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ORIGINAL RESEARCH

Asymmetric stock price and liquidity responses to changes in the FTSE SmallCap index

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Abstract We examine market reactions to changes in the FTSE SmallCap index membership, which are determined quarterly based on market capitalization and are free of information effects. Our main results are asymmetric price and liquidity responses between the firms that are shifted between FTSE indexes and the firms that are new to FTSE indexes. Firms promoted from a smaller-cap to a larger-cap FTSE index experience a permanent increase in stock price accompanied by improvements in liquidity. Similarly, firms demoted from a larger-cap to a smaller-cap FTSE index experience a permanent decrease in stock price accompanied by declines in liquidity. In contrast, firms added to the FTSE SmallCap index that were not previously in FTSE indexes show a transitory price gain and declines in liquidity. The results support the liquidity and price pressure hypotheses.

Keywords Event study · FTSE SmallCap index · Index changes · Institutional ownership · Liquidity · Stock prices · Trading volume

JEL Classification G12 · G14

1 Introduction

A large body of literature examines stock price reactions for stocks added to large-cap indexes of different countries, such as the S&P 500 (e.g., Chen et al. 2004), FTSE 100 (e.g., Mase 2006, 2007), and MSCI (e.g., Shu et al. 2004; Chakrabarti et al. 2005) indexes. In contrast, only two small-cap indexes, the Russell 2000 and S&P 600, both of which track US small companies, are analyzed. While researchers find significant and positive (negative) abnormal returns for additions to (deletions from) the Russell 2000 (e.g., Biktimirov et al. 2004; Chen 2006) and S&P 600 (e.g., Shankar and Miller 2006;

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Becker-Blease and Paul 2010), they disagree on whether these abnormal returns are permanent or temporary, as well as offer competing explanations. In an attempt to differentiate among rival hypotheses, we examine market reactions for firms that are added to or deleted from the Financial Times Stock Exchange (FTSE) SmallCap index over the period 1998–2008. This study appears to be the first to examine market reactions to changes in a non-US small-cap index. The examination of new small-cap indexes is warranted given that small-cap stocks are expected to be more sensitive than large ones to liquidity, investor awareness, or any other effects associated with index membership. As Loughran and Ritter (2000, p. 363) note, "just about every known stock market pattern is stronger for small firms than for big firms."

The FTSE All-Share index is a value-weighted index of UK stocks that consists of the FTSE 100, which comprises the largest 100 stocks, the FTSE 250, which contains 250 mid-cap stocks, and the FTSE SmallCap, which comprises small-cap stocks. The FTSE SmallCap index is widely followed, and it is the typical benchmark for evaluating the performance of mutual funds investing in UK small stocks. UK companies listed on the London Stock Exchange that are too small to be included in the FTSE SmallCap index comprise the FTSE Fledgling index.

The FTSE SmallCap index offers at least five advantages over the Russell 2000 and S&P 600 indexes for research on the effect of index changes. First, the Russell 2000 and S&P 600 indexes have only two groups of additions: pure additions and downward additions from the Russell 1000 and S&P 400/500 indexes, respectively. In contrast, the FTSE SmallCap index has three groups of additions: pure additions, upward additions from the FTSE Fledgling index, and downward additions from the FTSE 250 index. Similarly, whereas the Russell 2000 and S&P 600 indexes have only two groups of deletions, the FTSE SmallCap index has three groups. Examining the predictions of different hypotheses across two extra groups of stocks (additions from the FTSE Fledgling index and deletions to the FTSE Fledgling index) offers additional empirical evidence for differentiating among competing hypotheses.

Second, given that the reconstitution of the Russell 2000 index takes place once a year, the limited number of event days might lead to a clustering problem. The quarterly changes in the FTSE SmallCap index mitigate this problem by offering a larger number of event days.

Third, announcements about an addition to the S&P 600, which are hard to predict, can send a signal about future prospects of the company. In contrast, changes in the FTSE SmallCap index are determined primarily by the market value ranking of stocks at regular quarterly reviews. Therefore, announcements about the FTSE SmallCap index changes do not convey any new fundamental information about the stocks added to or removed from the index. This excludes the information signaling hypothesis as an explanation for the stock market reaction to index changes.

Fourth, changes in the S&P 600 index have different numbers of trading days between announcement and effective days. In contrast, this period is constant for changes in the FTSE SmallCap index. The review meetings take place on the Wednesday after the first Friday in March, June, September and December, and the index changes are announced the same day after the closing of the London Stock Exchange. These index changes become effective on the first trading day after the third Friday of the same month. The fixed number of trading days between the announcement and effective days facilitates the detection of any return and trading volume patterns during this period.

Fifth, changes to the Russell 2000 and S&P 600 indexes include both NYSE- and NASDAQ-listed stocks. However, Elliott and Warr (2003) document that NYSE stocks

have a different price pattern around the addition to the S&P 500 index than NASDAQ stocks. The examination of changes to the FTSE SmallCap index avoids this potential confounding exchange-listing effect by having all affected stocks listed on the same exchange.

We find that stocks promoted from the FTSE Fledgling index to the FTSE SmallCap index and from the FTSE SmallCap index to the FTSE 250 index experience significant and permanent gains in price that are accompanied by improvements in liquidity. Similarly, stocks demoted from the FTSE 250 index to the FTSE SmallCap index and from the FTSE SmallCap index to the FTSE Fledgling index experience significant and permanent declines in price that are accompanied by decreases in liquidity. In contrast, stocks added to the FTSE SmallCap index that were not previously in FTSE indexes experience a transitory increase in price. They also show significant declines in liquidity associated with an increase in institutional ownership and a decrease in the percentage of free float shares. Taken together, the results support the liquidity and price pressure hypotheses.

This paper contributes to the literature in several ways. First, this study appears to be the first to examine changes to a non-US small-cap index and to analyze three groups of additions and three groups of deletions. Second, and most importantly, we document asymmetric price and liquidity responses between the firms that are shifted between FTSE indexes and the firms that are new to FTSE indexes. Finally, we are able to offer an explanation for the observed asymmetric responses.

The structure of this paper is as follows. Section 2 discusses the studies examining the effect of index membership and presents the hypotheses suggested in the literature. Section 3 describes sample selection. Section 4 presents methods and results for abnormal returns, trading volume, institutional ownership, liquidity, and regression analyses. Section 5 discusses empirical results in the context of different hypotheses. The paper concludes in Section 6 with a brief summary of the major results and conclusions.

2 Previous research

A significant body of research examines market reactions for stocks added to or removed from popular indexes. These studies focus primarily on changes to the S&P 500 index (e.g., Chen et al. 2004; Kappou et al. 2010) and find significant positive stock price reactions to the announcement of new additions to the index. Several competing hypotheses exist for this reaction. These hypotheses differ not only in reasons for the abnormal returns, but also in predicted duration. The price pressure hypothesis, advanced by Harris and Gurel (1986), is the only explanation that predicts a temporary change in the price of new additions. Under this hypothesis, buying pressure from index funds causes a stock price to increase above its equilibrium level. This stock price increase induces passive traders to sell their shares. The subsequent stock price decline allows the traders to restore their positions at a profit. Consistent with the price pressure hypothesis, Harris and Gurel (1986) find a full price reversal for stocks added to the S&P 500 index.

In contrast, the downward-sloping demand curve (or imperfect substitutes) hypothesis, proposed by Shleifer (1986), predicts that price changes are permanent because the long-run demand for stocks slopes downward. This hypothesis assumes that stocks do not have perfect substitutes. Therefore, increased demand from index funds results in a permanent

stock price increase. Kaul et al. (2000) and Biktimirov (2004) provide evidence supporting the downward-sloping demand curve hypothesis.

The liquidity hypothesis suggested by Amihud and Mendelson (1986) is another hypothesis that predicts a permanent increase in value for added stocks. If liquidity improves following a stock's addition to an index, the lower present value of all expected trading costs leads to an increase in share price. Erwin and Miller (1998) present evidence consistent with the liquidity hypothesis by finding a significant decrease in the bid-ask spread for new additions to the S&P 500 index.

According to the investor awareness hypothesis, originally proposed by Merton (1987), investors invest only in those stocks of which they are aware. Therefore, an increase in investor awareness of a stock, caused by the addition of that stock to a stock index or listing on a major stock exchange, should lead to an increase in the stock price. Chen et al. (2004) advance this hypothesis by explaining the asymmetry in stock price changes following addition to and deletion from the S&P 500 index. The authors argue that addition to the S&P 500 index leads to a permanent increase in the stock price because more investors become aware of the newly added stocks. In contrast, deletion from the S&P 500 index would not quickly reduce the awareness of a stock. Therefore, deleted stocks experience only a temporary decline in price.

