the price pressure hypothesis visually as the price climbs after the actual rebalancing. The price pressure effect for the MSCI Europe sample is smaller than the price pressure effect for the S&P sample which leaves the Europe sample with a more permanent effect (imperfect substitutes effect). All results regarding the deletions for the MSCI Europe are statistically significant at the 99% confidence level except for the 14 and 60 days post-event CARs.

5.3 MSCI USA rebalancing

In this section I discuss the results of the remaining sample which is the MSCI USA index, the results are discussed in the same manner as the MSCI Europe section. Table 6 contains the CARs for the MSCI USA sample and appendix 8.1 to 8.3 contains the graphs for the MSCI USA. In this section the comparison is made between the MSCI USA and the late S&P sample as this is the equivalent of the MSCI USA index. Additionally the comparison is made between the MSCI USA and the MSCI Europe as these share the MSCI methodology.

Table 6: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the MSCI USA index. The event period is the period in which the rebalancing (event) of the index happened with different amount of trading days before and after the event denoted as K. The CAR is the average of the individual firm CARs over different periods in the event. The standard error is robust to account for heteroskedasticity. The t-stat is the result of the test statistic. N is the amount of firms included in the sample.

	Additions				**Deletions**			
	CAR				CAR			
Event period	[-K, K]	[-K, -1]	[0, K]	N	[-K, K]	[-K, -1]	[0, K]	N
	(t-stat)	(t-stat)	(t-stat)		(t-stat)	(t-stat)	(t-stat)	
[-4, 4]	0.38%	0.78%***	-0.40%*	371	1.34%	1.94%*	-0.61%	180
	(1.30)	(3.79)	(-1.74)		(1.00)	(1.95)	(-0.58)	
[-14, 14]	0.57%	1.88%***	-1.31%***	371	-6.62%***	-7.59%***	0.98%	180
	(1.00)	(5.43)	(-3.05)		(-4.18)	(-6.49)	(0.81)	
[-60, 60]	4.74%***	8.19%***	-3.78%***	350	-22.24%***	-21.36%***	0.57%	179
	(3.47)	(9.07)	(-3.57)		(-5.30)	(-6.50)	(-0.22)	

Significance levels : * : 10% ** : 5% *** : 1%

The MSCI USA shows similarities with the S&P index regarding the constituents as it only contains US firms, this is also reflected in the results from Table 6. It is important to notice that the MSCI USA is way smaller in terms of investments tracking it. In the USA the S&P is leading as an benchmark compared to investments tracking the MSCI (Morningstar database).

This influences the price reaction for additions to and deletions from the MSCI USA index as is supported by the results because some of them are insignificant compared to the S&P sample. This insignificance is the consequence of the volatility of the results as the graphs in appendix 8.1-8.3 show. Even though this makes the results less statistically supported it still has a lot of resemblance with the S&P and MSCI Europe indices. Comparing the CAR of the 14 day event period of the S&P (0.4%) with the CAR of the 14 day event period of the MSCI USA (0.57%) shows a lot of similarity in terms of magnitude. The main differences occur at the 4 and 60 day event period, whereby the signs are identical but the magnitudes differ. This is mainly caused by the price run up that I also identified with the MSCI Europe sample. Especially the pre-event period shows a large run up in price (8.19%) compared to the S&P results (6.17%). This shows that the same anticipation from investors is in place as is also the case with the MSCI Europe sample. The CAR for additions falls after the actual rebalancing with a negative 3.78% which supports the price pressure hypothesis but a permanent effect also remains so the imperfect substitutes hypothesis is also supported. This makes the MSCI USA sample different than the late S&P sample as this sample rejected the imperfect substitutes hypothesis.

Next is the price effect on deletions which is almost the same as the price effect seen for the MSCI Europe deletion sample. Whereby the price pressure hypothesis is rejected because the post-event CAR is not significantly different from 0% and therefore the imperfect substitutes is supported as the price effect is permanent. The graphs support this pre-event price drop which is the largest after the announcement date, but this is tested in section 5.4. The most interesting finding for the MSCI USA sample is that the CAR for the 4 day event period is positive. This could be explained by the fact that the MSCI has a large pre-event price drop and the 4 day event window does not reflect the full effect following from the rebalancing announcement. This is not statistically supported but seems as the best explanation and is discussed in section 6. Only the result for the 4 day full event window and the post event results are insignificant the rest of the results are significant at the 99% confidence level.

As I discuss a lot of findings a short summary of the results is in place. The main finding is that there is a difference between the results for the pre-2006 sample compared to the post-2006 sample. The pre-2006 results show more permanent effects (imperfect substitutes) and the post-2006 results more temporary effects (price pressure). Another general finding is that most of the abnormal returns for additions and deletions are earned in the pre-event period. There is also a difference between the S&P sample and the MSCI samples, especially in the pre-event period. The price effect for the MSCI samples is larger in magnitude and there is a larger run up in price pre-event. This finding supports section 3 where the difference between the methodologies are discussed and larger anticipation of investors is expected for the MSCI sample.

5.4 Announcement effect

This section discusses the results of the event study on the announcement effect. First the announcement effect on the additions is discussed and after that the announcement effect for the deletions. This event study is the same kind of event study used in the previous section but now the event is the announcement date of the rebalancing and not the actual rebalancing date. This event study is used to test *the information signaling hypothesis* because a large abnormal return on the announcement day shows unanticipated positive response from investors. Following the efficient market hypothesis (EMH) a positive price effect indicates that there is new information embedded in the announcement and therefore the information signaling hypothesis can be supported or rejected. The results of this event study are shown in Table 7.

The results for the additions show a clear separation between the S&P index and the MSCI indices in terms of significance and magnitudes. The results for the S&P are positive and significant at the 99% confidence level while the results for the MSCI indices are insignificant and smaller in terms of magnitude. Therefore the S&P sample shows a clear announcement

Table 7: This table shows the Abnormal Return (AR) that occurred on the announcement date instead of the actual rebalancing date. This means that the event date is adjusted to make the announcement date the actual event, which is 5 days before actual rebalancing for the S&P and 14 days before actual rebalancing for the MSCI indices. The abnormal return is shown for the actual announcement day (t=0) for all samples. The t-stat is the result of the test statistic.

	Additions		**Deletions**	
Sample	Abnormal Return (t=0)	t-stat	Abnormal Return (t=0)	t-stat
S&P 1974-2016	0.31%***	4.20	-0.67%**	-2.32
S&P 1974-2006	0.23%***	2.25	-0.71%**	-2.31
S&P 2006-2016	0.50%***	2.95	-0.45%	-0.53
MSCI Europe	0.13%	1.06	-0.53%*	-1.86
MSCI USA	0.004%	0.024	-0.29%	-0.69

Significance levels : * : 10% ** : 5% *** : 1%

effect and it potentially shows that investors perceive an addition to the S&P as a positive signal. So the information signaling hypothesis is supported for the S&P sample, but the effect is small relative to the multi-day CARs. The MSCI indices do not show this same effect as the abnormal returns on the announcement day are not significantly different from 0%. This finding is in line with the expectation that the MSCI investors anticipate on the rebalancing and therefore do not find the announcement embedding new information, they anticipate over a longer period. So the information signaling hypothesis is rejected for the MSCI sample. Another general finding is that the magnitudes of the announcement effects are small as they do not exceed 0.5%. The small price effect on the announcement effect emphasizes the price effect on the actual rebalancing date. This finding supports the hypothesis that most index tracking investors trade at or close to the actual rebalancing date instead of the announcement day. This gives room for arbitrage traders, they can profit from it by buying ahead of the actual rebalancing day and sell after the rebalancing happened.

The results for the deletions do not show the same separation between the S&P sample and the MSCI indices. The significance for the S&P sample is lower when compared to the additions but the absolute magnitudes are larger. The lower significance can be caused by the fact that firms deleted from the index performed worse before actual deletion and investors already sold their shares before the announcement. It can also be caused by an lower amount of observations with higher variability. Still a negative abnormal return is found for all samples which supports the information signaling hypothesis although not significantly. Therefore it is hard to conclude about the announcement effect on deletions. The results indicate that there is an effect on the announcement day but it is not clear if this is caused by the actual announcement or by poor performance of the individual firm.

5.5 Liquidity effect

The results for the liquidity effect are discussed in three separate parts because I test the liquidity effects with three different measures. The first measure that I discuss is the Amihud Illiquidity measure (see section 4). The second liquidity measurement is the turnover measurement which is essentially the denominator of the Amihud measure (see section 4), this to show potential differences between the two. The effects should be the opposite of each other as the Amihud ratio measures illiquidity and the turnover ratio measures liquidity. The last test for a liquidity effect is a t-test between the means of the Amihud measure in the estimation window compared to the means of the Amihud measure in the event window. A positive t-stat for this test indicates that the Amihud measure is larger in the estimation window compared to the event window which shows that the liquidity in the event window is higher. The results for the liquidity effects are shown in Table 8.

