Liquidity Effects of Changes in a Pan-European Stock Index

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ABSTRACT

Adding or deleting a security to or from an index can influence the share price considerably. A possible explanation that has been brought forward in the literature is the liquidity hypothesis according to which an increase in liquidity after an addition is responsible for the observed rise in value. In the following paper, we examine liquidity effects on securities that have been added to or deleted from the pan-European index STOXX 50 between 1998 and 2003, using bid-ask spreads as indicators for liquidity. While there is a medium term price effect, bid-ask spreads do not change significantly due to the index addition or deletion. Regression analysis shows that the explanatory power of bid-ask spreads for the observed price effect is negligible.

As a consequence of our empirical findings, the liquidity hypothesis has to be rejected for the STOXX 50. This result, however, does not appear particularly surprising, as the STOXX 50 is composed of already highly liquid securities whose trading liquidity appears not to depend on membership in an international index. A possible explanation for the rejection of the liquidity hypothesis is that the applicability of the liquidity hypothesis hinges on the liquidity class of the stocks concerned before being added. Marginal increases of liquidity due to an index addition might decline with larger initial liquidity of the stocks added. Subsequent studies could focus on the particular shape of this "liquidity curve" of stocks.

JEL Classification codes: G14, G15

1. Introduction

Many empirical studies have produced results suggesting that adding a stock to or deleting it from an index can have a significant influence on the share price of the stocks concerned. This so called "index effect" and its causes have been subject to many discussions. Possible explanations are based on additional information being communicated by the adjustment of the index composition,[1] price pressure due to increased short-term demand for the stocks added,[2] or a long-term shortage of supply due to downward sloping demand curves for stocks.[3]

Yet another explanation refers to the transaction costs incurred when trading securities. According to this neo-institutional reasoning, the index effect is due to a decrease (increase) in transaction costs of the stocks added to (deleted from) an index. While transaction costs include several categories of costs, the argument focuses on information acquisition costs and implicit trading costs.[4] First, adding securities to an index increases the attention paid to the respective stocks by the investment community and, consequently, enhances and expands the information on those stocks accessible in the market. The resulting improvement of the information available to investors reduces their cost of information acquisition and raises the share price.[5] Second, a stock that is being added to an index enjoys more liquidity as more investors trade the shares. Higher liquidity results in lower implicit transaction costs, more specifically lower bid-ask spreads, and again in rising share prices.[6]

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[1] See, for example, Denis et al. (2003), Graham/Pirie (1994), Dhillon/Johnson (1991), Jain (1987).

[2] See, for example, Lynch/Mendenhall (1997), Harris/Gurel (1986).

[3] See, for example, Shleifer (1986).

[4] Harris (2003), p. 421, splits transaction costs into explicit costs (including information acquisition costs), implicit costs and missed trade opportunity costs. Implicit costs are liquidity induced transaction costs expressed by the bid-ask spread. See also Hasbrouck/Schwartz (1988), p. 10.

[5] See Merton (1987), as well as Schmitz-Esser (2001), pp. 199ff., Steiner/Heinke (1997), pp. 135f.

[6] Amihud/Mendelson (1986) prove that an increase in liquidity leads to a decrease of bid-ask spreads.

Some researchers have paid particular attention to the effects of a change in index composition on the liquidity of stocks. Edmister et al. (1996) show that being added to the S&P 500 results in a long-term increase in share price and find evidence for a parallel long-term rise of liquidity. They observe that turnover increases permanently and that the size of the price effect is related to the amount of open interest in index derivatives. In their opinion, this suggests an improvement of liquidity and, subsequently, a reduction of transaction cost.

Erwin/Miller (1998) also find evidence that liquidity is increasing upon addition of stocks to the S&P 500: according to their tests, bid-ask spreads decrease significantly after the addition. This effect, however, is limited to stocks without traded options. For stocks with options, there is no improvement in liquidity; on the contrary, the results of Erwin/Miller (1998) support the price pressure hypothesis for this type of securities.

Hegde/McDermott (2003) analyze bid-ask spreads of 74 stocks added to the S&P 500 during the years of 1993 through 1998. They discover a correlation between abnormal returns initiated by the index addition and a reduction of bid-ask spreads. Similar to Edmister et al. (1996), they conclude on a sustained increase in liquidity.

Investigating additions to the S&P 500 over an earlier period than Hegde/McDermott (2003), namely between 1986 and 1994, Beneish/Whaley (1996) find only evidence of a temporary decrease of bid-ask spreads, however. They attribute this short-term effect to the increased demand of index funds around the implementation day.[7]

Becker-Blease/Paul (2003a, 2003b) study the visibility improvements and the liquidity effects for the addition of over 230 stocks to the S&P 500 over 17 years. By looking at the number of analysts covering the respective stocks as

[7] See Beneish/Whaley (1996), p. 1921.

well as the Amivest liquidity ratio[8] before and after the index addition, they again find evidence for both an increase in market visibility and liquidity.