One potential problem with the S&P 500 index effect studies is that under the information signaling hypothesis (e.g., Jain 1987) the addition of a stock to the index sends positive news about the prospects of a firm. Consistent with this hypothesis, Denis et al. (2003) find significant increases in analysts' earnings per share forecasts and significant improvements in realized earnings for companies added to the S&P 500 index. Cai (2007) provides another support for the information signaling hypothesis by documenting a significantly positive price reaction for the industry and size matched firms of the firms added to the S&P 500 index.

Although changes to many large-cap indexes have been examined in the literature, only two small-cap indexes are analyzed. Both these indexes, the Russell 2000 and S&P 600, track the performance of US small stocks.

Similar to the large-cap S&P 500 index, examination of the small-cap indexes produces conflicting evidence. Specifically, consistent with the price pressure hypothesis, Biktimirov et al. (2004) and Shankar and Miller (2006) find temporary price changes for additions to and deletions from the Russell 2000 and S&P 600 indexes, respectively. In contrast, consistent with the downward-sloping demand hypothesis, Chen (2006) documents a permanent price change for additions to and deletions from the Russell 2000 index. Becker-Blease and Paul (2010) suggest increased stock liquidity as the primary source of value for stocks added to the S&P MidCap 400 and S&P 600 indexes. Moreover, Docking and Dowen (2006) examine changes to the S&P 600 index and find an asymmetrical reaction for additions and deletions, which supports the investor awareness hypothesis.

In an attempt to discriminate among these competing hypotheses, we examine market reactions to changes in the FTSE SmallCap index, which tracks the performance of small stocks listed on the London Stock Exchange.

3 Sample selection

FTSE International Limited introduced the FTSE SmallCap index in January 4, 1993. It is part of the FTSE All-Share index, which also includes the FTSE 100 and FTSE 250

indexes, that combined track the performance of the 350 largest UK companies. After the constituents of the FTSE 100 and FTSE 250 indexes are determined, companies left in the FTSE All-Share make up the FTSE SmallCap. Thus, unlike the FTSE 100 and FTSE 250 indexes, the number of companies in the FTSE SmallCap index fluctuates over time.

FTSE International Limited also maintains the FTSE Fledgling index. It consists of all the UK companies eligible for inclusion in the FTSE UK Index Series but too small to be included in the FTSE All-Share. Specifically, those companies whose full market value is less than 0.05 % of the full market value of the FTSE SmallCap index are deleted from the FTSE All-Share at the review and added to the FTSE Fledgling index. The value of the FTSE Fledgling index is calculated only at the end of the day.

The index committee reviews the constituents of the FTSE SmallCap index quarterly based on the rules related primarily to the rankings of market capitalization. The rankings are computed using market data taken at the close of business on the day before the review. Although a small number of additions to the FTSE SmallCap also occur between quarterly reviews due to a stock re-assessment or demerger, this study focuses on quarterly changes to the index. The quarterly changes are predictable and, therefore, should not have information content.

We define the effective day (ED) as the last trading day before an index change becomes effective. Because the FTSE releases quarterly reviews to the public after the market closes, we identify the next trading day as the announcement day (AD). Given the fixed number of trading days between announcement and effective days, AD is ED − 6. The event window runs from 30 trading days before to 60 trading days after the effective day, (ED − 30, ED + 60).

The initial sample of 936 index additions and 736 index deletions for the period January 1998 through December 2008 is identified from the *FTSE UK Quarterly Review* (in March, June, and September) and *FTSE UK Annual Review* (in December). The sample period starts in 1998, because beginning in that year the effective days for annual index changes were combined with December's quarterly index changes. In addition, since March 1996 the FTSE SmallCap index has been calculated in real time, rather than at the end of the day.

The initial sample is reduced to a final, clean sample of 672 additions and 532 deletions after an application of the following screens. The first screen removed stocks that became public within 30 trading days before the effective day to avoid any effects associated with a recent IPO (7 additions removed). The second screen removed stocks for which the event window overlapped with another index change (26 additions and 4 deletions removed). The third screen removed multiple appearances of a stock in the same group. Thus, if a stock appears more than once in any of the sample groups, only the earliest event for this stock was kept (99 additions and 61 deletions removed). The fourth screen removed stocks having more than 20 non-trading days in the 91-day event window (132 additions and 139 deletions removed).

We divide additions to the FTSE SmallCap Index into three groups:

1. Pure additions include 187 stocks added to the FTSE SmallCap Index that were not previously in any other FTSE index.
2. Upward additions include 196 stocks promoted from the FTSE Fledgling Index to the FTSE SmallCap Index.
3. Downward additions include 289 stocks demoted from the FTSE 250 Index to the FTSE SmallCap Index.

Deletions from the FTSE SmallCap Index consist of three groups as well:

1. Pure deletions include 30 stocks deleted from the FTSE SmallCap Index that were not shifted to any other FTSE index.
2. Downward deletions include 299 stocks demoted from the FTSE SmallCap Index to the FTSE Fledgling Index.
3. Upward deletions include 203 stocks promoted from the FTSE SmallCap Index to the FTSE 250 Index.

In our empirical analyses, we present results for all six groups in all cases. However, pure deletions consist of only 30 stocks. Also, pure deletions include stocks that no longer met FTSE index eligibility criteria because of worsened liquidity or declined free float. Given the small sample size and potential bias of pure deletions, we refrain from making conclusions about them and focus on the other groups in our discussion.

4 Analyses

4.1 Abnormal returns

We perform abnormal return analysis to examine whether additions to and deletions from the FTSE SmallCap index experience abnormal returns. If abnormal returns are present, we analyze whether they are transitory, consistent with the price pressure hypothesis, or permanent as predicted by other hypotheses. We obtain all security and market data required for the abnormal return analysis, as well as all other analyses, from the Thomson Reuters Datastream database.

Similar to Chen et al. (2004), Chen (2006), Cai (2007), and Becker-Blease and Paul (2010), we use market-adjusted returns to calculate abnormal returns around the index changes. The return on the FTSE SmallCap index is used as a proxy for the return on the market portfolio.[1] As some stocks share the same announcement and effective days, we use the "crude dependence" adjustment, described by Brown and Warner (1980), to correct for a possible event clustering problem. In addition to a parametric t test, we calculate a nonparametric rank test described by Corrado (1989), which does not require a symmetrical distribution of security abnormal returns for correct specification.[2]

4.1.1 Quarterly index changes

Table 1 Panel A presents abnormal returns for the three groups of additions to the FTSE SmallCap index implemented at the quarterly reviews. Both pure additions and upward additions experience significant positive cumulative abnormal returns of 2.78 and 13.78 %, respectively, in the 24-day period before the announcement day (AD − 24, AD − 1). These results are consistent with the significant pre-announcement run-up in prices for additions to the FTSE 100 index (e.g., Vespro 2006; Mase 2007; Mazouz and Saadouni 2007). Significant positive returns continue on the announcement and effective days, and during the 5-day period between these days (AD + 1, ED − 1). As a result, pure additions

[1] As robustness checks, we also use a market model and two other proxies for the market return: the FTSE All-Share value-weighted and Datastream UK equal-weighted indexes. Neither the market model nor the choice of the proxies for the market return affects the general results.

[2] We also compute a nonparametric sign test suggested by Corrado and Zivney (1992) and Cowan (1992). The results are qualitatively unchanged and are not shown here to save space.

Table 1 Cumulative average abnormal returns (CARs) for stocks added to or deleted from the FTSE SmallCap index at the quarterly reviews

Panel A: additions groups

Period	Pure additions ($N = 187$)			Upward additions ($N = 196$)			Downward additions ($N = 289$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, AD − 1	2.78 %	2.50*	2.55*	13.78 %	12.14***	5.38***	−13.45 %	−9.49***	−8.66***
AD	1.19 %	5.24***	4.95***	0.80 %	3.46***	3.45***	−0.95 %	−3.28**	−3.06**
AD + 1, ED − 1	4.46 %	8.82***	7.66***	3.79 %	7.31***	7.30***	−1.04 %	−1.61	0.70
ED	1.73 %	7.63***	4.28***	2.09 %	9.00***	4.92***	1.27 %	4.40***	3.28**
AD − 24, ED	10.15 %	8.06***	6.96***	20.45 %	15.85***	9.17***	−14.17 %	−8.80***	−7.30***
AD − 24, ED + 20	7.74 %	4.79***	3.46***	19.53 %	11.80***	5.57***	−13.76 %	−6.66***	−4.48***
AD − 24, ED + 40	4.47 %	2.35*	1.60	21.29 %	10.90***	5.00***	−12.00 %	−4.92***	−3.34***
AD − 24, ED + 60	1.14 %	0.53	0.98	19.98 %	9.04***	3.62***	−15.40 %	−5.58***	−3.82***