The Amihud measure shows clear results as almost all results are insignificant except for additions to the MSCI Europe. This rejects the liquidity hypothesis that there is a significant relationship between the liquidity of a firm and the CAR of the firm, at least for the US sam-

Table 8: This table contains the regression and analysis results for the liquidity hypothesis, which are 3 different kind of tests. The illiquidity and Turnover coefficients are the result of a regression of the 14 days event period CAR on the respective measure. The Illiq measure is the Amihud measure which is explained in section 3. The Turnover is the volume divided by the market value of the firm. The T-test tests for a difference between the amihud measure in the estimation period and the event period. A positive t-stat result for the T-test indicates that the liquidity in the event period is higher than the liquidity in the estimation period.

	Additions			**Deletions**		
	Coefficients			Coefficients		
Sample	Illiq (t-stat)	Turnover (t-stat)	T-test	Illiq (t-stat)	Turnover (t-stat)	T-test
S&P 1974-2016	-0.208	-0.056**	13.96	0.826	0.924**	-3.47
	(-0.46)	(-2.37)		(0.49)	(2.26)	
S&P 1974-2006	-0.389	-0.0465***	9.941	0.877	1.612**	-3.43
	(-0.79)	(-3.88)		(-0.50)	(2.22)	
S&P 2006-2016	-1.109	-0.0816***	15.77	-149.76	0.568	7.06
	(-0.31)	(-3.66)		(-0.67)	(1.40)	
MSCI Europe	0.080**	0.0396	-0.964	0.0491	-0.0950	4.57
	(2.01)	(1.03)		(0.81)	(-1.48)	
MSCI USA	-0.008	-0.0209	-0.891	0.0097	0.169	1.24
	(-0.39)	(-0.36)		(0.71)	(1.84)	

Significance levels : * : 10% ** : 5% *** : 1%

ple. This finding was not proposed by previous literature as Amihud and Mendelson (1986) found a significant liquidity effect for additions. The negative signs of the coefficients are also an interesting finding as I expected a positive sign. The negative signs indicates that a more liquid firm would benefit more from an addition to the index than a more illiquid firm. This is counter-intuitive as I would expect that a more illiquid firm would benefit more because when the firms becomes more liquid the 'liquidity premium' shrinks and the actual price goes up. It is interesting that the MSCI Europe shows an positive significant effect which indicates that European firms added to the MSCI Europe confirm the liquidity hypothesis. It is hard to say anything about the magnitudes of the coefficients as the Amihud measure is scaled to market value and I divided the measure with 1000 to make it easier to present. This makes the economic interpretation hard and therefore the signs and significance are better indicators of the liquidity effect measured by the Amihud measure.

The turnover measurement does not support the results following from the Amihud measurement as they do not show the opposite effect as expected. But these results are more intuitive, as the negative sign indicates that a more liquid firm (in the estimation period) experiences a more negative effect on the CAR compared to a more illiquid firm. This finding supports the liquidity effect for the S&P sample which counteracts the Amihud measure as this measure rejected the liquidity effect for the S&P. This can be caused by the Amihud measure being more sensitive to changes as it reacts to a change in return and a change in volume while the turnover is based solely on volume and market capitalization. The turnover measure is not significantly supporting the liquidity hypothesis for the MSCI samples, especially the MSCI Europe sample shows counteracting results. The sign for the MSCI Europe is insignificantly positive which indicates that a more liquid firm earns higher CARs than a more illiquid firm. This finding is the complete opposite of what I expected and also the complete opposite of the result following from the Amihud measure. For all samples the turnover measurement shows the same signs as the Amihud measure which makes it hard to conclude about the liquidity hypothesis while they should show opposite signs. It depends on the measure used whether the liquidity hypothesis is rejected or supported as the measures show opposite results. I prefer the turnover measurement as the Amihud measure is sensitive to endogeneity errors as explained in Section 3. So following the turnover measurement the liquidity hypothesis is supported for the S&P sample and rejected for the MSCI samples.

The last test is a t-test to see whether the mean of the Amihud measure is higher or lower in the estimation period compared to the event window. As the Amihud measure is a measure of illiquidity I expect the mean of the Amihud measure to be higher in the estimation period which indicates that the illiquidity is higher in the estimation period. The results in Table 8 support this hypothesis for the S&P sample as the t-stat is positive and significant. This means that the liquidity is higher in the event period, which means that investors trade more in the event period compared to the estimation period. This is supported by the turnover measure. The positive t-stat for the S&P also supports the hypothesis that the S&P sample is less predictable as investors trade significantly more in the event period and not prior to the event period. The opposite holds for the MSCI samples as the results are insignificant and negative which means that the liquidity in the event period is not statistically different from the liquidity in the estimation period. This is also an expected result as the MSCI indices are more predictable and investors start trading ahead of the actual event. These findings conclude that the timing regarding trading activities are different for the S&P sample when compared to the MSCI samples as expected in Section 4.

5.6 Market size effect

The result for the market size effect is discussed in two different parts as I used two different regressions for the market size effect. The first regression is the 14 days CAR regressed on a dummy variable (Small) of the individual firm as explained in Section 3. A firm is defined as 'small' if the median market capitalization in the estimation window belongs to the bottom 50% of the sample, large is the opposite of small. The second regression is the market size, defined as market capitalization, regressed on the 14 days CAR. The market capitalization of the firms is scaled based on the respective index to account for potential time and inflation effects. The results of the regressions are shown in Table 9.

The first regression shows the effect on the firm's CAR for being 'small', with a negative sign indicating a more negative CAR compared to large firms solely based on market capitalization. For additions this is the case as all coefficient signs are negative but not all significantly different

Table 9: This table contains the regression results for the market size effect which consists of two different regressions. The Small and Market size coefficients are the result of a regression of the 14 days event period CAR on the respective measure. The Small coefficient is the result of a regression of a dummy variable with the value 1 when the firm belongs to the smallest 50% firms based on market capitalization. The Market size coefficient is the market value of a firm regressed on the 14 days CAR this to see the size effect with a 100 million increase in size.

	Additions Coefficients		**Deletions** Coefficients	
Sample	Small (t-stat)	Market Size (t-stat)	Small (t-stat)	Market size (t-stat)
S&P 1974-2016	-3.76%***	10.20%***	-1.63%	39.0%***
	(-3.15)	(2.87)	(-0.25)	(3.12)
S&P 1974-2006	-1.77%	8.0%**	0.01%	39.50%***
	(-1.13)	(2.35)	(0.00)	(3.03)
S&P 2006-2016	-3.05%*	10.70%	-14.64%	35.0%
	(-1.67)	(1.17)	(-1.17)	(0.83)
MSCI Europe	-1.68%	0.96%	-5.51%***	8.79%
	(-1.30)	(0.41)	(-2.67)	(1.41)
MSCI USA	-3.08%***	6.30%	-8.01%***	16.60%***
	(-2.72)	(1.53)	(-2.57)	(2.74)

Significance levels : * : 10% ** : 5% *** : 1%

from 0. This is not what I expected as normally smaller firms earn higher returns compared to larger firms. This is for example researched by Fama and French (1991) who created the three factor model in which smaller firms are expected to earn higher stock returns. An explanation for the negative sign can be that smaller firms added to an index get a lower weight in the index compared to larger firms. The smaller weight in the index causes index trackers/investors to buy less stocks of the firm and therefore trigger a smaller price impact. Another finding is that for the S&P 1974-2016 sample and the MSCI USA sample the results are significant at the 99% confidence level. The result of the S&P 1974-2016 sample is mainly driven by the S&P 2006-2016 sample as this sample is also significant whereas the S&P 1974-2006 sample is not. This is also reflected by the MSCI USA sample which is similar to the S&P 2006-2016 sample in terms of construction. Therefore it can be concluded that larger firms perform better when added to an index in terms of CAR for the S&P and MSCI USA sample. The MSCI Europe does not show this significant market size effect. For deletions the results are different, as the result for the MSCI Europe is significant and the results for the S&P are insignificant. Most of the negative coefficients remain only the S&P 1974-2006 sample shows a positive coefficient but this is highly insignificant. Therefore the deletions show the same market size effect as the additions, with a small firm being worse off compared to a large firm.