Relatively few studies directly examine liquidity effects of changes to the composition of European stock indices, although some authors can confirm the liquidity hypothesis based on turnover results.[9] Focusing on several measures of liquidity, Gassen/Kaltofen (2002) find indications for a liquidity increase after the creation of the German small cap index SMAX. Bid-ask spreads decrease and trade intensity increases significantly for the stocks included in the new index.

The following study contributes to the understanding of liquidity effects caused by index changes at European stock markets by specifically looking at bid-ask spreads of stocks that are added to or deleted from the pan-European index STOXX 50. While other studies examining the index effect at European stock markets have concentrated on national indices, this is the first time that a supranational index is analyzed. In total, we draw on data from eleven different markets providing for a sample representing the European capital market as a whole.

While a statistically significant price effect can be derived from the price data of the stocks in the sample, we cannot find any significant changes to the bid-ask spreads. There clearly is an index effect, but it does not seem to be related to an increase in liquidity. In fact, the explanatory power of bid-ask spreads for the increase in share prices is negligible.

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[8] The Amivest liquidity Ratio calculates the volume change caused by a one percent price change; see Dubofsky/Groth (1984) and Stenzel (1995), pp. 126ff.

[9] See, for example, Gassen/Kaltofen (2002), Gerke/Arneth/Fleischer (2001), Schmitz-Esser (2001), Steiner/Heinke (1997).

The remainder of the paper is organized as follows: The next section discusses different ways of measuring liquidity and their respective advantages. Sections three and four explain the methodology used for the study and discuss the empirical findings. The final section summarizes the insights and provides an outlook on further research.

2. Measuring liquidity

In general, a liquid market allows market participants to trade at the best price independent of the transaction size or the timing of the trade. Therefore, liquidity is one of the most important characteristics of security markets, as only liquid markets can provide the optimum price for all parties.[10] The term liquidity, however, has very often multiple meanings and is operationalized in different ways.[11] This lack of a unique definition derives from the fact that the concept of liquidity is multi-dimensional:[12]

- The depth of the market is determined by the number of shares supplied or demanded at or near a specific price. With increasing transaction size, a deep market becomes more important, since large transactions can lead to price jumps in a shallow market.

- Market width or breadth is measured by the bid-ask spread indicating the transaction costs that have to be paid when immediately executing a trade of a specific size.

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[10] See Harris (2003), p. 394, Bienert (1996), pp. 199f., Schmidt/Iversen (1991), p. 210; Bortenlänger (1996), p. 49, points out that liquidity can even be crucial for market survival, as a lack of liquidity causes market participants to leave the market, subsequently reducing liquidity even further.

[11] See Stenzel (1995), p. 125.

[12] See Harris (2003), pp. 398ff., Bortenlänger (1996), p. 50, Bienert (1996), pp. 199f., Brunner (1996), pp. 6ff, Stenzel (1995), pp. 125f., Schmidt/Iversen (1991), pp. 210f., Hasbrouck/Schwartz (1988), p. 10, Garbade (1982), pp. 420ff.

- The immediacy of a market stands for the period of time needed from the decision to execute a transaction of a specific size and at a specific level of transaction costs.

- The market resiliency measures the time needed for an adjustment of supply and demand after a change in price. Consequently, it also expresses the speed at which a deviation from the equilibrium price is corrected.

The multiple dimensions covered by the term liquidity make the choice of an appropriate measure for liquidity difficult. The best possible measure would need to address all four dimensions of liquidity; many measures discussed in the literature, however, are related to only one or two of those dimensions. In the following discussion, we will focus on those measures that have been used for the analysis of index adjustments.[13]

- Trading volume is a simple and popular liquidity measure that can be observed directly in the market. However, it is an indirect measure as it only refers to executed trades and is not directly related to any of the four dimensions of liquidity that are essentially determined by not yet executed demand and supply.[14]

- The Amivest liquidity ratio determines the volume change that is induced by a one percent change in prices and, therefore, allows to mainly evaluate the depth of the market. On the other hand, it does not give any indication of immediacy.[15]

- In contrast, the bid-ask spread is able to reflect three dimensions of market liquidity. First, it constitutes a considerable part of the transaction costs of investors and is, hence, an indicator of market width.[16] Second, it represents

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[13] For a review of a broader range of liquidity measures, see Brunner (1996), pp. 15ff., Stenzel (1995), pp. 126ff.

[14] See Brunner (1996), pp. 15ff., Stenzel (1995), p. 134, Oesterhelweg/Schiereck (1993), p. 392

[15] See Stenzel (1995), pp. 126ff., Grossman/Miller (1988), Dubofsky/Groth (1984); Becker-Blease/Paul (2003b) use this ratio for an index effect study.