Panel B: deletions groups

Period	Pure deletions ($N = 30$)			Downward deletions ($N = 299$)			Upward deletions ($N = 203$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, AD − 1	−4.89 %	−2.13*	−3.35***	−12.67 %	−7.96***	−5.58***	13.06 %	10.95***	6.94***
AD	−0.68 %	−1.46	−1.03	−1.07 %	−3.30***	−1.63	−0.07 %	−0.28	−1.30
AD + 1, ED − 1	−6.95 %	−6.65***	−3.99***	−5.75 %	−7.91***	−4.99***	−1.64 %	−3.02**	−1.90
ED	−4.03 %	−8.62***	−2.95**	−3.18 %	−9.79***	−3.64***	−0.23 %	−0.93	−1.23
AD − 24, ED	−16.54 %	−6.36***	−5.27***	−22.67 %	−12.54***	−7.86***	11.12 %	8.21***	4.89***
AD − 24, ED + 20	−17.59 %	−5.27***	−5.41***	−12.04 %	−5.19***	−5.07***	11.16 %	6.42***	3.20**
AD − 24, ED + 40	−18.09 %	−4.60***	−4.34***	−8.54 %	−3.12**	−3.77***	12.74 %	6.21***	2.30*

Table 1 continued

Panel B: deletions groups

Period	Pure deletions ($N = 30$)			Downward deletions ($N = 299$)			Upward deletions ($N = 203$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, ED + 60	−17.42 %	−3.91***	−3.61***	−11.44 %	−3.69***	−3.48***	14.16 %	6.10***	2.30*

Abnormal returns are computed by using the market-adjusted model. The FTSE SmallCap index is used as a proxy for the market return. AD is the announcement day, and ED is the effective day

***, **, and * indicate significance at the 0.1, 1, and 5 % level, respectively, using a two-tail test

and upward additions gain, on average, abnormal 10.15 and 20.45 %, respectively, over the 31-day period running from AD − 24 to ED.

However, following the effective day, the stock price behavior differs between these two groups. Accumulated gain for pure additions reverses and declines to an insignificant 1.14 % after ED + 60. In contrast, the gain for upward additions stays at almost the same level of 19.98 %, which is significant at the 0.1 % level under both the *t* test and rank test. Thus, pure additions to the FTSE SmallCap index seem to exhibit a price reversal similar to pure additions to the Russell 2000 (Biktimirov et al. 2004) and S&P 600 (Shankar and Miller 2006) indexes.

Unlike pure additions and upward additions, downward additions, which consist of stocks demoted from the FTSE 250 index to the FTSE SmallCap index, lose in value. Specifically, they experience a significant negative cumulative abnormal return of −14.17 % from AD − 24 to ED. Similar to upward additions, they do not show any reversal over the following period, and their negative cumulative average abnormal return of −15.40 % from AD − 24 to ED + 60 is significant at the 0.1 % level under both the *t* test and rank test.

Figure 1 plots the cumulative average abnormal returns for the three groups of additions from ED − 30 (AD − 24) to ED + 60. As indicated by our analysis in Table 1, the graphs suggest a transitory stock price increase for pure additions and permanent price changes for upward additions and downward additions.

Table 1 Panel B presents abnormal returns for the three groups of deletions from the FTSE SmallCap index. Similar to the additions groups, all three groups of deletions experience significant cumulative returns during the 31-day period before the effective day (AD − 24, ED). Pure deletions and downward deletions lose 16.54 and 22.67 %, respectively, whereas upward deletions gain 11.12 %. Pure deletions and upward deletions

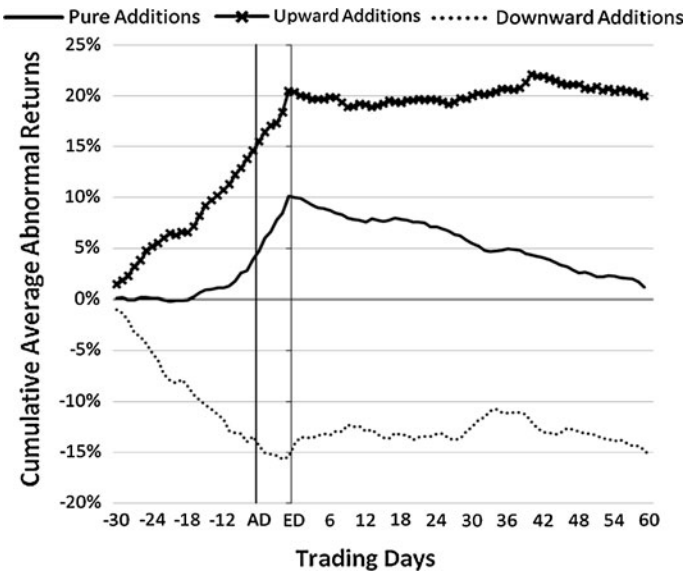

Fig. 1 Cumulative average abnormal returns for three groups of additions to the FTSE SmallCap index at the quarterly reviews. AD is the announcement day, and ED is the effective day. Trading days are numbered relative to the effective day

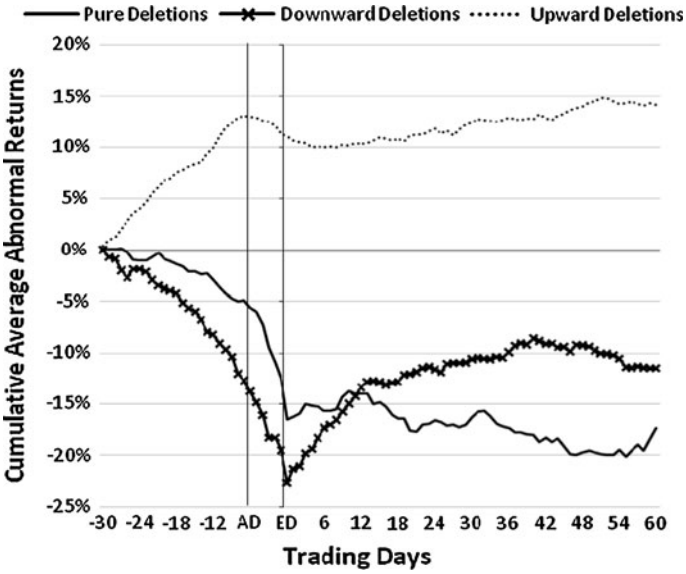

Fig. 2 Cumulative average abnormal returns for three groups of deletions from the FTSE SmallCap index at the quarterly reviews. AD is the announcement day, and ED is the effective day. Trading days are numbered relative to the effective day

do not show a price reversal and their cumulative abnormal returns of −17.42 and 14.16 % from AD − 24 to ED + 60 remain significant at the 0.1 % level under both the *t* test and the rank test.

Downward deletions exhibit a partial short-lived price reversal. Their negative cumulative abnormal return of −22.67 % after the effective day declines to −11.44 % over the next 60 days. However, it still remains significant at the 0.1 % level according to both the *t* test and the rank test.

Figure 2 plots average cumulative abnormal returns for the three groups of deletions from ED − 30 (AD − 24) to ED + 60. Downward deletions display a partial price reversal, but, as shown in Table 2 Panel B, their negative cumulative return remains significant 60 days after the effective day.

Taken together, the abnormal return analysis of quarterly index changes suggests a transitory price reaction for pure additions, which is consistent with the price pressure hypothesis, and a permanent price change for stocks that move from one FTSE index to another. In particular, stocks promoted from a smaller-cap index to a larger-cap index experience a permanent price gain, whereas the opposite is true for stocks demoted from a larger-cap index to a smaller-cap one. We note, however, that stocks demoted from the FTSE SmallCap index to the FTSE Fledgling index (downward deletions) also show a partial short-lived price reversal.