The second regression shows the price effect on the firm's CAR if the market capitalization of the firm increases by 100 million dollar/euro. The results are clear as all coefficients are positive which means that an increase in market capitalization is positive for the firm's CAR. This result holds for additions and deletions which supports the previous regression that larger firm's earn larger CARs compared to smaller firms. The results for the S&P 1974-2016 sample and the S&P 1974-2006 sample are significant whereas the other results for additions are not. This indicates that the effect was more clear in the period pre-2006 as the other samples are only covering the post-2006 time period. For the US samples the price impact of a 100 million dollar increase in market capitalization is around 10%. The Europe sample shows a much lower coefficient regarding additions which indicates that the effect of market capitalization on the CAR is much lower. The deletions show similar results but the magnitudes of the coefficients are much higher, this is caused by the CARs of the deletions being much larger in absolute term compared to additions (Section 5.1-5.3). Therefore the main conclusion for the market size is that an increase in market capitalization impacts the individual firm's CAR positively.

5.7 Robustness checks

I use two statistical adjustments to check for robustness of the results. For event clustering I use the crude dependence adjustment is used which is proposed by Brown and Warner (1980) (see section 4). To adjust for cross-sectional heteroskedasticity I use the method proposed by Boehmer et al. (1991) whereby the variance is adjusted to account for increased variance during the event window (see section 4). The tables in Appendix 8.7 show the adjusted t-stats.

The crude dependence adjustment has a clear impact for all samples. Almost all results have a lower t-stat when adjusted for event clustering. This shows that some of the additions/deletions are clustered in the same period as expected. The adjustment especially impacts the MSCI Europe where only the 60 day result remains significant whereas before the other results were also significant. This does not change the interpretation of the actual results but the event clustering skews the significance of the regular event study upwards and should not been overlooked.

The results of the cross-sectional heteroskedasticity adjustment shows similar results as the event clustering adjustment. There is an decrease in the t-stat compared to the unadjusted results from the event study. This indicates that the volatility/standard error is higher in the event window compared to the estimation window. This was expected as the returns in the event window are impacted by the event and are more volatile than during the estimation window. The results of this adjustment do not change the interpretations and conclusions of the event study and confirms the expectation that the volatility of the returns is higher in the event window.

6 Conclusion and Implications

The general findings of my research are that additions to an index earn positive abnormal returns and deletions show negative abnormal returns. The price effect for the pre-2006 samples is more permanent while the post-2006 samples show more temporary price pressure. Another finding is that the S&P rebalancing is less predictable compared to the MSCI samples which is reflected in an positive abnormal return on the announcement day for the S&P samples. The effect of liquidity on the firm's CAR depends on the used liquidity measure. Another finding is that an increase in market size of the firm impacts the firm's abnormal return positively.

The Imperfect substitutes hypothesis and the price pressure hypothesis are the main hypothesis explaining the results for the rebalancing event study. The main finding for the rebalancing event study is that the price pressure is more present in the later samples compared to the early sample. This is supported by the results of the later time period samples (S&P and MSCI samples). These samples share the fact that the post-event CAR is negative and mostly significant for additions. This negative post-event CAR shows an reversal of the price effect which supports the price pressure hypothesis for most late time period samples. This also shows that the price effect of index rebalancing changed over time, which can be explained by the increase in investors/funds tracking the index.

Appendix 8.6 shows a graph with the historic growth of the top 10 largest ETF's. The exponential growth in ETF's can possibly explain the transition from the more permanent effect to the more temporary price pressure effect. The reason that the increase in indexing can explain the price pressure effect is that there is more demand coming from the ETF funds compared to previous years. This demand is not because there is new information in the market but because the funds need to rebalance according to the index. Therefore the demand is temporary and the price effect is temporary as well. Another explanation can be that the market becomes more efficient and only new firm information triggers a permanent price effect for that firm. This is an interesting subject to research in further studies.

Another finding is that there is a difference between the S&P sample and the MSCI samples possibly caused by their methodology underlying the rebalancing. The S&P samples show a small pre-announcement run up in price but most of the price effect happens on and after the announcement. This finding shows that the anticipation of investors to the rebalancing of the S&P is low which is supported by the announcement effect. This is explained by the opaque methodology that the S&P applies. It is difficult for investors to predict which firms are going to be added to or deleted from the S&P ahead of the announcement. This also limits the ability for arbitrage traders to trade ahead of the announcement. MSCI methodology on the other hand is transparent which makes the rebalancing easier to predict. The results support this observation because there is a steady run up in price before the actual announcement and rebalancing for the MSCI samples, which shows anticipation of investors.

The effect of liquidity on the price effect is not clear as it depends on the measurement of liquidity used. The liquidity hypothesis is supported for the MSCI Europe sample when the Amihud measure is used and supported for all S&P samples when the Turnover measure is used. I find the turnover, as percentage of firm value, to be a better measurement of liquidity and therefore I conclude that the S&P samples show a negative liquidity effect and the MSCI samples do not. The effect is negative meaning that firms with lower liquidity before the rebalancing benefit more from an addition than firms with higher liquidity pre-rebalancing. Another conclusion regarding liquidity is that liquidity increases in the period of the rebalancing which shows the increased demand of investors as expected. The size of the firm also impacts the price effect of the rebalancing because smaller firms experience smaller abnormal returns compared to the larger firms in the sample, the effect is not significant for all samples. This can be explained by the way indices are constructed, as most indices are constructed based on market capitalization. This means that smaller firms get a lower weight in the index which leads to smaller demand of investors and a smaller price effect. It is only useful for investors to consider the market size for the MSCI USA as this is the only recent sample with an significant results.

The robustness checks show that when adjusted for event clustering and cross-sectional heteroskedasticity the significance of the results are lower. This shows that there is event clustering in the samples and this is especially present in the MSCI Europe sample. This is expected as the MSCI rebalances according to a predefined schedule, which creates event clustering. The impact of the adjustments is not strong enough to change the interpretation and conclusion of the event study results.

The main conclusion that can be drawn from my research is that it can be beneficial/cost-reducing to trade ahead of the actual rebalancing of an index. The effect does manifest itself in different ways between different samples. One way it can be beneficial is if the share is bought/sold just after or on the announcement of an addition to or deletion from an index. This is beneficial because all samples showed that after the announcement the price went up for additions or down for deletions, the magnitude however differed between samples. The S&P sample showed a larger price effect after the announcement compared to the MSCI samples which showed a larger run up in advance of the announcement, most likely explained by methodology. How beneficial the strategy is also depends on the permanent or temporary character of the price effect as the effect is different between samples. If the price effect is permanent the early trading strategy earns positive returns for the investor. If the price effect is temporary it does not matter if the share is bought before or after the announcement date, as the price reverses back after the actual rebalancing. So if bought early the investors at least paid no premium and the same holds when bought after the actual rebalancing when the price has reverted back. This only holds for additions as all samples showed a negative CAR for deletions over the longer event periods so selling shares in advance of the rebalancing for deletions is always beneficial based on the results.

For further research I suggest to deepen out the relationship between price effects and indexing by looking more in depth to market variables such as volatility and financial distress etc. For investors further research in to index choices and in to the optimal degrees of freedom for passive investment managers can help to improve investment policies and hence returns.

7 Bibliography

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8 Appendix

8.1 4 days Cumulative Abnormal Return (CAR) on additions (left side) and deletions (right side)