[16] See Stenzel (1995), p. 131.

the cost for immediate execution and is, therefore, a measure for immediacy.[17] Third, it can be used together with additional market information to evaluate market depth.[18] On the downside, usually available bid-ask spreads are only those publicly quoted by market makers. Yet, trades can be executed at other bid and ask prices than those quoted, so that the effective spread may well be smaller than the quote. To avoid this downside, Roll (1984) tries to estimate the effective spread from price data.[19] These estimates, however, have their own methodological problems.[20]

Despite this restriction in the use of spread data, the bid-ask spread nevertheless substantially represents market liquidity.[21] It covers three of four liquidity dimensions and can, therefore, be a useful - albeit not perfect - tool to evaluate market liquidity.[22] The increasing availability of spread data for many markets in Europe, especially markets affected by changes to the STOXX 50 index, lead us to the use of this measure for the following analysis.

3. Data and methodology

3.1 Sample construction and event windows

Among the 296 different indices that make part of the STOXX index family, the STOXX 50 and EURO STOXX 50 indices are the most known and popular.

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[17] The bid-ask spread is part of the transaction costs for an investor interested in immediate execution via a market maker or similar intermediary as he has to buy at the ask price, but can only sell at the lower bid price. He can avoid paying the spread by investing additional time into finding a counterpart that is willing to pay his optimal price. If the market is highly liquid and offers immediacy to investors without the help of market makers, the latter need to adjust the spreads in order to compete. The bid-ask spread, therefore, is an indicator of immediacy. Harris (2003), pp. 398f., explains the relationship between the different dimensions of liquidity, Brunner (1996), p. 27, and Stenzel (1995), p. 131, discuss the bid-ask spread as indicator of immediacy.

[18] See Stenzel (1995), p. 132.

[19] See Roll (1984), p. 1127, as well as Brunner (1996), pp. 27ff., Stenzel (1995), p. 132, Hasbrouck (1990), p. 239; a more detailed critique of the bid-ask spread as measure of liquidity can be found in Grossman/Miller (1988), pp. 628ff.

[20] See, for example, Harris (1990)

[21] Schmidt/Iversen (1991), p. 211.

[22] See Brunner (1996), p. 33, Stenzel (1995), p. 134.

They contain the 50 largest stocks of all European markets and the Euro zone markets respectively. The stocks are selected by using the free float market capitalization as single criterion. The free float is calculated by STOXX based on the percentage of total outstanding shares that is freely available on the market.[23]

Our sample for the empirical analysis consists of all changes to the composition of the STOXX 50 and the EURO STOXX 50 that have taken place between its creation in February 1998 and June 2003. As the number of changes to each index individually is limited and not sufficient for a significant statistical analysis, we consider all changes to both indices in a combined sample. In total, both indices combined have been adjusted 49 times since their creation.[24] Because some of the changes where due to a corporate event, we had to eliminate the respective stocks from the sample. Additionally, stocks without a sufficient history of price and spread data had to be removed, leaving us with a total sample size of 34 additions and 29 deletions for the price analysis, as well as 28 additions and 24 deletions for the spread analysis.[25] The spread sample size for the deletions is relatively small which has been taken into account when designing the tests and interpreting the results. The price and spread data for the study were taken from Bloomberg, the index data used to calculate abnormal returns stem from Thomson Financial Datastream.

We define as event days the announcement day *A* on which a change to the index composition is announced by STOXX[26], as well as the implementation day *E* on which the index is calculated for the first time according to its new composition. Regular index reviews of the (EURO) STOXX 50 are always announced on the first trading day in September and realized on the third Friday of that month, in both cases after the closing bell. Therefore, the first day that

[23] For a detailed definition of the free float, see STOXX (2003), pp. 12 and 14.

[24] The EURO STOXX 50 has been adjusted 26 times, the STOXX 50 29 times since creation; six stocks have been added to both indices at the same time.

[25] Six additions and five deletions had to be eliminated from the spread sample because bid-ask spreads were not available for the entire event period.

[26] We use the date of the STOXX press release as announcement day.

the index is calculated according to its new composition is the following Monday. However, as the index composition is adjusted continuously in case of corporate events, some changes have been made between periodical reviews. For these changes, the time between announcement and implementation is considerably shorter.