4.1.2 Repeated quarterly index changes

In addition to the clean sample of stocks added to or removed from the FTSE SmallCap index at quarterly index changes, we perform abnormal return analysis for two special

Table 2 Cumulative average abnormal returns (CARs) for repeated additions to or deletions from the FTSE SmallCap index at the quarterly reviews

Panel A: repeated additions groups

Period	Pure additions ($N = 6$)			Upward additions ($N = 25$)			Downward additions ($N = 68$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, AD − 1	2.90 %	0.52	1.53	9.63 %	3.95***	3.44**	−15.09 %	−6.06***	−6.69***
AD	4.31 %	3.82***	2.84**	1.16 %	2.33*	2.42*	−0.49 %	−0.97	−1.89
AD + 1, ED − 1	3.84 %	1.52	2.82**	4.61 %	4.15***	4.82***	0.48 %	0.42	1.77
ED	4.40 %	3.89***	2.49*	1.45 %	2.91**	3.02**	1.55 %	3.06**	3.42***
AD − 24, ED	15.45 %	2.46*	3.43***	16.85 %	6.09***	5.94***	−13.54 %	−4.79***	−4.90***
AD − 24, ED + 20	7.88 %	0.98	1.03	14.93 %	4.20***	4.53***	−16.02 %	−4.42***	−4.10***
AD − 24, ED + 40	6.30 %	0.66	0.21	13.18 %	3.14**	4.01**	−19.72 %	−4.61***	−4.20***
AD − 24, ED + 60	4.50 %	0.42	−0.20	7.25 %	1.53	3.12**	−19.87 %	−4.10***	−3.94***

Panel B: repeated deletions groups

Period	Downward deletions ($N = 30$)			Upward deletions ($N = 29$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, AD − 1	−18.75 %	−5.16***	−3.39***	15.55 %	5.21***	3.78***
AD	−1.39 %	−1.88	−0.96	−1.83 %	−3.00**	−0.43
AD + 1, ED − 1	−3.04 %	−1.83	−4.20***	−3.66 %	−2.69**	−2.15*
ED	−3.43 %	−4.62***	−2.83**	−1.01 %	−1.67	−1.21
AD − 24, ED	−26.61 %	−6.44***	−5.35***	9.05 %	2.67**	2.17*
AD − 24, ED + 20	−23.44 %	−4.42***	−4.08***	13.86 %	3.19**	2.42*
AD − 24, ED + 40	−15.04 %	−2.40*	−3.02**	15.85 %	3.09**	1.80
AD − 24, ED + 60	−13.91 %	−1.96*	−1.97*	13.96 %	2.40*	2.11*

Abnormal returns are computed by using the market-adjusted model. The FTSE SmallCap index is used as a proxy for the market return. AD is the announcement day, and ED is the effective day

***, **, and * indicate significance at the 0.1, 1, and 5 % level, respectively, using a two-tail test

samples of FTSE SmallCap index changes.[3] The first sample consists of stocks (99 additions and 61 deletions) removed from the clean sample of quarterly index changes because they appeared in the same group for the second time. Our goal is to determine whether abnormal returns of repeated additions and deletions behave differently from the abnormal returns of additions and deletions reported in Table 1. According to the investor awareness hypothesis, repeated additions and deletions are expected to exhibit a smaller price reaction than first-time additions and deletions.

After we dropped 1 upward deletion due to an acquisition during the event window, the final sample of repeats consists of 6 pure additions, 25 upward additions, 68 downward

[3] We thank two anonymous reviewers for suggesting these samples.

additions, 1 pure deletion, 30 downward deletions, and 29 upward deletions. Because the pure deletions group has only 1 stock, this group is not examined.

Table 2 Panel A shows abnormal returns for the three groups of repeated additions to the FTSE SmallCap index. All three repeated additions groups experience abnormal returns similar to those reported in Table 1. Specifically, repeated pure additions demonstrate a transitory price increase around the FTSE SmallCap index changes, whereas upward additions and downward additions experience a permanent gain and a permanent decline in value, respectively. Specifically, a significant positive cumulative return of 15.45 % from AD − 24 to ED for pure additions declines to an insignificant return of 4.50 % over the next 60 days. In contrast, a positive cumulative average abnormal return of 7.25 % from AD − 24 to ED + 60 for upward additions is significant at the 1 % level according to the rank test. Similarly, a negative cumulative average abnormal return of −19.87 % from AD − 24 to ED + 60 for downward additions is significant at the 0.1 % level under both the *t* test and rank test.

Inconsistent with the investor awareness hypothesis, we do not find a considerably smaller price reaction for repeated additions compared to the additions shown in Table 1. For example, repeated upward additions and downward additions show cumulative average abnormal returns of 16.85 and −13.54 %, respectively, in the period from AD − 24 to ED. These returns are comparable with cumulative average abnormal returns of 20.45 and −14.17 % reported for the same groups of additions in Table 1. Moreover, the cumulative average abnormal return of 15.45 % from AD − 24 to ED for repeated pure additions is even larger than a cumulative abnormal return of 10.15 % shown for pure additions in Table 1 over the same period.

Taken together, the behavior of cumulative average abnormal returns of the repeated additions groups is consistent with the pattern of abnormal returns reported in Table 1, and does not provide support for the investor awareness hypothesis.

The examination of the average cumulative abnormal returns for two repeated deletions groups in Table 2 Panel B renders the same conclusion. Similar to Table 1, repeated downward deletions and upward deletions experience a permanent price reaction. The magnitudes of cumulative average abnormal returns reported in Panel B of Tables 1 and 2 are comparable as well.

These results are consistent with Mase (2007) who finds almost identical pre- and post-event abnormal returns for new additions to the FTSE 100 index and the additions that have previously been constituents of the index. In contrast, Zhou (2011) reports that new-entry additions to the S&P 500 index experience almost double the cumulative abnormal returns than reentry additions in the period from AD to ED. The unpredictable nature of S&P 500 index changes might contribute to the difference in the results between FTSE and S&P 500 index additions.

4.1.3 Non-quarterly index changes

The second special sample consists of stocks added to or removed from the FTSE SmallCap index between the quarterly reviews. Changes in the FTSE 250 index primarily cause changes to the FTSE SmallCap index between quarterly reviews. As a result, the non-quarterly index changes sample includes only stocks promoted to (upward deletions) or demoted from the FTSE 250 index (downward additions). It does not include pure deletions because those deletions are a consequence of special corporate actions, such as a merger, acquisition, bankruptcy, or transfer from the Official list to the Alternative

Table 3 Cumulative average abnormal returns (CARs) for non-quarterly additions to or deletions from the FTSE SmallCap index

Period	Downward additions ($N = 4$)			Upward deletions ($N = 93$)		
	CARs	*t* test	Rank test	CARs	*t* test	Rank test
AD − 24, AD − 1	−15.30 %	−3.46***	−3.73***	7.37 %	5.97***	3.60***
AD	1.50 %	1.66	1.59	−1.41 %	−5.60***	−3.99***
AD + 1, ED − 1	−0.65 %	−0.22	−1.03	−1.39 %	−1.66	−1.83
ED	0.92 %	1.02	0.32	−2.76 %	−10.94***	−7.30***
AD − 24, ED	−13.04 %	−2.82**	−3.21**	3.07 %	2.38*	−0.68
AD − 24, ED + 20	−11.83 %	−1.93	−2.28*	6.57 %	3.84***	2.40*
AD − 24, ED + 40	−11.47 %	−1.56	−2.05*	8.53 %	4.16***	1.24
AD − 24, ED + 60	−15.12 %	−1.81	−2.42*	11.57 %	4.95***	2.26*

Abnormal returns are computed by using the market-adjusted model. The FTSE SmallCap index is used as a proxy for the market return. AD is the announcement day, and ED is the effective day

***, **, and * indicate significance at the 0.1, 1, and 5 % level, respectively, using a two-tail test

Investment Market.[4] The FTSE SmallCap index does not have a fixed number of member stocks and, therefore, deletions from the index do not require offsetting index additions. Therefore, this non-quarterly index changes sample also does not include upward additions, pure additions, and downward deletions, which are generally implemented only at quarterly reviews. Several cases of non-quarterly pure additions and upward additions were all associated with merger, acquisition, or demerger, and, therefore, they were not included in the final sample.

Similar to quarterly index changes, non-quarterly additions and deletions are predictable because they are based on market values. However, the exact date of the non-quarterly index change is not known in advance. In addition, unlike quarterly index changes, ED usually immediately follows AD. Similar to quarterly index changes, we define AD as the next trading day following an announcement, and ED as the last trading day before an index change becomes effective.

We use the FTSE web site to collect the announcement and effective dates of non-quarterly review index changes for the period from the end of 2002–2008. We remove index changes caused by corporate events, such as mergers/demergers and acquisitions. The initial sample consists of 9 downward additions and 108 upward deletions. We removed 1 downward addition that we could not uniquely identify in the Thomson Reuters Datastream database and 3 upward deletions that had confounding corporate events during the event period. Finally, we removed 4 downward additions and 12 upward deletions that had AD and ED on the same day. The final sample of non-quarterly index changes consists of 4 downward additions and 93 upward deletions.

Table 3 presents cumulative average abnormal returns for non-quarterly additions to or deletions from the FTSE SmallCap index. Despite the fact that the dates of non-quarterly index changes are generally not predictable, similar to quarterly index changes both downward additions and upward deletions experience significant cumulative abnormal returns in the days preceding the announcement. Downward additions have a negative

[4] The Alternative Investment Market (AIM) is a sub-market of the London Stock Exchange. It does not have minimum market capitalization requirement and has a less stringent regulatory system than that applied to the main market.

cumulative abnormal return of −15.30 % in the period from AD − 24 to AD − 1, which is slightly larger in absolute value than a cumulative abnormal return of −13.45 % for quarterly downward additions over the same period shown in Table 1. The abnormal cumulative gain of 7.37 % from AD − 24 to AD − 1 for non-quarterly upward deletions is almost half that of the gain of 13.06 % for quarterly upward deletions. Both cumulative abnormal returns for both downward additions and upward deletions remain significant for 60 days after ED.