Figure 1: S&P 500 full sample CAR

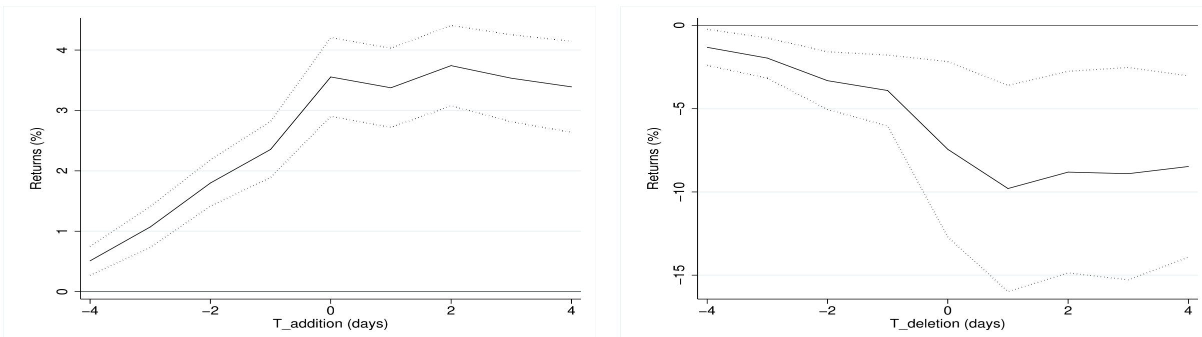


Figure 2: S&P 500 1974-2006 sample CAR

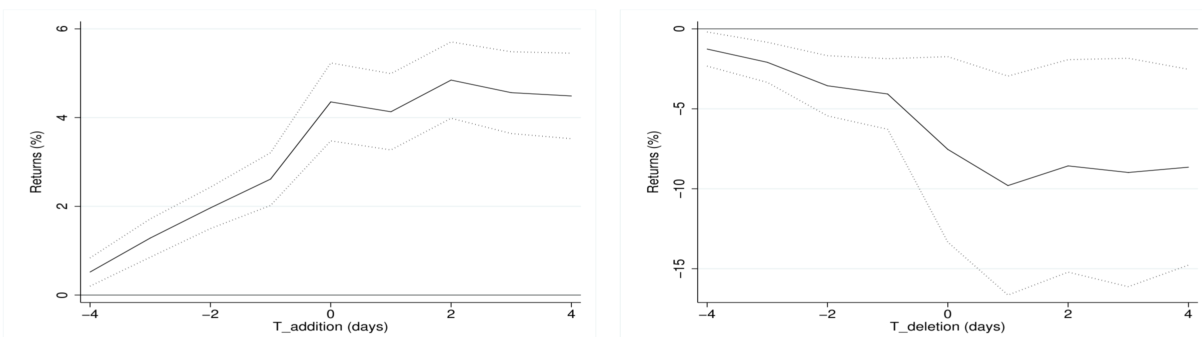


Figure 3: S&P 500 2006-2016 sample CAR

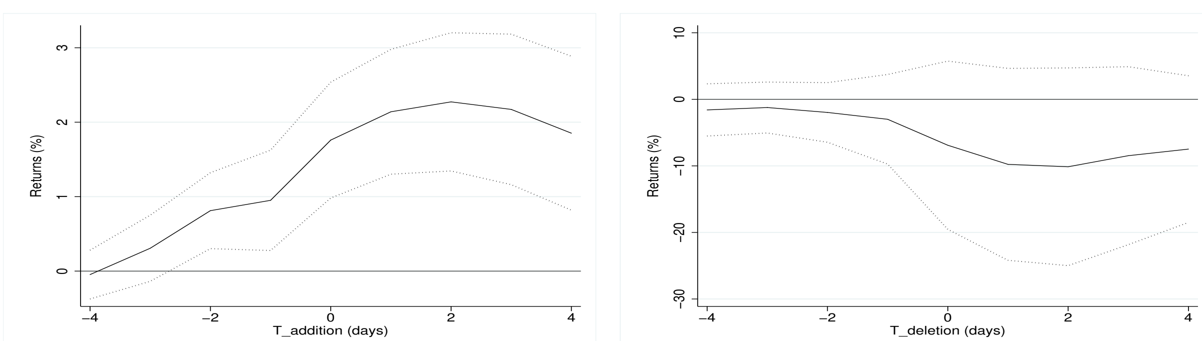


Figure 4: MSCI Europe sample CAR

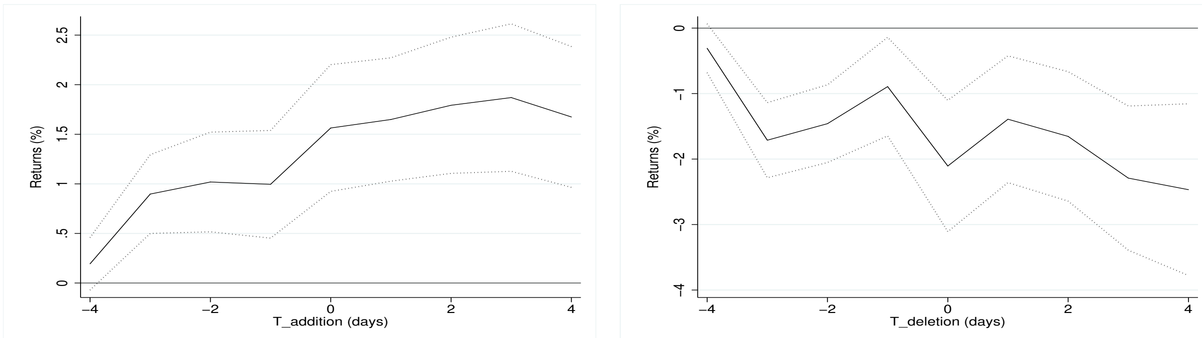
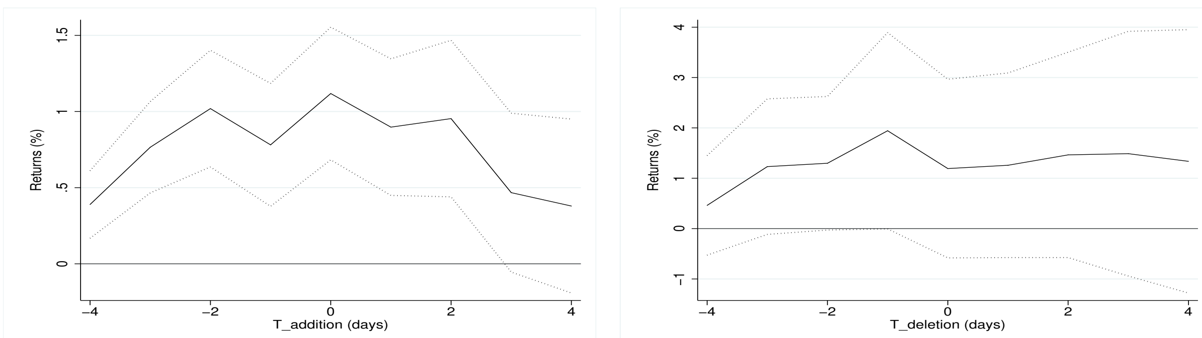


Figure 5: MSCI USA sample CAR



8.2 14 days Cumulative Abnormal Return (CAR) on additions (left side) and deletions (right side)