3.2 Calculation of abnormal returns

Since the market model and a mean reverting model show disadvantageous behavior in abnormal returns analyses, we use market adjusted returns to test for a price effect.[27] The abnormal returns $AR_{i,t}$ are calculated as the difference between the observed security return $r_{i,t}$ on day t and the corresponding return of the respective national lead index $r_{m,t}$ as proxy for the market return.

$$AR_{i,t} = r_{i,t} - r_{m,t} \qquad (1)$$

Averaged abnormal returns AAR_t, the simple cross-sectional mean of the N abnormal returns in the sample, are calculated to evaluate the announcement's and the implementation's impact on returns. Cumulated average abnormal returns $CAAR_{[x;y]}$, where x and y stand for different points of event time, allow for the testing of abnormal returns over a period of time.[28]

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t} \qquad (2)$$

$$CAAR_{[x;y]} = \sum_{t=x}^{y} AAR_t \qquad (3)$$

When averaging and cumulating the abnormal returns, the varying time span between announcement and implementation has to be taken into account. Consequently, the announcement days where aligned for all sample stocks,

[27] See Campbell et al. (1997), MacKinley (1997), Boehmer et al. (1991), Berry et al. (1990), Brown/Warner (1985), Brown/Warner (1980), for a critical discussion of the different methods to calculate abnormal returns.

[28] See, for example, Schmitz-Esser (2001), pp. 221f., Campbell et al. (1997), p. 161, MacKinley (1997), p. 24.

regardless of when the announcement took actually place relative to the implementation day.

To test for a statistically significant deviation of abnormal returns from zero, we employ a standard t-test using both past returns and cross-sectional data to estimate standard errors. Past returns were taken from an estimate window extending from E-125 to E-75. Since cross-sectional standard error estimates might be biased if events are clustered (which is the case here), we report the results for both test statistics φ_1 and φ_2.[29]

3.3 Calculation of bid-ask spreads

The difference between ask price and bid price as quoted in the market is the absolute bid-ask spread in currency units. Alternatively, a relative spread can be calculated, relating the absolute spread to the general price level.[30] Let $\vartheta_{i,t}$ denote the absolute spread, $p^a_{i,t}$ and $p^b_{i,t}$ the ask and bid prices respectively, then the relative spread $\vartheta^*_{i,t}$ is

$$\vartheta^*_{i,t} = \frac{\vartheta_{i,t}}{\left(\frac{p^a_{i,t} + p^b_{i,t}}{2}\right)} \qquad (4)$$

The relative spread allows a better evaluation of the economic significance of the spread, but is sensible to price movements caused by the events under investigation.[31] We, therefore, will use both absolute and relative spreads for the analysis.[32]

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[29] φ_1 is the test statistic using a standard deviation estimate from past returns. φ_2 uses a standard error estimate from cross-sectional returns. For a detailed discussion of different test approaches for abnormal returns see Schmitz-Esser (2001), pp. 222ff.

[30] See, for example, Erwin/Miller (1998), p. 135, Miller/McConnell (1995), p. 366, Beneish/Gardner (1995), p. 152, for a definition of absolute and relative spreads.

[31] See Hegde/McDermott (2003), p. 427, Erwin/Miller (1998), p. 135, Miller/McConnell (1995), pp. 366f., Schmidt/Iversen (1991), p. 211, Branch/Freed (1977), p. 159.

[32] An estimate of the transaction cost components [see Harris (2003), pp. 299ff., Campbell et al. (1997), p. 103, Glosten (1987), pp. 1295ff.] is beyond the scope of this study. In their analysis of bid-ask spreads, Hegde/McDermott (2003), pp. 440ff., estimate the adverse selection component, but also remain critical of the models used.

To test for a significant change of the bid-ask spread in reaction to the addition to or deletion from the (EURO) STOXX 50, we average the spread over symmetrical periods of time before and after the implementation of the index change for each stock in the sample:[33]

$$ABAS_{i,[t_x;t_y]} = \frac{1}{\tau}\sum_{t=t_x}^{t_y}\vartheta_{i,t} \qquad (5)$$

ABAS stands for average bid ask spread, while t_x and t_y denote the earlier and later limits of the time periods used for the test. The number of days τ in each of the periods varies between one and fifteen. The time periods $\left[t_x^-;t_y^-\right]$ and $\left[t_x^+;t_y^+\right]$ are determined so that they lie symmetrical around *E*; the event day itself does not make part of these periods.

The mean of the differences d_i between the average spreads after and before the implementation is tested for a significant deviation from zero using the test statistic

$$\omega_1 = \left|\frac{\bar{d}_i}{\tilde{s}_d}\cdot\sqrt{N}\right| \text{ where } \tilde{s}_d = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(d_i-\bar{d}_i\right)^2} \qquad (6)$$

Since some spread samples are significantly smaller than 30 the parametric test might not always be specified correctly.[34] Hence, we use a Wilcoxon sign rank test to test for a significant deviation of the median of differences d_i from zero and, thus, triangulate the results.[35] For that purpose, a rank is assigned to every difference in the sample in ascending order.

[33] Similar test approaches are used by Erwin/Miller (1998) and Beneish/Gardner (1995). An alternative test approach not employed in this study is a spread ratio test, using the ratio of the average spread of a trading day over an estimated normal spread derived from an estimation window; see Hegde/McDermott (2003), pp. 427ff., or Beneish/Whaley (1996), pp. 1918f., for this methodology.