Taken together, except for a smaller run-up in price for upward deletions, non-quarterly downward additions and upward deletions tend to show a price pattern similar to their quarterly counterparts around FTSE SmallCap index changes. To avoid any potential bias associated with repeated and non-quarterly index changes, we perform all subsequent analyses by using the clean sample of quarterly index changes described in Section 3 throughout the rest of the paper.

4.2 Trading volume

We analyze trading volume around the FTSE SmallCap quarterly index changes using procedures similar to those in Campbell and Wasley (1996) and Palmon et al. (2009). The purpose of this analysis is to determine if abnormal volume is associated with abnormal returns. As Cready and Hurtt (2002) suggest, supplementing abnormal return analysis with trading volume analysis increases the power of the tests designed to detect market response. A brief description of our methods for calculating abnormal volume follows.

First, we calculate the log-transformed percentage of shares outstanding[5]:

$$V_{i,t} = \ln\left(\frac{100n_{i,t}}{S_{i,t}} + 0.000255\right) \tag{1}$$

where $n_{i,t}$ is the number of shares traded for security i on day t, and $S_{i,t}$ is the number of shares outstanding on day t.

Next, we estimate market model abnormal trading volume as:

$$AV_{i,t} = V_{i,t} - (\alpha_i + \beta_i V_{m,t}) \tag{2}$$

where α_i and β_i are ordinary least squares estimates computed over a 180-day pre-event estimation window (ED − 210, ED − 31). The market volume for day t is calculated by using all stocks in the FTSE All-Share index:

$$V_{m,t} = \frac{1}{N_t}\sum_{i=1}^{N_t} V_{i,t} \tag{3}$$

where N_t is the number of stocks in the FTSE All-Share index on day t.[6]

For robustness checks, we use different test statistics and estimation periods. For example, we use both a parametric t test and a nonparametric rank test. We report only the rank test statistic because Campbell and Wasley (1996) find that the nonparametric test

[5] Ajinkya and Jain (1989) and Cready and Ramanan (1991) suggest log transformation of the volume data to approximate a normal distribution. Similar to Cready and Ramanan, we add 0.000255 to the daily percentage of shares outstanding to accommodate zero volume.

[6] Given that the composition of the FTSE All-Share index changes from one year to another, we use January's index constituent list to calculate daily market volume for that year.

statistic is always more powerful in detecting abnormal trading volume than the parametric test statistic. Similar to Chakrabarti et al. (2005), Shankar and Miller (2006), and Mase (2007), we use the pre-event estimation period to report the main results.

For an unbiased estimation of the parameters of the market model we apply two screens to the sample. The first screen removed stocks for which the estimation period overlapped with another index change (68 additions and 76 deletions removed). The second screen removed stocks having more than 100 non-trading days in the 180-day estimation period (98 additions and 17 deletions removed).

Table 4 reports abnormal trading volume for FTSE SmallCap index additions and deletions. All additions and deletions experience a significant increase in trading volume on the effective day. The change in trading volume ranges from a 115 % increase for downward additions to a 276 % increase for pure deletions. Both the pure additions and upward additions groups have positive abnormal volumes significant at least at the 5 % level for every day from ED − 5 to ED + 1. In contrast, downward additions experience a significant positive abnormal volume only during 3 days around the effective day.

Upward deletions also have a significant positive abnormal volume only during 3 days, but it starts 1 day later, on the effective day. Downward deletions have the longest window of a significant positive abnormal volume that starts on ED − 4 and ends on ED + 8.

Taken together, consistent with the results of the abnormal return analysis, the trading volume analysis confirms that changes in the FTSE SmallCap index represent a significant event for the affected companies. Moreover, the largest increase in trading volume on the effective day suggests that index funds tracking FTSE indexes are more concerned with minimizing tracking error than profit. A similar conclusion has been reached regarding the trading behavior of index funds that follow the S&P 500 index (e.g., Kappou et al. 2010; Geppert et al. 2011).

4.3 Institutional ownership

Previous studies have documented significant increases (decreases) in institutional ownership for companies added to (removed from) the S&P 500 (e.g., Chen et al. 2004), Russell 2000 (e.g., Biktimirov et al. 2004) and S&P 600 (e.g., Shankar and Miller 2006) indexes. In this section, we examine institutional ownership changes for companies added to or removed from the FTSE SmallCap index at the quarterly reviews, which can help explain some of the market reactions discussed earlier.

We obtain the percentage of shares owned by investment companies and the percentage of free float shares from the Thomson Reuters Datastream database. The percentage of free float shares is determined by subtracting strategic holdings, such as shares held by a government or government institution, one company in another, pension funds or endowment funds, investment companies, and employee/family, from the total number of shares outstanding. Because institutional ownership data are only available since May 2002, we use index changes starting from the June 2002 quarterly review. For the examination of the percentage of free float shares, the sample is reduced somewhat because of missing data for some stocks.

We use the procedures similar to those employed by Biktimirov et al. (2004) and Shankar and Miller (2006) to calculate the mean percentage of institutional ownership over the 2 months before the month of the index change and then over the two months after. Table 5 presents some descriptive statistics for the percentage of investment company holdings and percentage of free float shares before and after quarterly changes to the FTSE SmallCap index for all six groups.

Table 4 Abnormal trading volume for stocks added to or deleted from the FTSE SmallCap index at the quarterly reviews

Days	Pure additions ($N = 108$)		Upward additions ($N = 186$)		Downward additions ($N = 212$)		Pure deletions ($N = 28$)		Downward deletions ($N = 277$)		Upward deletions ($N = 134$)	
	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test
AD − 24	31.4	−0.08	30.4	−0.15	27.7	1.41	59.0	−0.02	31.2	−0.01	19.0	0.42
AD − 14	29.4	−0.65	56.0	0.83	30.3	1.86	6.1	−0.86	35.1	0.19	26.0	0.64
AD − 4	48.3	−0.11	46.2	0.40	20.0	0.72	70.3	0.10	39.1	0.32	34.4	0.78
AD − 3	56.5	0.05	88.4	1.82	18.8	0.49	43.3	−0.32	53.9	0.78	34.5	0.52
AD − 2	48.4	0.05	66.8	0.91	25.3	0.86	3.4	−0.65	39.9	0.41	29.9	0.42
AD − 1	55.8	0.14	60.3	0.93	20.2	0.96	0.6	−0.94	28.8	0.20	33.6	0.55
AD	131.4	1.77	99.4	2.17*	29.2	1.42	103.6	0.64	69.6	1.17	64.4	1.75
ED − 5	143.9	2.33*	120.5	1.99*	39.9	1.96	72.6	0.09	91.5	1.59	33.5	0.53
ED − 4	156.0	2.32*	126.7	2.75**	24.5	1.45	141.6	1.23	122.5	2.64**	38.4	0.95
ED − 3	171.5	2.98**	148.2	2.91**	35.8	2.31*	211.1	2.33*	122.6	2.65**	54.9	1.40
ED − 2	199.2	3.34***	153.5	3.67***	25.9	1.73	265.5	2.39*	137.9	2.93**	60.9	1.72
ED − 1	218.9	3.71***	161.7	3.87***	46.3	2.69**	262.9	2.54*	144.0	3.17**	57.7	1.69
ED	254.1	4.40***	241.7	4.04***	115.5	7.42***	276.4	2.84**	258.6	5.80***	154.9	5.52***
ED + 1	135.3	2.32*	91.6	6.09***	40.8	2.71**	232.9	2.11*	205.4	4.13***	95.0	3.16**
ED + 2	113.5	1.64	76.2	1.64	39.6	1.86	196.9	1.87	144.9	2.91**	79.1	2.32*
ED + 3	78.1	1.16	50.7	0.80	31.9	1.53	150.4	1.43	154.5	3.02**	53.0	0.08
ED + 4	69.2	0.89	49.6	0.66	22.2	0.95	68.3	0.00	177.6	3.17**	47.0	0.16
ED + 5	52.7	0.79	8.8	0.56	24.1	1.14	187.0	1.39	162.5	2.84**	56.7	0.06
ED + 10	107.6	1.26	73.7	1.16	29.9	1.05	137.4	1.23	68.0	0.98	44.8	0.09
ED + 20	74.8	0.66	27.8	0.08	14.1	0.01	106.2	0.48	61.3	0.85	63.7	1.63
ED + 30	35.1	−0.21	24.2	−0.32	−1.2	−0.32	34.7	−0.38	29.6	0.12	38.4	0.84