Figure 6: S&P 500 full sample CAR

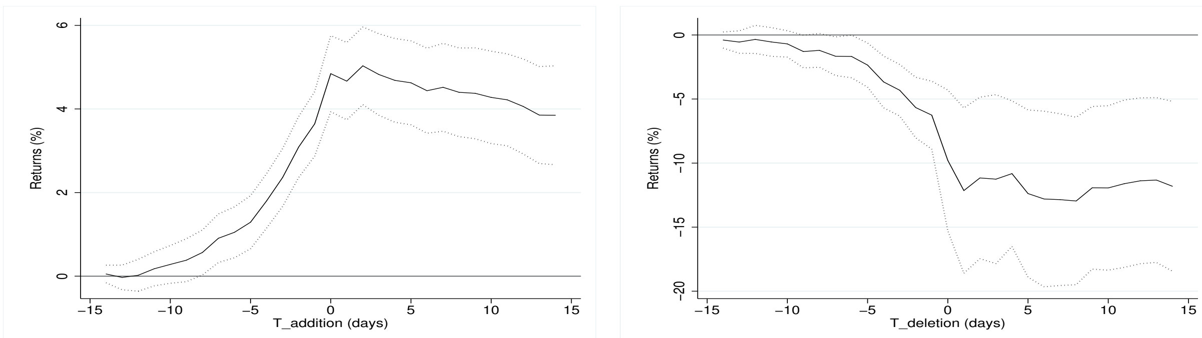


Figure 7: S&P 500 1974-2006 sample CAR

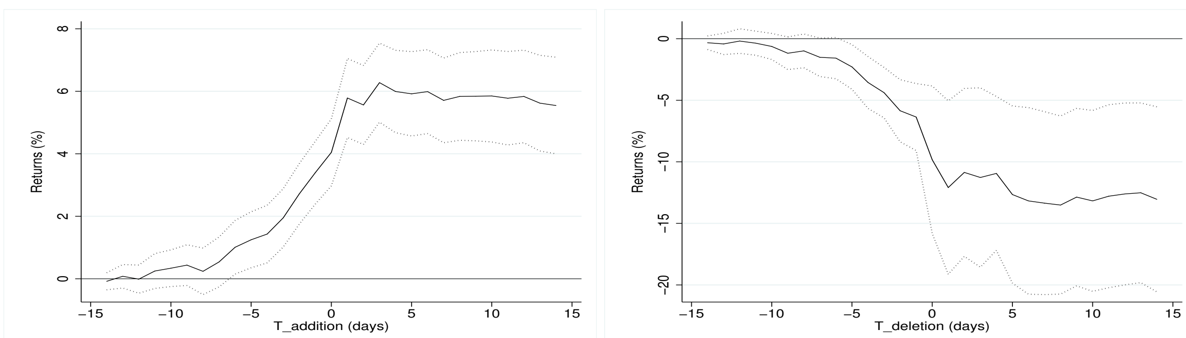


Figure 8: S&P 500 2006-2016 sample CAR

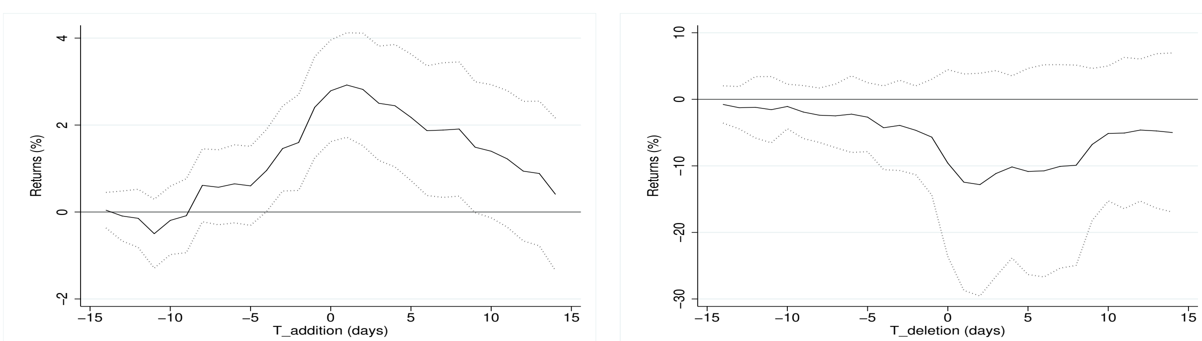


Figure 9: MSCI Europe sample CAR

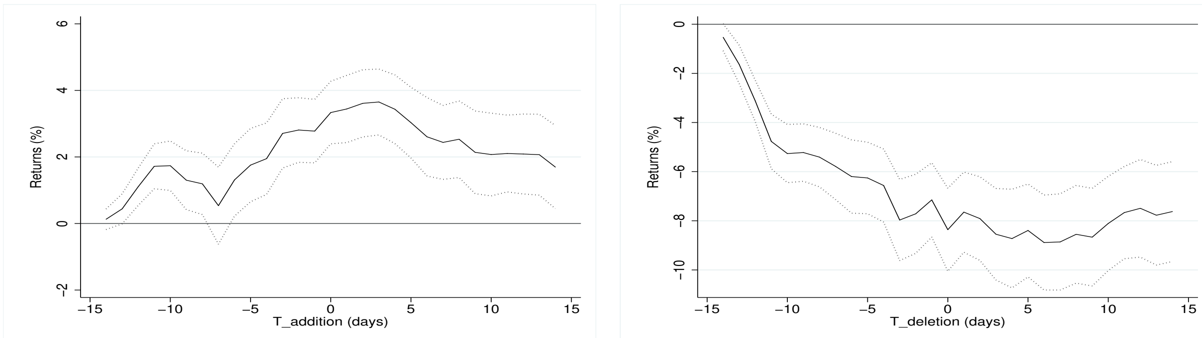
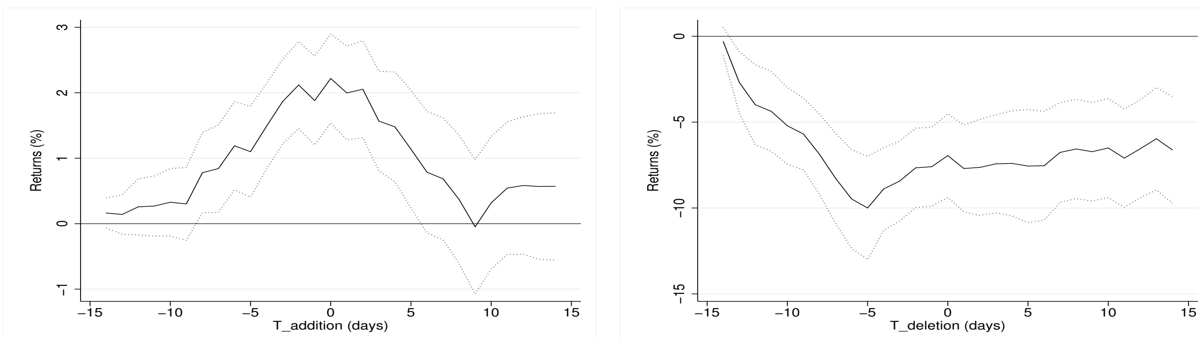


Figure 10: MSCI USA sample CAR



8.3 60 days Cumulative Abnormal Return (CAR) on additions (left side) and deletions (right side