[34] Schaich (1998), p. 205 points out that this test is only valid for sample sizes larger than 30.

[35] See, for example, Fahrmeir et al. (2003), pp. 439ff. for a discussion of the Wilcoxon sign rank test.

The test uses the sum of all ranks that have been assigned to values larger than zero as test statistic ω_2:

$$\omega_2 = \sum_{i=1}^{N} rg\left|d_i\right| Z_i \text{ with } Z_i = \begin{cases} 1 & d_i > 0 \\ 0 & d_i < 0 \end{cases} \quad (7)$$

The results of all tests are reported in the following section.

4. Empirical results

4.1 Abnormal returns

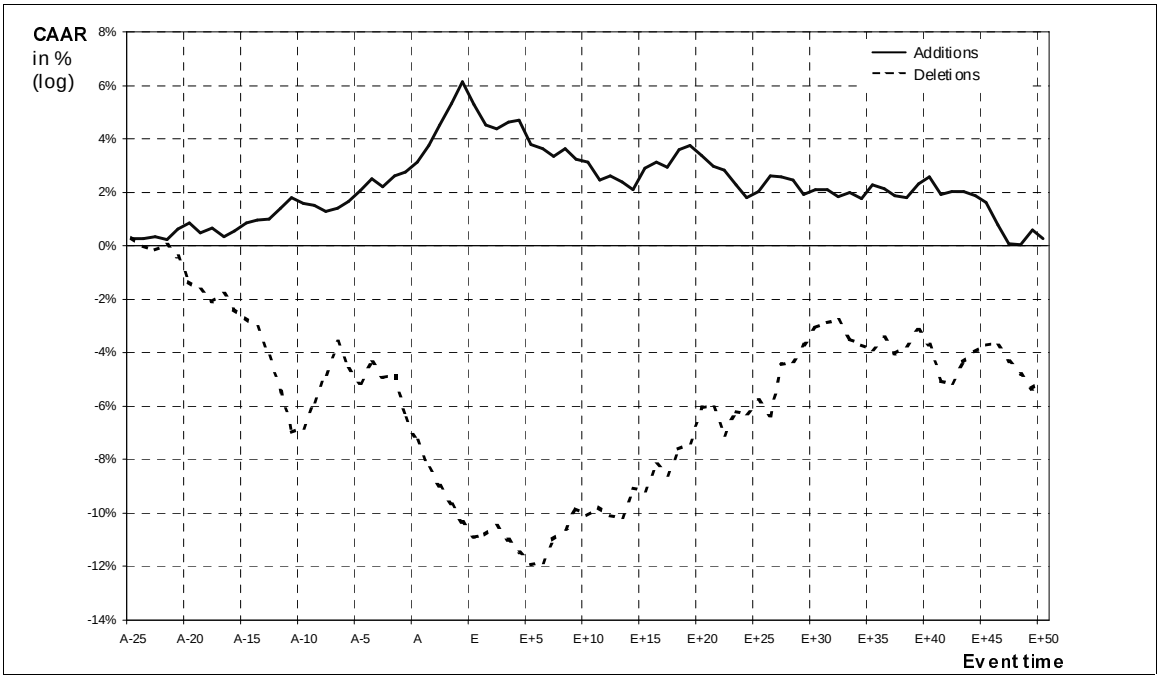

Figure 1: Changes to the (EURO) STOXX 50 - Cumulated average abnormal returns
The figure depicts the market adjusted abnormal returns, cumulated from A - 25. The length of the period between the announcement and the implementation of the change varies and is shown here as three days. The average length of this period is 13,97 days for additions and 13,40 days for deletions.
Source: Data analysis

Figure 1 shows the cumulated abnormal returns for both additions and deletions. It depicts clearly an upward movement of abnormal returns for additions and a corresponding downward movement for deletions. Both developments are partly corrected right after the implementation day E. The abnormal returns of the additions sample even reverts back to zero after a fifty day period.

Table 1 shows that the development of the abnormal return in the period from 25 days before the announcement up to the implementation is clearly significant for both additions and deletions. Deletions, however, suffer from a stronger effect than additions: the total cumulated abnormal return adds up to -10,4 percent before the implementation day. The market seems to have a stronger view on deletions.