Table 4 continued

Days	Pure additions ($N = 108$)		Upward additions ($N = 186$)		Downward additions ($N = 212$)		Pure deletions ($N = 28$)		Downward deletions ($N = 277$)		Upward deletions ($N = 134$)	
	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test	$\overline{AV_t}$	Rank test
ED + 60	27.4	−0.50	29.6	−0.14	−22.7	−2.30	52.3	−0.07	3.8	−0.77	20.2	0.06

Average abnormal trading volume ($\overline{AV_t}$) (in percentage) is estimated using an equally-weighted market index with all stocks in the FTSE All-Share index as a proxy for market trading volume and a 180-day pre-event estimation period (ED − 210, ED − 31). AD is the announcement day, and ED is the effective day

***, **, and * indicate significance at the 0.1, 1, and 5 % level, respectively, using a two-tail test

Table 5 Descriptive statistics for changes in institutional ownership at the quarterly reviews

	Percentage of investment company holdings						Percentage of free float shares				
	M	Mean	Median	Max	Min		M	Mean	Median	Max	Min
Pure additions ($N = 112$)	−2	12	0	62	0	Pure additions ($N = 72$)	−2	69	72	100	11
	−1	13	7	62	0		−1	68	69	100	23
	0	14	8	62	0		0	67	70	100	23
	1	16	12	93	0		1	65	70	100	7
	2	16	13	93	0		2	66	70	100	7
Upward additions ($N = 107$)	−2	20	17	62	0	Upward additions ($N = 103$)	−2	63	65	100	17
	−1	21	17	62	0		−1	62	64	100	7
	0	20	19	61	0		0	63	65	100	7
	1	21	19	61	0		1	63	64	100	11
	2	21	19	61	0		2	63	63	100	11
Downward additions ($N = 120$)	−2	23	20	72	0	Downward additions ($N = 116$)	−2	62	66	100	12
	−1	23	18	76	0		−1	62	67	100	12
	0	23	18	79	0		0	62	64	100	12
	1	23	19	72	0		1	63	66	100	10
	2	22	20	71	0		2	64	67	100	10
Pure deletions ($N = 9$)	−2	31	26	66	3	Pure deletions ($N = 9$)	−2	61	59	96	33
	−1	30	21	62	3		−1	62	60	96	36
	0	26	21	62	3		0	66	68	96	36
	1	26	24	62	2		1	66	68	97	36
	2	26	19	62	2		2	66	71	97	36
Downward deletions ($N = 138$)	−2	27	26	67	0	Downward deletions ($N = 137$)	−2	60	62	100	13
	−1	27	27	68	0		−1	60	60	100	13
	0	26	26	65	0		0	61	61	100	13
	1	26	25	65	0		1	60	62	100	13
	2	25	25	65	0		2	60	61	100	13
Upward deletions ($N = 84$)	−2	22	19	69	0	Upward deletions ($N = 82$)	−2	67	71	100	22
	−1	22	19	69	0		−1	67	71	100	23
	0	22	19	69	0		0	66	68	100	24
	1	22	19	70	0		1	67	70	100	22
	2	21	19	74	0		2	67	71	100	24

Descriptive statistics for the percentage of investment company holdings and percentage of free float shares for 2 months before and 2 months after changes to the FTSE SmallCap index. M = 0 is the month in which addition or deletion occurs

As shown in Table 5, pure additions experience the largest increase in the percentage of shares held by investment companies, which is accompanied by a decrease in the percentage of free float shares. Specifically, the mean (median) of the percentage of shares held by investment companies rises from 12 % (0 %) to 16 % (13 %), whereas the mean (median) of the percentage of free float shares declines from 69 % (72 %) to 66 % (70 %).

In contrast, pure deletions show the largest decline in the percentage of shares held by investment companies, which is accompanied by an increase in the percentage of free float shares. The mean (median) of the percentage of shares held by investment companies

Table 6 Mean difference of percentage of investment company holdings and percentage of free float shares following the FTSE SmallCap index changes at the quarterly reviews

	Percentage of investment company holdings				Percentage of free float shares		
	Mean Difference	Pr > |t|	Pr > |S|		Mean Difference	Pr > |t|	Pr > |S|
Pure additions ($N = 112$)	3.32	0.005	0.001	Pure additions ($N = 72$)	−3.06	0.092	0.028
Upward additions ($N = 107$)	0.56	0.376	0.449	Upward additions ($N = 103$)	0.34	0.726	0.441
Downward additions ($N = 120$)	−0.94	0.301	0.152	Downward additions ($N = 116$)	1.27	0.236	0.166
Pure deletions ($N = 9$)	−4.56	0.303	0.336	Pure deletions ($N = 9$)	4.89	0.383	0.336
Downward deletions ($N = 138$)	−1.43	0.044	0.012	Downward deletions ($N = 137$)	0.64	0.395	0.092
Upward deletions ($N = 84$)	−0.62	0.509	0.674	Upward deletions ($N = 82$)	−0.24	0.866	0.640

Mean difference of percentage of investment company holdings (or free float shares) is defined as the stock's average percentage of investment company holdings (or free float shares) in the two-month period before the month of the index change subtracted from the average percentage of investment company holdings (or free float shares) in the two-month period after. Pr > |t| and Pr > |S| are p values for t test and Wilcoxon signed rank sum test, respectively

decreases from 31 % (26 %) to 26 % (19 %), while the mean (median) of the percentage of free float shares rises from 61 % (59 %) to 66 % (71 %). Other groups, which include stocks shifted between FTSE indexes, do not experience large changes in institutional ownership around the index changes.

To examine the significance of the changes in Table 5, we compute the change in the percentage of shares held by investment companies and the percentage of free float shares between the 2 months before the month of the index change and 2 months after. We then test for significant differences using a standard t test and a nonparametric Wilcoxon signed rank sum test. The results are reported in Table 6.

As Table 6 shows, pure additions experience an average increase of 3.32 % in the percentage of investment company holdings, which is significant at least at the 1 % level under both statistical tests. They also experience a 3.06 % decline in the percentage of free float shares, which is significant at the 9 and 3 % levels under the t test and Wilcoxon signed rank sum test, respectively.

Downward deletions show an average decrease of 1.43 % in the percentage of investment company holdings, which is significant at the 5 % level under both tests. However, they do not experience significant changes in the percentage of free float shares.

The very small sample size of only 9 firms prevents us from finding significant results for pure deletions. Although they have the largest decrease of −4.56 % in the percentage of shares held by investment companies and the largest increase of 4.89 % in the percentage of free float shares, neither of the changes is statistically significant. Other groups do not show significant changes in the percentage of shares held by institutional investors.

Taken together, the results of the institutional ownership analysis suggest an increase in the percentage of investment company holdings and a decrease in the percentage of free float shares for firms that are completely new to the FTSE family of indexes. In contrast, firms that are shifted from one index to another do not experience significant changes in institutional ownership, except for a significant decrease in the percentage of investment company holdings for downward deletions.

The observed changes in institutional ownership can explain the documented abnormal returns around index changes. Specifically, an increase in institutional ownership for pure additions can cause an imbalance of orders between index funds that have to buy a newly added stock and other traders. Consequently, this imbalance of orders results in temporary price pressure. Similarly, a significant decrease in the percentage of investment company holdings for downward deletions can explain a partial price reversal for this group. In contrast, the absence of significant institutional ownership changes for other groups is consistent with the lack of considerable price pressure on them.

4.4 Liquidity

Madhavan (2003) and Becker-Blease and Paul (2010) find significant increases in stock liquidity for companies added to the Russell 2000 and S&P 600 indexes, respectively. In this section we examine changes in liquidity for companies added to or removed from the FTSE SmallCap index. Several liquidity measures have been offered in the literature, with each measure capturing a different facet of liquidity. Therefore, we use four measures for stock liquidity: the dollar volume, illiquidity ratio, relative spread, and zero returns ratio.

Dollar volume is the average of the natural logarithm of daily trading volume in dollars.

The illiquidity ratio, *ILLIQ*, is the average of the daily ratio of absolute stock return to its daily trading volume in dollars:

$$ILLIQ_i = \frac{1}{T_i}\sum_{t=1}^{T_i}\frac{|R_{i,t}|}{VOLD_{i,t}} \tag{4}$$

where $R_{i,t}$ is the return of stock i on day t, $VOLD_{i,t}$ is the daily trading volume in dollars for stock i, and T_i is total number of days for stock i during the pre-event and post-event periods. Amihud (2002) suggests the illiquidity ratio as a measure of price impact. A more liquid stock is expected to have a smaller illiquidity ratio.