Figure 11: S&P 500 full sample CAR

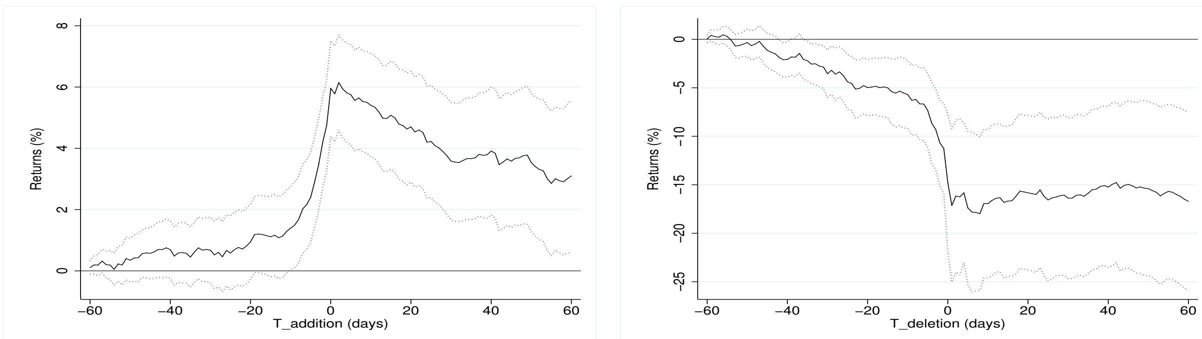


Figure 12: S&P 500 1974-2006 sample CAR

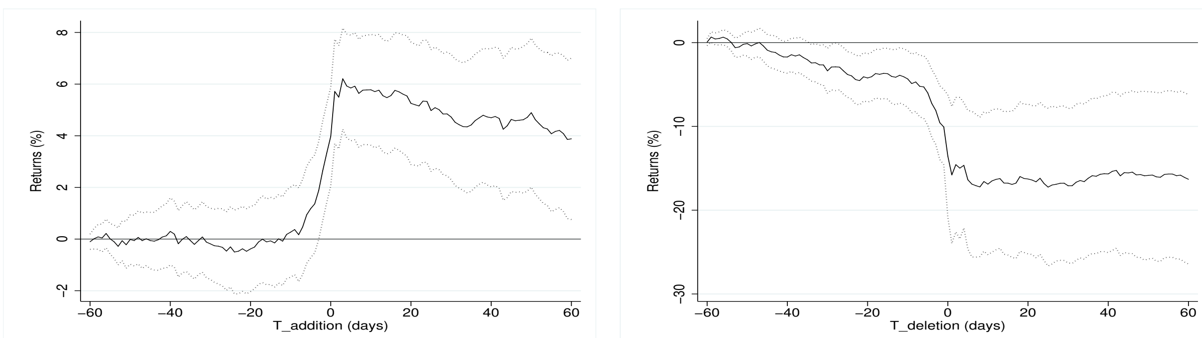


Figure 13: S&P 500 2006-2016 sample CAR

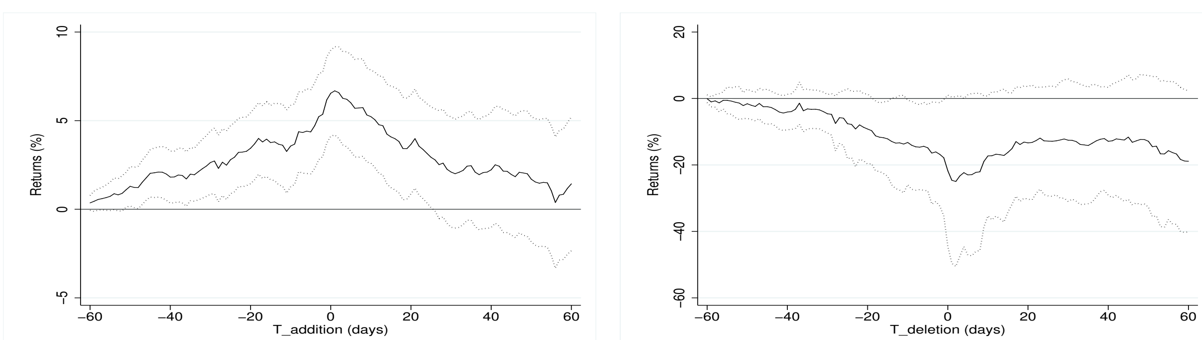


Figure 14: MSCI Europe sample CAR

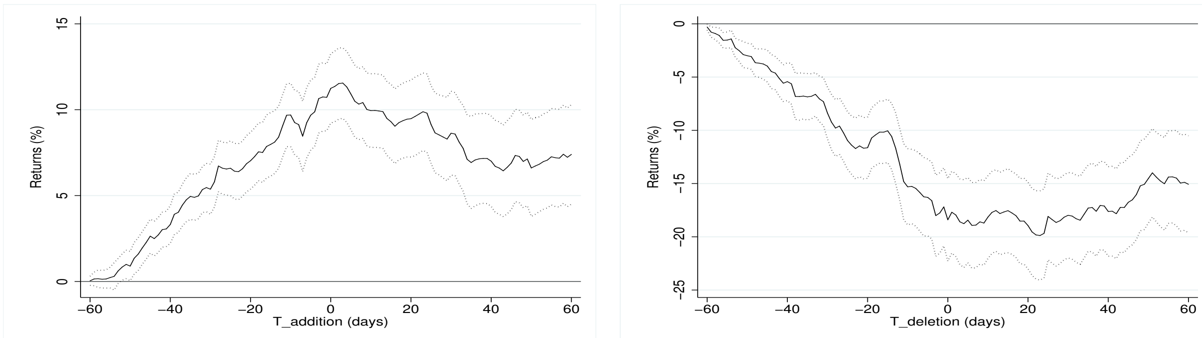
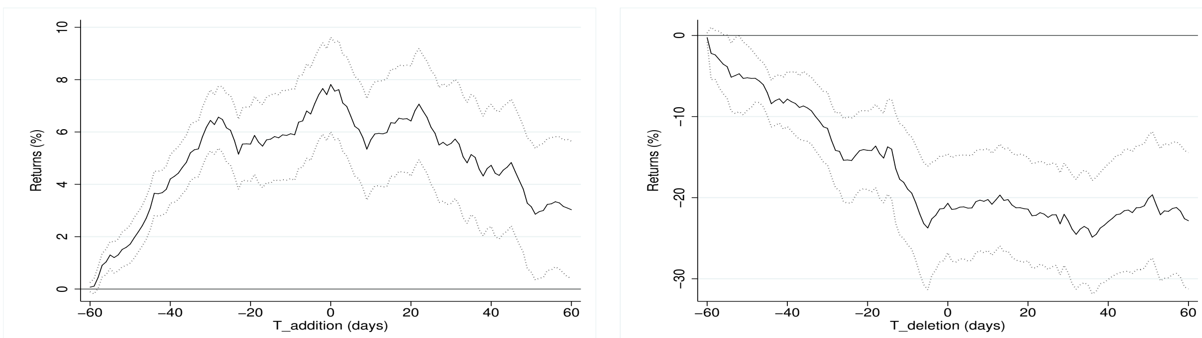


Figure 15: MSCI USA sample CAR



8.4 4 day Average daily abnormal returns (AAR) on additions (left) and deletions (right)