	Additions			Deletions		
Event period	**CAAR**	φ_1	φ_2	**CAAR**	φ_1	φ_2
[A - 25; A + 1]	3,73	2,015**	1,736	-8,32	3,475*	2,804*
[A - 25; A - 1]	2,77	1,553	1,413	-6,44	2,797*	2,552**
[A; A + 1]	0,96	1,911	2,295**	-1,88	2,881*	2,278**
[E; E + 1]	-1,61	3,187*	2,401**	-0,46	0,712	0,756
[E + 2; E + 50]	-4,26	1,705	2,239**	5,82	1,805	1,183
[A - 5; A + 1]	2,06	2,184**	1,501	-3,71	3,041*	2,655**
[A - 5; A - 1]	1,10	1,376	0,977	-1,83	1,776	2,061**
[E - 5; E + 5]	1,30	1,095	1,101	-1,52	0,996	0,658
[E - 5; E - 1]	3,64	4,564*	5,133*	0,03	0,030	0,021
[E; E + 5]	-2,34	2,683*	2,616**	-1,55	1,377	1,172
[A - 25; E - 1]	6,12	2,712*	2,262**	-10,35	3,579*	3,314*

Table 1: Changes to the (EURO) STOXX 50 - Cumulated average abnormal returns (percent)
The table shows the average cumulated market adjusted abnormal returns (CAAR) for several periods around the announcement day A and the event day E. The pre-announcement period has been aligned for all stocks in the sample, since the time span between announcement and implementation varies. φ_1 is the statistic of a two-sided t-test of the mean where the standard deviation was estimated from past returns. φ_2 uses a standard error estimate from cross-sectional returns.
* Significant at 1%
** Significant at 5%
Source: Data analysis

When interpreting these results, though, a selection bias due to the particular nature of the selection process for the (EURO) STOXX 50 has to be taken into account. Due to the fact that the market capitalization is the only criterion for membership in the STOXX indices, it is probable that stocks added to the index see a considerable increase in their market value prior to the addition. It seems as if deletions perform worse than the market and are taken off the index as a consequence. The fact that the abnormal returns of additions (deletions) increase (decrease) significantly before the announcement itself support this conjecture (see Table 1).

Still, the development of abnormal returns is not only determined by a long-term trend. When looking at individual days' abnormal returns for additions, a clear upward price effect of +1,6 percent can be identified one day prior to the

implementation. The abnormal return is significantly different from zero at a significance level of one percent ($\varphi_1 = 4{,}596$; $\varphi_2 = 4{,}924$). The same holds true for the correction on the implementation day and the day afterwards, although the abnormal returns on these days are only significant for φ_1 at a 5 percent level.

These results for the additions point to price pressure in the market, as there is a short term positive abnormal return right before the implementation and a correction afterwards. Investment funds tracking the (EURO) STOXX 50 or using it as a benchmark seem to restructure their portfolios on the day before the change is implemented.

For deletions, no such clear result can be ascertained. None of the individual days' abnormal returns close to the implementation date are significant. In fact, the only individual days' returns that are significant appear during the pre-announcement period, but their significance is weak. Also, the apparent correction depicted in Figure 1 is not statistically significant. Apparently deletions suffer rather from a long-term downward trend than from short-term price pressure. There is no obvious explanation for this asymmetry of the results.

In summary, the returns of stocks added to or deleted from the (EURO) STOXX 50 show positive respectively negative abnormal returns for the examined period, although a clear price effect on a day-to-day basis can only be identified for additions. Deletions rather seem to be subject to a long-term downward trend that might also be the cause for their deletion. There is rudimentary evidence of price pressure in the market, as abnormal returns are (partly) corrected over a fifty day period. Only for deletions, a cumulated effect remains beyond fifty days after the implementation.