Relative spread is the average of the difference between the daily closing ask and bid prices divided by the mid-point of closing ask and bid prices.

The zero returns ratio is the ratio of the number of zero return days to the total number of trading days. Lesmond et al. (1999) suggest this measure as a proxy for transaction costs.

We calculate the average of each liquidity measure over a 180-day period before and after the effective day and then test for significant differences.[7] Similar to Chen et al. (2004) and Becker-Blease and Paul (2010), we compute post-change liquidity starting 61 days after the effective date to avoid any confounding effects introduced by index fund and arbitrage trading. Thus, the pre-change period runs from ED − 210 to ED − 31, and the post-change period lasts from ED + 61 to ED + 240.

To avoid the confounding effects on liquidity measures of another index change, we eliminated stocks that had an additional index change during the 180-day pre-change or

[7] As robustness checks, we also used 45-day and 90-day periods. The results are qualitatively unchanged.

post-change periods (188 additions and 112 deletions removed). To test the difference between the pre-change and post-change levels for each group, we use a parametric paired *t* test and two nonparametric tests, Wilcoxon signed rank sum and sign tests.

Table 7 shows the mean (median) of the pre-change levels, changes, and percentage of stocks that experience increases in liquidity measures following addition to or deletion from the FTSE SmallCap Index at the quarterly reviews.

Pure additions experience declines in liquidity following their inclusion in the FTSE SmallCap index. They show increases in the illiquidity ratio, relative spread, and zero returns ratio that are significant, at least at the 1 % level, under all tests. Their trading volume shows a decline, which is significant at the 4 % level according to the Wilcoxon signed rank sum test.

Decreases in liquidity for pure additions might be related to the decline in the percentage of free float shares following a stock's inclusion in the FTSE SmallCap index. Because index funds normally buy and hold the shares, the number of shares available for trading declines. As Singal (2004, p. 171) suggests, this decrease in the number of shares available for trading might negatively impact liquidity.

Upward additions show an increase in trading volume that is significant, at least at the 3 % level, under all three tests. They also experience decreases in the illiquidity ratio and relative spread that are significant, at least at the 5 % level, according to the sign test. Taken together, the presented evidence suggests improvements in liquidity for upward additions.

Downward additions show clear decreases in liqiudity. Changes in all four measures for liquidity are significant, at least at the 0.01 % level, under all tests.

Unlike pure additions, pure deletions show an increase in trading volume that is significant under the Wilcoxon signed rank sum and sign tests, at least at the 4 % level. Changes in the three other measures of liquidity are not significant. In contrast, upward deletions and downward deletions show consistent and highly significant changes in the four liquidity proxies. Upward deletions experience overall improvements in liquidity, whereas downward deletions show declines in liquidity.

Taken together, the results of the liquidity analysis suggest improvements in liquidity for stocks promoted from a smaller cap index to a larger cap index. In contrast, liquidity worsens for stocks demoted from a larger cap index to a smaller cap index. These improvements/declines in liquidity are associated with permanent increases/decreases in stock prices documented by the abnormal return analysis.

4.5 Regression analysis

In this section, we examine whether changes in liquidity explain index price effects by estimating the ordinary least square regressions of the 90-day cumulative abnormal return on raw changes in the liquidity proxies. Due to the predictable nature of quarterly changes to the FTSE SmallCap index, which happen at specific dates and include publicly available criteria, additions to and deletions from the index begin experiencing abnormal returns before the announcement and effective days. Therefore, the dependent variable is the cumulative abnormal stock return from 30 days before the effective day to 60 days after the effective day. Independent variables are raw changes in four liquidity proxies and seven control variables: the measure of arbitrage risk (*A1*) suggested by Wurgler and Zhuravskaya (2002), firm size, and five dummy variables for groups.

A1 is the variance of the error term from a regression of the stock's excess return on the market's excess return over the 180 trading day estimation period covering day ED − 210

Table 7 Changes in liquidity for stocks added to or deleted from the FTSE SmallCap index at the quarterly reviews

Pre-change levels				Changes				Percentage of increases			
Volume	ILLIQ[a]	Spread	Zeros	Volume	ILLIQ[a]	Spread	Zeros	Volume	ILLIQ	Spread	Zeros
Pure additions ($N = 150$)											
2.4138	0.3195	0.0255	0.2290	−0.0142	0.6771	0.0091	0.0612	45.33 %	70.67 %	62.67 %	63.33 %
(2.4209)	(0.1216)	(0.0235)	(0.1778)	(−0.0118)	(0.1031)	(0.0038)	(0.0667)	Sign test Pr > |z|:			
Paired *t* test Pr > |*t*|:				*0.3115*	*0.0004*	*<0.0001*	*0.0008*	*0.2530*	*<0.0001*	*0.0019*	*0.0011*
Wilcoxon signed rank sum test Pr > |S|:				*0.0347*	*<0.0001*	*<0.0001*	*0.0002*				
Upward additions ($N = 175$)											
2.3773	0.3149	0.0321	0.3255	0.0409	0.0262	−0.0013	−0.0194	58.29 %	39.43 %	42.29 %	44.57 %
(2.3946)	(0.1771)	(0.0273)	(0.3222)	(0.0176)	(−0.0283)	(−0.0015)	(−0.0111)	Sign test Pr > |z|:			
Paired *t* test Pr > |*t*|:				*<0.0001*	*0.5510*	*0.4760*	*0.1505*	*0.0284*	*0.0052*	*0.0413*	*0.1509*
Wilcoxon signed rank sum test Pr > |S|:				*<0.0001*	*0.3515*	*0.0715*	*0.2504*				
Downward additions ($N = 159$)											
2.5993	0.0589	0.0200	0.1120	−0.0874	0.2116	0.0141	0.0865	8.81 %	86.16 %	86.16 %	81.13 %
(2.6123)	(0.0311)	(0.0181)	(0.0722)	(−0.0797)	(0.0593)	(0.0086)	(0.0611)	Sign test Pr > |z|:			
Paired *t* test Pr > |*t*|:				*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Wilcoxon signed rank sum test Pr > |S|:				*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*				
Pure deletions ($N = 27$)											
2.1833	1.2799	0.0365	0.4440	0.0558	−0.0045	−0.0011	0.0296	70.37 %	55.56 %	44.44 %	51.85 %
(2.2326)	(0.4128)	(0.0292)	(0.4667)	(0.0396)	(0.0370)	(−0.0016)	(0.0056)	Sign test Pr > |z|:			
Paired *t* test Pr > |*t*|				*0.2574*	*0.9919*	*0.8071*	*0.3028*	*0.0343*	*0.5637*	*0.5637*	*0.8474*
Wilcoxon signed rank sum test Pr > |S|:				*0.0024*	*0.5778*	*0.9256*	*0.4126*				

Table 7 continued

Pre-change levels				Changes				Percentage of increases			
Volume	ILLIQ[a]	Spread	Zeros	Volume	ILLIQ[a]	Spread	Zeros	Volume	ILLIQ	Spread	Zeros
Upward deletions ($N = 115$)											
2.4968	0.1435	0.0194	0.2119	0.0650	−0.0804	−0.0043	−0.0563	85.22 %	16.52 %	31.30 %	31.30 %
(2.5207)	(0.0548)	(0.0163)	(0.1667)	(0.0646)	(−0.0224)	(−0.0022)	(−0.0500)	Sign test Pr > |z|:			
Paired t test Pr > |t|:				*0.0054*	*0.0018*	*0.0003*	*<0.0001*	*<0.0001*	*<0.0001*	*0.0002*	*<0.0001*
Wilcoxon signed rank sum test Pr > |S|:				*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*				
Downward deletions ($N = 278$)											
2.3336	2.9729	0.0546	0.3585	−0.0624	1.8952	0.0519	0.0185	32.37 %	58.99 %	65.47 %	58.27 %
(2.3464)	(0.6710)	(0.0477)	(0.3778)	(−0.0463)	(0.1930)	(0.0090)	(0.0278)	Sign test Pr > |z|:			
Paired t test Pr > |t|:				*<0.0001*	*0.3542*	*0.0002*	*0.0764*	*<0.0001*	*0.0027*	*<0.0001*	*0.0058*
Wilcoxon signed rank sum test Pr > |S|:				*<0.0001*	*<0.0001*	*<0.0001*	*0.0180*				

Mean (median) of the pre-change levels, changes, and percentage of stocks experiencing increases in liquidity following addition to or deletion from the FTSE SmallCap index. ED is the effective day. Pre-change levels are averaged over a 180-day period that ends at ED − 31. Post-change levels are averaged over a 180-day period that starts at ED + 61. Volume is the average of the natural logarithm of daily trading volume in dollars. ILLIQ, illiquidity ratio, is the average of the daily ratio of absolute stock return to its daily trading volume in dollars. Spread, relative spread, is the average of the difference between the daily closing ask and bid prices divided by the mid-point of closing ask and bid prices. Zeros, zero returns ratio, is the ratio of the number of zero return days to the total number of trading days. Pr > |t|, Pr > |S|, and Pr > |z| are p values for paired t test, Wilcoxon signed rank sum test, and sign test, respectively

[a] Units are 10^{-6}

to day ED − 31. The FTSE SmallCap index is used as a proxy for the market return. Wurgler and Zhuravskaya (2002) suggest that a stock with a high *A1* does not have close substitutes available and, therefore, is more difficult to arbitrage. According to the downward-sloping demand curve (or imperfect substitutes) hypothesis, stocks with high *A1* should experience a permanent stock price reaction associated with addition to or deletion from an index.