Figure 16: S&P 500 full sample AAR

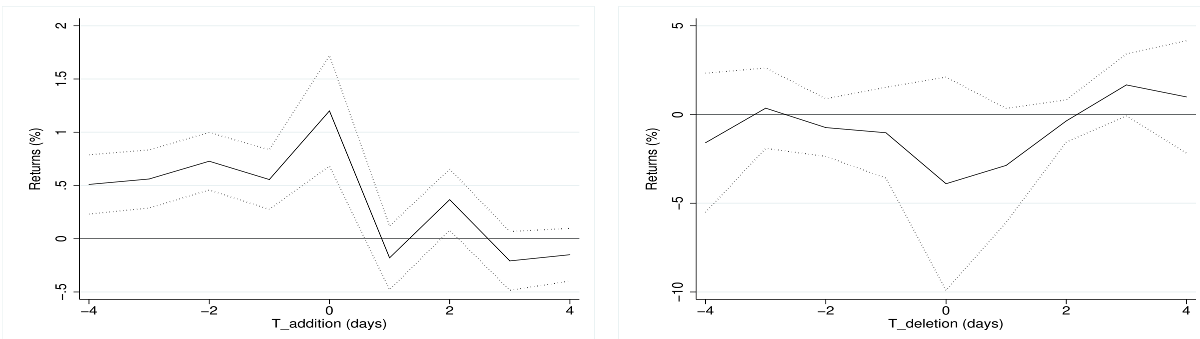


Figure 17: S&P 500 1974-2006 sample AAR

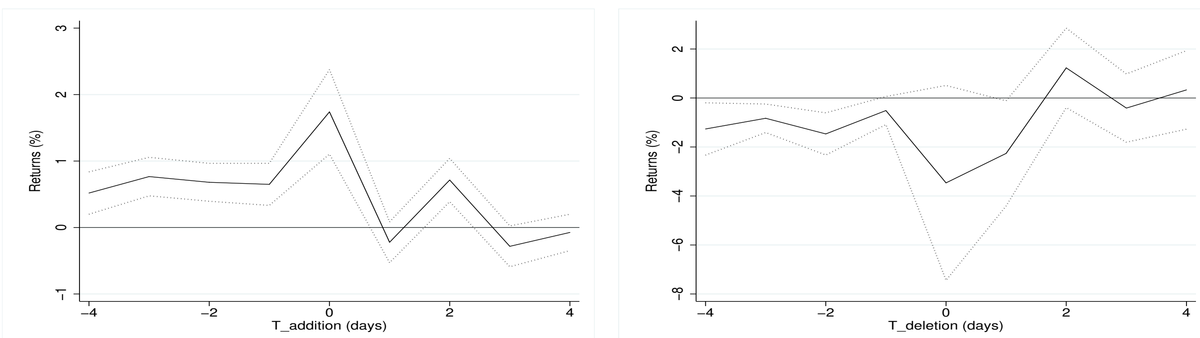


Figure 18: S&P 500 2006-2016 sample AAR

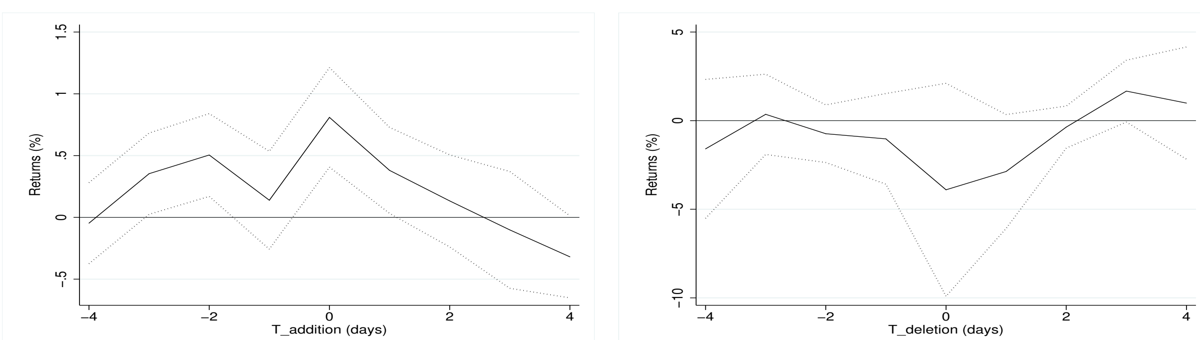


Figure 19: MSCI Europe sample AAR

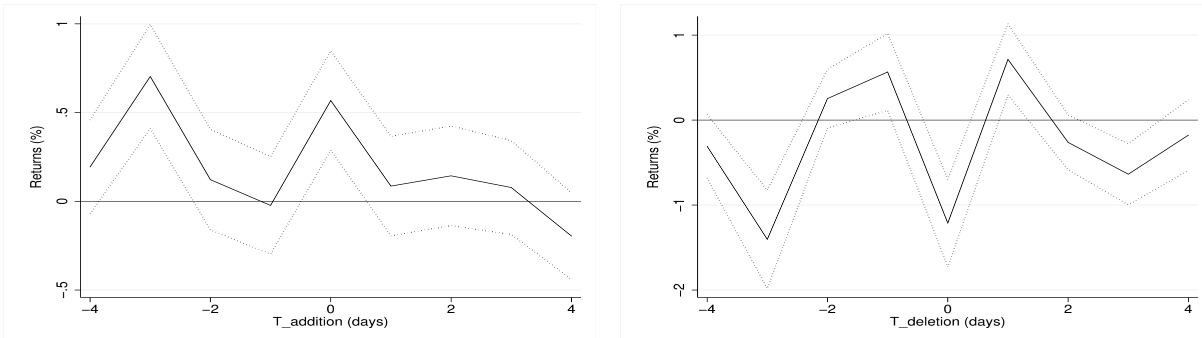
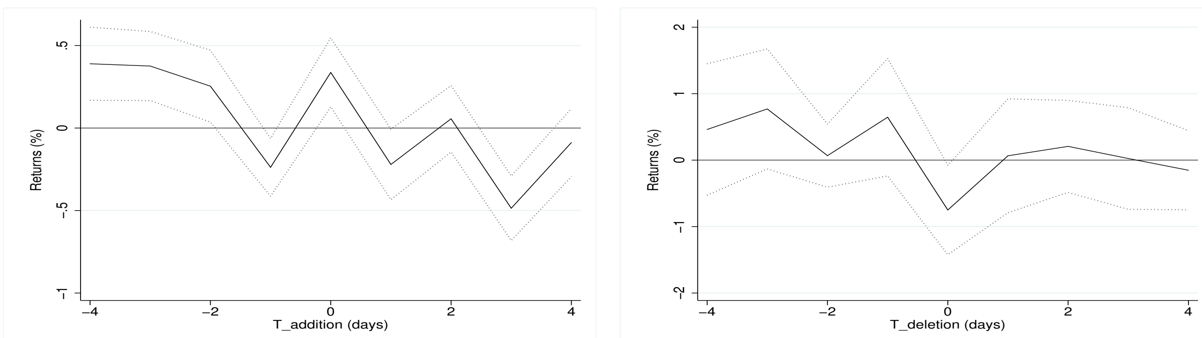


Figure 20: MSCI USA sample AAR



8.5 Announcement effect daily abnormal returns (AAR) on additions (left) and deletions (right)

Figure 21: S&P 500 full sample Announcement effect

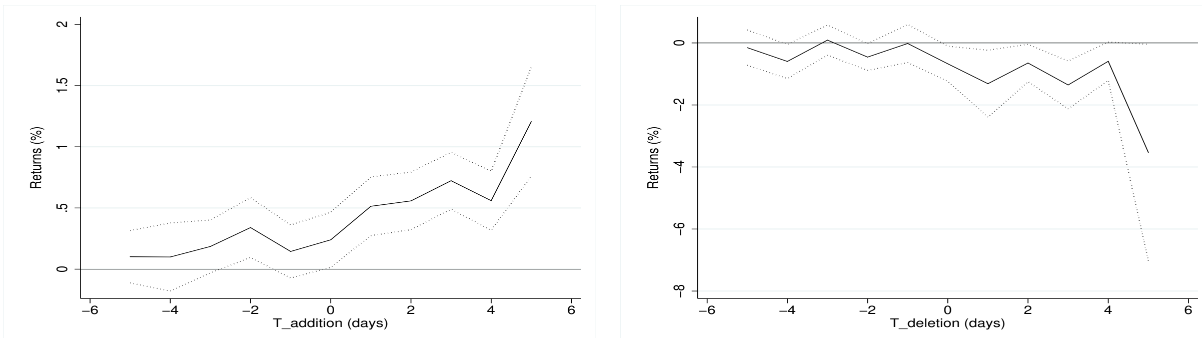


Figure 22: S&P 500 1974-2006 sample Announcement effect

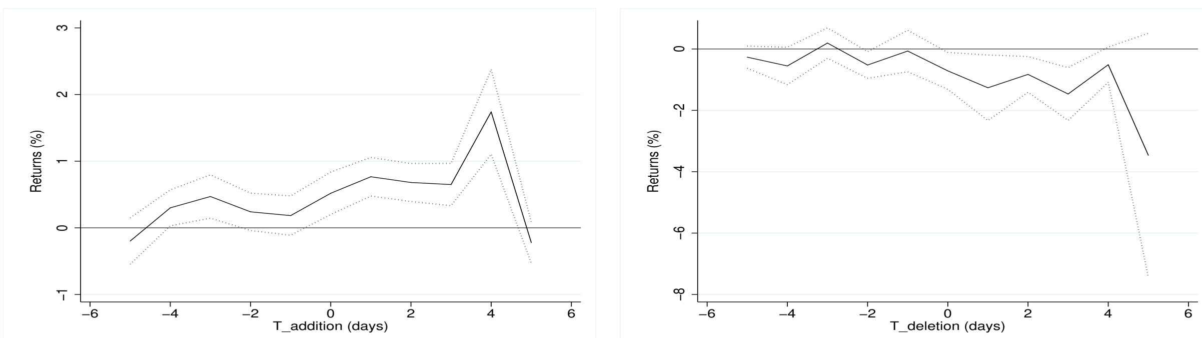


Figure 23: S&P 500 2006-2016 sample Announcement effect

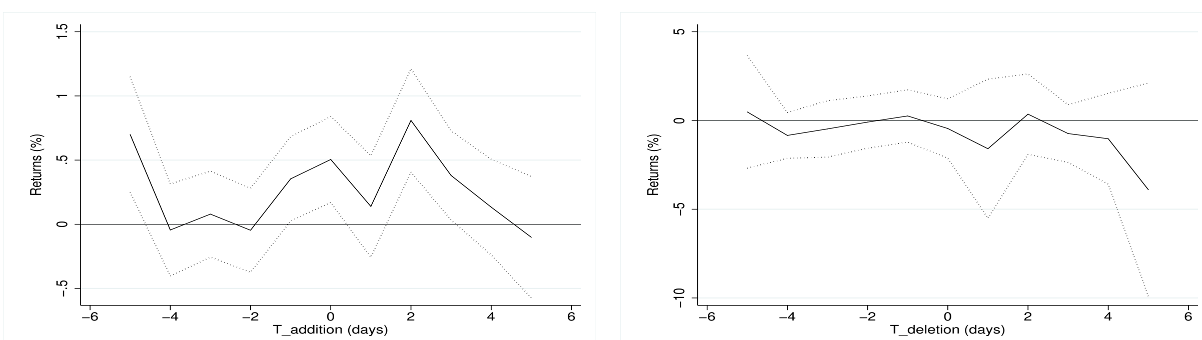
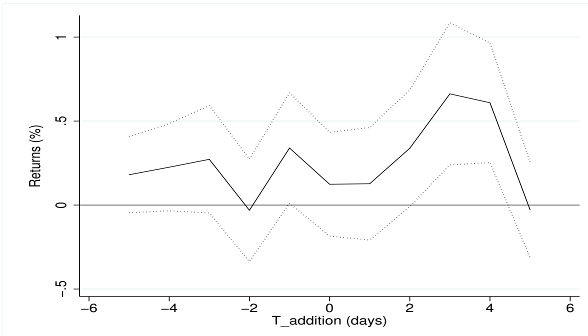


Figure 24: MSCI Europe sample Announcement effect



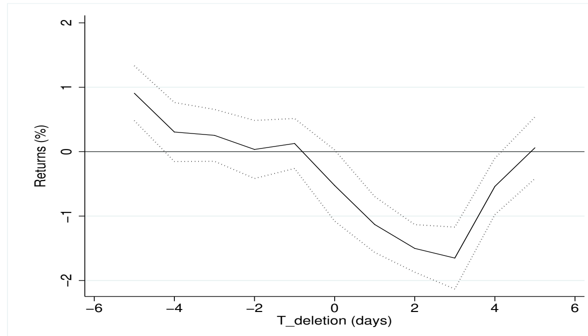
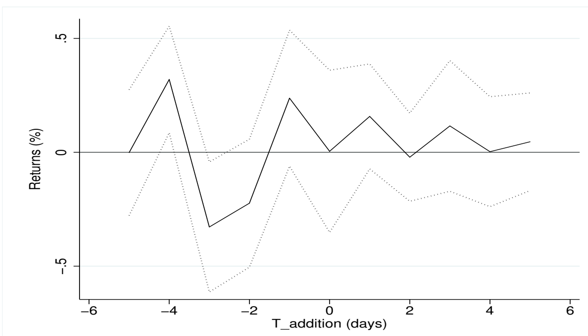
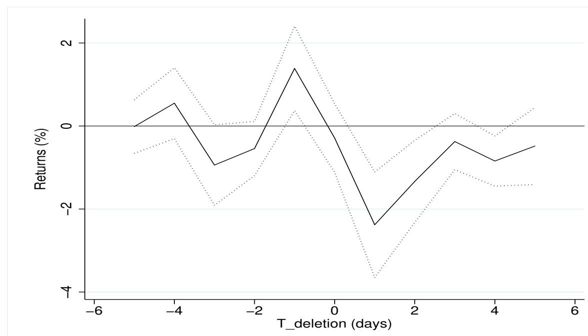