4.2 Bid-ask spreads

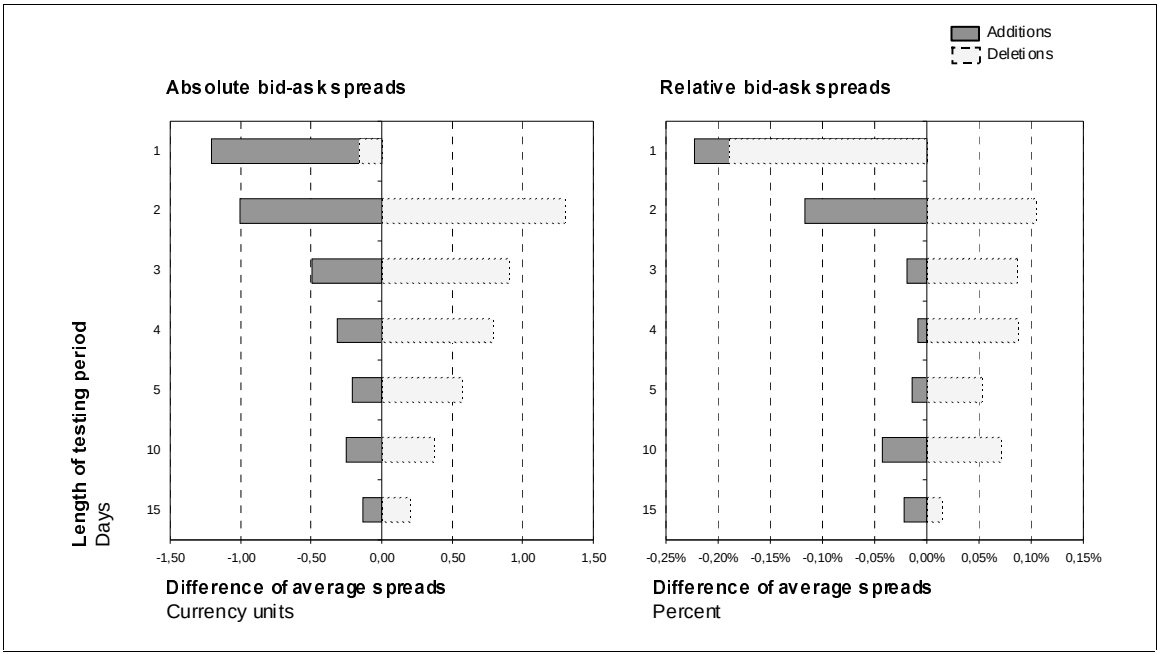

Figure 2: Changes to the (EURO) STOXX 50 - Average differences of bid-ask spreads
The figure shows the differences between the average bid-ask spreads before and after the implementation of a change to the composition of the (EURO) STOXX 50. The absolute spread is the difference between bid price and ask price of a trading day, the relative spread is this difference divided by the mid-point between bid and ask price. The testing period is the number of days over which the pre- and post-implementation spreads where averaged.
Source: Data analysis

It might be deducted from Figure 2 that the addition or deletion of stocks does indeed have an effect on the liquidity of those stocks. The spreads decrease and increase for additions and deletions respectively. The differences of absolute spreads seem to be substantial, the relative spreads, however, make clear that the economic magnitude of the spread differences is rather negligible. The spreads change less than 5 basis points for additions and less than 10 basis points for deletions for most of the test periods. Furthermore, the decrease in differences that can be observed as test periods become larger suggests that we only see a short-term change in spreads that does not have any long-term effects on liquidity.

Length of test period (Days)	Absolute bid-ask spreads (Currency units)			Relative bid-ask spreads (Percent)		
	Difference	ω_1	ω_2	**Difference**	ω_1	ω_2
Panel A: Additions						
1	-1,204	1,306	117	-0,223%	1,706	115
2	-1,003	0,952	143	-0,117%	1,515	125
3	-0,493	0,851	190	-0,019%	0,286	195
4	-0,317	0,783	191	-0,008%	0,160	197
5	-0,211	0,753	172	-0,014%	0,350	190
10	-0,252	1,419	165	-0,042%	0,712	181
15	-0,133	1,354	147	-0,022%	0,563	196
Panel B: Deletions						
1	-0,160	0,602	99	-0,190%	2,079**	90
2	1,296	0,989	125	0,105%	0,537	111
3	0,904	1,000	134	0,087%	0,649	105
4	0,792	1,020	149	0,088%	0,768	128
5	0,575	0,981	151	0,053%	0,599	126
10	0,370	1,442	241*	0,071%	1,517	210
15	0,203	1,346	208	0,014%	0,399	171

Table 2: Changes to the (EURO) STOXX 50 - Difference of average pre- and post-implementation bid-ask spreads

The table depicts the differences between the average bid-ask spread before and after the implementation of a change to the composition of the (EURO) STOXX 50. The absolute spread is the difference between bid price and ask price of a trading day, the relative spread is this difference divided by the mid-point between bid and ask price. The testing period is the number of days over which the pre- and post-implementation spreads where averaged. ω_1 is the value of a standard t-test testing for a significant deviation of the mean difference from zero. ω_2 is the result of a Wilcoxon sign rank test testing for a significant deviation of the median difference from zero.

* Significant at 1%

** Significant at 5%

Source: Data analysis

The statistical analysis confirms this supposition, as shown by Table 2. Changes of the spreads are not statistically significant in any meaningful sense, neither for the additions nor the deletions sample. There is no systematic increase or decrease of the spreads in reaction to the implementation of the change. Therefore, as preliminary conclusion, we can state that a change in the composition of the (EURO) STOXX 50 does not have any significant impact on liquidity.

In order to further test this conclusion, we have examined the relationship between bid-ask spreads and abnormal returns for the day before the implementation through a simple cross-sectional regression analysis.[36] The objective of the analysis was to evaluate the explanatory power of a day-to-day

[36] For an overview of the application of regression analysis to Econometrics and problems that might arise, see, for example, Poddig/Dichtl/Petersmeier (2000), pp. 201ff.

change in bid-ask spreads for the abnormal returns observed. Thus, the univariate model underlying the regressions was specified as

$$AR_{i,t} = \hat{\alpha} + \hat{\beta} \cdot (\vartheta_{i,t} - \vartheta_{i,t-1}) + \varepsilon \qquad (8)$$

where $AR_{i,t}$ and $\vartheta_{i,t}$ denote the abnormal return and the bid-ask spread of security i on day t. We used both absolute and relative spreads as independent variables. $\hat{\alpha}$ and $\hat{\beta}$ are the estimates for the intercept and the coefficient of the regression line respectively, while ε stands for the regression residual.