The firm size is a stock's market value (*MV*) calculated on day ED − 30. Shankar and Miller (2006) suggest a size effect in the post-announcement returns by examining changes in the S&P SmallCap 600 index.

Five group dummy variables control for factors related to the way a stock is added to or deleted from the FTSE SmallCap index. They are equal to one if a stock is a member of the upward additions, downward additions, pure deletions, downward deletions or upward deletions groups, respectively, and zero otherwise.

Table 8 presents four regressions to allow for different measures of liquidity. All measures of liquidity are significant at the 0.01 % level and have expected signs. A positive coefficient for changes in volume, and negative coefficients for changes in the illiquidity ratio, relative spread and zero returns ratio suggest that improvements in liquidity are associated with a positive cumulative abnormal return around index change, whereas decreases in liquidity are related to a negative cumulative abnormal return.

The negative and significant coefficients for the firm size variable indicate that larger companies gain less than smaller companies when they are added to the FTSE SmallCap index. Alternatively, larger companies lose more when they are removed from the index.

The lack of consistently significant coefficients for the *A1* variable does not support the downward-sloping demand curve hypothesis as a possible explanation for the stock price reaction around index changes.

Taken together, the regression analysis supports a positive relationship between changes in liquidity and stock returns around the FTSE SmallCap index changes. These results are consistent with Madhavan (2003) and Becker-Blease and Paul (2010) who report significant increases in stock liquidity for companies added to the Russell 2000 and S&P 600 indexes, respectively.

5 Discussion

Stocks promoted from a smaller-cap to larger-cap FTSE index (upward additions and upward deletions) experience permanent stock price increases accompanied by improvements in liquidity. In contrast, stocks demoted from a larger-cap to smaller-cap FTSE index (downward additions and downward deletions) experience permanent stock declines accompanied by decreases in liquidity. Taken together, the market reactions of stocks that move from one FTSE index to another provide support for the liquidity hypothesis.

The market reactions for pure additions are different from other groups. First, pure additions are the only group that experiences a transitory stock price change and a significant increase in institutional ownership. This evidence supports the price pressure hypothesis, which explains the temporary price pressure caused by the misbalance of orders between index funds that have to include a newly added stock into their portfolios and other traders. These results are consistent with evidence in Biktimirov et al. (2004) and Shankar and Miller (2006) who find transitory price gains and institutional ownership increases for pure additions to the Russell 2000 and S&P 600 indexes, respectively.

Table 8 Regressions on CAR around changes to the FTSE SmallCap index at the quarterly reviews

	(1)	(2)	(3)	(4)
Constant	3.14011***	3.18499***	3.60049***	3.33282***
	(<0.01 %)	(<0.01 %)	(<0.01 %)	(<0.01 %)
△Volume	0.32889***			
	(<0.01 %)			
△ILLIQ		−3405.8321***		
		(<0.01 %)		
△Spread			−1.0848***	
			(<0.01 %)	
△Zeros				−0.38022***
				(<0.01 %)
MV	−0.16776***	−0.16993***	−0.19274***	−0.17702***
	(<0.01 %)	(<0.01 %)	(<0.01 %)	(<0.01 %)
A1	−13.9859	−19.68636*	−1.84451	−14.74064
	(14.10 %)	(3.79 %)	(83.86 %)	(12.00 %)
Pure deletions dummy	−0.24240**	−0.22701**	−0.23385**	−0.24273**
	(0.39 %)	(0.68 %)	(0.32 %)	(0.38 %)
Downward additions dummy	−0.05571	−0.08106	−0.05700	−0.06400
	(24.02 %)	(8.68 %)	(20.29 %)	(17.61 %)
Upward deletions dummy	0.31733***	0.33969***	0.3551***	0.30741***
	(<0.01 %)	(<0.01 %)	(<0.01 %)	(<0.01 %)
Upward additions dummy	0.07577	0.08997*	0.07061	0.05612
	(9.91 %)	(4.97 %)	(10.39 %)	(22.50 %)
Downward deletions dummy	−0.32104***	−0.33556***	−0.32601***	−0.36824***
	(<0.01 %)	(<0.01 %)	(<0.01 %)	(<0.01 %)
N	904	904	904	904
Adj R^2	17.5 %	17.7 %	26.2 %	17.7 %

The dependent variable is the market-adjusted CAR from ED − 30 to ED + 60. The FTSE SmallCap index is used as a proxy for the market return. ED is the effective day. Volume, ILLIQ, Spread, and Zeros are defined in Table 7. A1 is the variance of the error term from a regression of the stock's excess return on the market's excess return over the 180 trading day estimation period covering day ED − 210 to day ED − 31. MV is the stock's market value on day ED − 30. Two-tailed *p* values are shown in brackets below the estimated coefficients

***, **, and * indicate significance at the 0.1, 1, and 5 % level, respectively, using a two-tail test

A partial price reversal for downward deletions, which experience a significant decrease in the percentage of investment company share holdings, suggests additional support for the relation between price pressure and change in institutional ownership. In contrast, when a stock is moved from one index to another, and roughly similar amounts of money follow the indexes, then there should not be much price pressure for the stock. Consistent with the prediction of the price pressure hypothesis, other groups, which do not experience significant changes in institutional ownership, do not show significant price pressure.

Second, inclusion in the index is associated with decreases in liquidity for pure additions. This result is inconsistent with Madhavan (2003) and Becker-Blease and Paul (2010) who report improvements in liquidity for companies added to the Russell 2000 and S&P 600 indexes, respectively.

The declines in liquidity might be explained by the change in institutional ownership for pure additions following their inclusion in the FTSE SmallCap index. Pure additions are the only group that experiences a significant increase in the percentage of investment company holdings and a significant decline in the percentage of free float shares. As Singal (2004, p. 171) suggests, a decrease in the number of shares available for trading following a stock's addition to an index might negatively impact liquidity. A negative relation between index membership and liquidity is also supported by the significant increase in trading volume for pure deletions following their removal from the index.

Overall, the presented evidence supports the liquidity and price pressure hypotheses. We do not find support for other hypotheses offered in the literature, such as the downward-sloping demand curve, investor awareness, and information signaling hypotheses. Specifically, a transitory price gain for pure additions and insignificant *A1* coefficients in the regression analyses are not consistent with the downward-sloping demand curve hypothesis, which predicts a permanent price change and significant values for *A1* coefficients. A transitory price increase for pure additions and a permanent price decline for pure deletions are not consistent with the investor awareness hypothesis, which has opposite predictions (a permanent stock price increase for additions and a temporary decrease for deletions). In addition, contrary to the prediction of the investor awareness hypothesis, repeated additions and deletions experience a price reaction that is comparable to that of first-time additions and deletions. Finally, a transitory price increase for additions is not consistent with the information signaling hypothesis. Moreover, changes to the FTSE SmallCap index, which are predictable, are not expected to have information content to begin with.

6 Conclusion

Stocks added to (removed from) the small-cap Russell 2000 and S&P 600 indexes experience positive (negative) abnormal returns following the announcement. However, researchers disagree on whether these abnormal returns are permanent or temporary and offer competing explanations. We address this controversy by examining market reactions for firms that are added to or deleted from the FTSE SmallCap index.

Our main results are asymmetric price and liquidity responses between the firms that are shifted between FTSE indexes and the firms that are new to FTSE indexes. Firms promoted from a smaller-cap to a larger-cap FTSE index experience a permanent increase in stock price accompanied by improvements in liquidity. Similarly, firms demoted from a larger-cap to a smaller-cap FTSE index experience a permanent decrease in stock price accompanied by declines in liquidity. This evidence supports the liquidity hypothesis.

In contrast, firms added to the FTSE SmallCap index that were not previously in FTSE indexes experience a transitory stock price gain and declines in liquidity. A transitory stock price reaction and a significant increase in institutional ownership for pure additions are consistent with the predictions of the price pressure hypothesis. We explain the declines in liquidity for pure additions by documenting a decrease in the percentage of free float shares for these stocks.

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