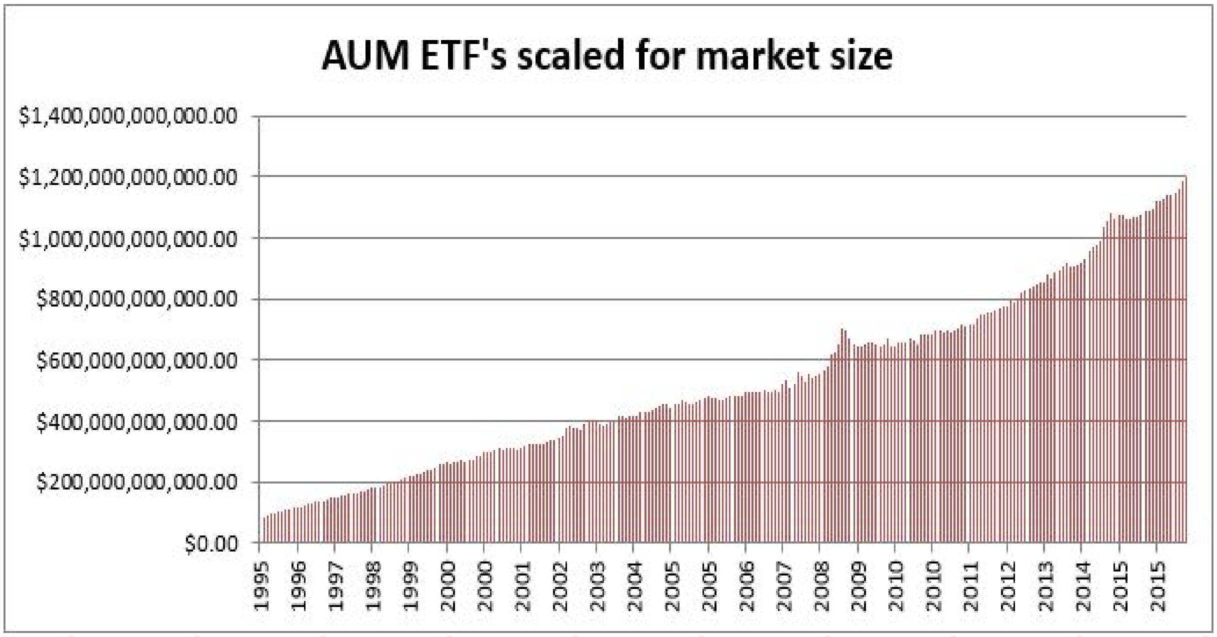
Figure 25: MSCI USA sample Announcement effect

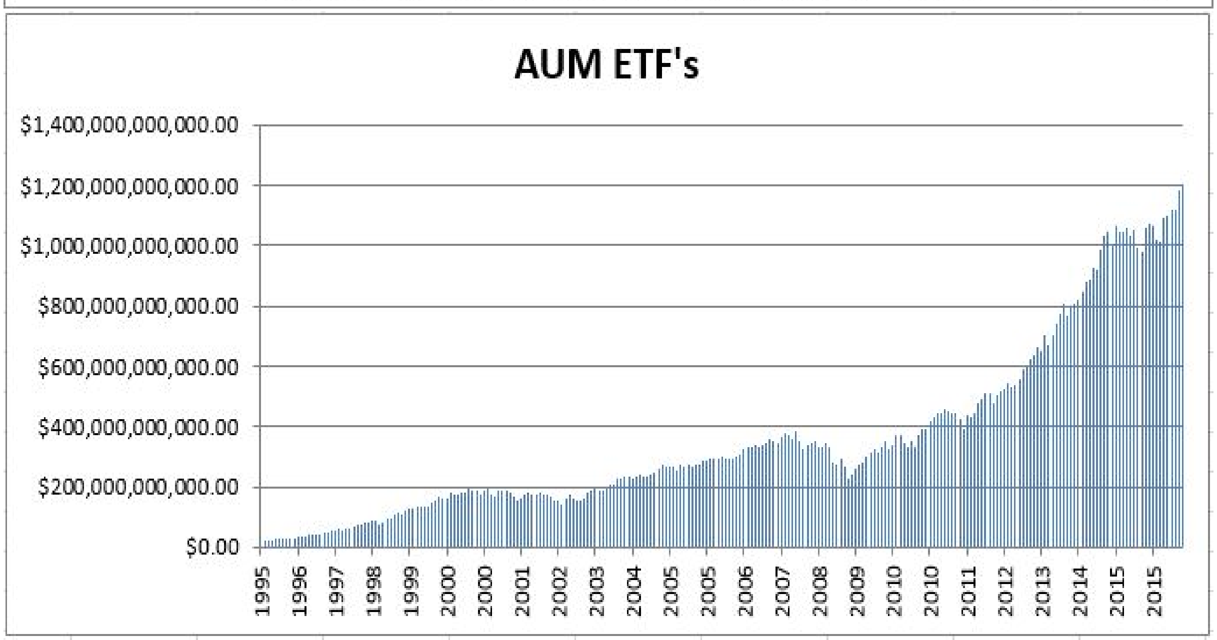




8.6 Development index tracking funds (ETF's)

Figure 26: This figure shows the development of Assets Under Management (AUM) for the top 10 largest funds tracking the index (ETF's). The blue bars is just the standard AUM development, whereas the red bars are the AUM's corrected for the market size development of the index (S&P).





8.7 Robustness checks

Table 10: This table shows the Cumulative Abnormal Returns (CAR) for the additions to and deletions from the respective indices. The event period is the period in which the rebalancing (event) of the index happened with varies amount of trading days before and after the event. The CAR is the average of the individual firm CARs over different periods in the event. Panel A shows the t-stat which is adjusted for event clustering. Panel B shows the t-stat which is adjusted for cross-sectional heteroskedasticity

Panel A: The Crude dependence (event clustering) adjustment

	Additions			**Deletions**		
		CAR			CAR	
Event period	[-4, 4]	[-14, 14]	[-60, 60]	[-4, 4]	[-14, 14]	[-60, 60]
	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)
S&P 1974-2016	3.4%**	3.8%**	3.0%**	-8.47%***	-11.70%***	-16.30%***
	(2.10)	(2.44)	(2.08)	(-2.83)	(-4.47)	(-3.32)
S&P 1974-2006	4.49%**	5.54%***	3.88%**	-8.65%***	-12.90%***	-15.94%**
	(2.08)	(2.65)	(1.99)	(-2.58)	(-3.91)	(-2.56)
S&P 2006-2016	1.85%	0.41%	1.22%	-7.48%	-5.00%	-18.32%***
	(0.86)	(0.19)	(0.59)	(-0.74)	(-0.48)	(-2.65)
MSCI Europe	1.68%	1.61%	7.64%***	-2.47%	-7.62%***	-15.95%***
	(0.57)	(0.49)	(2.74)	(-1.31)	(-3.79)	(-4.54)
MSCI USA	0.38%	0.57%	4.74%*	1.34%	-6.62%*	-22.24%***
	(0.20)	(0.18)	(1.71)	(0.37)	(-1.70)	(-3.68)

Panel B: Cross-sectional heteroskedasticity adjustment

	[-4, 4]	[-14, 14]	[-60, 60]	[-4, 4]	[-14, 14]	[-60, 60]
	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)	(t-stat)
S&P 1974-2016	3.4%***	3.8%***	3.0%*	-8.47%**	-11.70%***	-16.30%***
	(3.16)	(4.73)	(1.84)	(-2.01)	(-2.69)	(-2.92)
S&P 1974-2006	4.49%***	5.54%***	3.88%*	-8.65%***	-12.90%***	-15.94%**
	(3.14)	(4.55)	(1.82)	(-2.58)	(-2.94)	(-2.16)
S&P 2006-2016	1.85%	0.41%	1.22%	-7.48%	-5.00%	-18.32%**
	(1.07)	(0.74)	(0.99)	(-0.74)	(-0.83)	(-2.23)
MSCI Europe	1.68%*	1.61%	7.64%**	-2.47%*	-7.62%***	-15.95%***
	(1.87)	(1.17)	(2.56)	(-1.92)	(-3.85)	(-5.14)
MSCI USA	0.38%	0.57%	4.74%*	1.34%*	-6.62%	-22.24%***
	(1.18)	(1.61)	(1.71)	(1.74)	(-0.60)	(-4.68)

Significance levels : * : 10% ** : 5% *** : 1%