As Table 3 shows, the results from the regression analysis support our preliminary conclusion that there is no impact of the index adjustment on liquidity. In no case, the regressions are significant for the day right before the implementation of the index change, even though significant abnormal returns can be observed for additions. For both additions and deletions the quality of the regressions is generally poor. The explanatory power of the bid-ask spreads for abnormal returns is close to zero.

If put into perspective, this result is of little surprise. A possible explanation is that the stocks added to or deleted from the STOXX 50 indices are the largest and doubtless most liquid securities in Europe. Therefore, although the (EURO) STOXX 50 is one of the most popular pan-European stock indices attracting a lot of attention by investors, the fact of being added to or deleted from this index has little impact on the respective stocks' liquidity.[37]

With our results in mind and taking into account previous results of liquidity studies that find increases in liquidity after an index addition,[38] a possible interpretation could be that the effect predicted by the liquidity hypothesis depends on the liquidity class of the respective security before being added to or deleted from an index.

[37] Shleifer (1986), p. 588, has already discussed a similar phenomenon for large companies that are added to the S&P 500. See also Amihud/Mendelson (1988), p. 7.

[38] See, for example, Becker-Blease/Paul (2003b), Hegde/McDermott (2003), Gassen/Kaltofen (2002), Edmister et al. (1996).

Spreads	Intercept α		Coefficient β		R^2	F-Value
Panel A: Additions						
Absolute	0,0187	(5,035)*	0,0033	(1,697)	10,0%	2,88
Relative	0,0191	(4,827)*	-0,4470	(0,746)	2,1%	0,56
Panel B: Deletions						
Absolute	-0,0045	(0,796)	0,0014	(0,237)	0,3%	0,06
Relative	-0,0056	(0,938)	0,6682	(0,570)	1,5%	0,33

Table 3: Changes to the (EURO) STOXX 50 - Regression analysis for spreads and abnormal returns on the day before implementation

The table shows the intercepts α and coefficients β of simple univariate regressions where the abnormal returns of day E - 1 are the dependant and the day-to-day changes in absolute resp. relative bid-ask spreads from E - 2 to E - 1 are the explanatory variables. Values in parentheses are t-ratios for the intercepts and the coefficients. R^2 expresses to what extent the independent can explain the dependant variable, F-Value is a test statistic evaluating the quality of the regression.

* Significant at 1%

** Significant at 5%

Source: Data analysis

5. Summary and Conclusions

We have analyzed price and bid-ask spread data for additions and deletions to the (EURO) STOXX 50 between 1998 and 2003 with a particular focus on the liquidity impact of changes to the index composition. Although we find some confirmation of a medium term price effect, particularly for additions to the (EURO) STOXX 50, there is no evidence of an impact on liquidity.

Significant positive abnormal returns for additions on the day before the implementation of the index adjustment and a significant correction in the days after the implementation lead us to the conclusion that there is a medium term price effect, because the cumulated abnormal return reverts back to its previous level within 50 days of the adjustment. Abnormal returns for deletions do not show a similar effect on a daily basis, but we have found support for an endogenous long-term downward trend that may have been the cause for these stocks to be deleted from the index. Consequently, the cumulative negative effect of deletions is only partly reversed over the 50-day period.

The analysis of bid-ask spreads for the two samples does not yield any significant results. Comparing average spreads before and after the implementation, we found only marginal changes. The explanatory power of spreads for abnormal returns is negligible according to a simple univariate

regression model. As a result, we have to reject the liquidity hypothesis for the (EURO) STOXX 50 for the period of 1998 to 2003.

A possible explanation for this result might be that the stocks contained in the STOXX 50 indices are the largest and most liquid securities in Europe. As they already belong to a high liquidity class prior to the addition to the index and are the most important stocks in their respective countries, the fact of being added to the STOXX 50 does not induce more market participants to trade in these securities. Even after having been deleted from the index, the stocks are still part of major indices in their home country and it is likely that they will enjoy roughly the same attention as before.

The validity of the liquidity hypothesis, thus, may depend on the pre-addition liquidity class and the importance of the securities on their respective home markets. It would be interesting to investigate whether the liquidity of a security is tied to a "liquidity curve" with decreasing marginal liquidity growth. With such a concave curve in mind, the fact that an addition to the STOXX 50 does not produce an impact on liquidity may be explained by a high position of the securities concerned on this "liquidity curve", where only little additional gains in liquidity are possible.

We see that further research needs to be done in this area first to improve the understanding of liquidity increases of securities in relation to index membership and second to contrast the market structures of different European capital markets.

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