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Strategic trading by index funds and liquidity provision around S&P 500 index additions

T. Clifton Green[a], Russell Jame[b,*]

[a]Goizueta Business School, Emory University, 1300 Clifton Road, Atlanta, GA 30322, USA
[b]School of Banking and Finance, University of New South Wales, Gate 2 High Street, Sydney, NSW 2052, Australia

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Abstract

We examine the trades of index funds and other institutions around S&P 500 index additions. We find index funds begin rebalancing their portfolios with the announcement of composition changes and do not fully establish their positions until weeks after the effective date. Trading away from the effective date is more prevalent for stocks with lower levels of liquidity and among large index funds, which is consistent with index funds accepting higher tracking error in order to reduce the price impact of their trades. Small and mid-cap funds provide liquidity to index funds around additions, and added stocks with a greater proportion of these natural liquidity providers experience lower inclusion returns.

JEL classification: G14

Keywords: S&P 500 index additions; Index funds; Tracking error; Price pressure; Strategic trading

0. Introduction

Index composition changes have a substantial impact on stock prices. For example, stocks newly added to the S&P 500 rise 7.35% on average between announcement and the effective date. Several explanations have been offered for this phenomenon. Shleifer (1986) argues that index composition changes are information-free and suggests the price response reflects downward-sloping demand curves for stocks. Investors require beneficial prices to trade with passive index funds due to the lack of close investment substitutes. Harris and Gurel (1986) make a similar argument but suggest the effect is

*Corresponding author.
E-mail addresses: clifton_green@bus.emory.edu (T.C. Green), r.jame@unsw.edu.au (R. Jame).

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temporary. Short-run liquidity constraints lead to price pressure, which they find largely reverses in the weeks following the index change.[1]

In this article, we study the strategic response of index funds to the anticipated price pressure associated with S&P 500 index additions. The optimal trading strategy depends on how index funds weigh the benefits of higher expected returns from trading away from the effective date with the costs of greater expected tracking error. The prevailing view holds that index funds adjust their portfolios on the effective date. Beneish and Whaley (1996) suggest indexers can enhance returns by trading during the announcement period, yet Blume and Edelen (2004) find the tracking errors associated with trading early are high relative to those observed in practice. On the other hand, Elton, Gruber, and Busse (2004) find no relation between tracking error and investor flows into index funds, which suggests investors may support trading strategically around composition changes.

We analyze holdings and transaction level data from index funds and other institutions around S&P 500 index composition changes. Our analysis of 145 index changes reveals a number of new and interesting results. We find index funds do trade strategically around index changes. Indexers tend to trade newly added stocks beginning with the announcement of the composition change, and they do not fully establish their positions until weeks after the effective date. For example, of the $214 million traded on average by our sample of index funds in the period between the announcement and 5 days after the effective date, we find roughly 50% takes place before or after the effective date.

Empirically, the decision to trade strategically around the effective date is largely driven by fund characteristics. We find large index funds that demand the most liquidity are more likely to trade before and after the effective date. Moreover, once a fund instigates a plan to break up trades around the effective date, it tends to continue the practice at future composition changes. At the stock level, we find that index funds are more likely to trade illiquid stocks before the effective date. After controlling for liquidity, index funds are more likely to trade larger stocks early, which is consistent with their larger role in the index. All the observed patterns are consistent with index funds responding to price pressure associated with index changes.

Demand from index funds for newly added stocks is primarily accommodated by other institutional investors. In particular, small- and mid-cap funds provide roughly 70% of the shares bought by index mutual funds in the quarter around inclusion. The result is consistent with included stocks previously experiencing a period of strong performance, which increases their size and makes them less attractive to funds that emphasize small stocks. We further document that stocks with a larger fraction of shares held by natural liquidity providers experience significantly smaller inclusion price effects. For example, a one standard deviation change in the percentage held by small- and mid-cap funds leads to a 2.99% smaller return from the announcement to the effective date.

Strategic trading by index funds around composition changes has a beneficial impact on performance. Trading strategically before or after the effective date, rather than at the closing price on the effective date, produces incremental dollar profits of roughly $500 million for funds in our sample. Using transaction-weighted average purchase and sales

[1]Work that supports either short- or long-term downward sloping demand curves includes Beneish and Whaley (1996), Lynch and Mendenhall (1997), Kaul, Mehrotra, and Morck (2000), Wurgler and Zhuravskaya (2002), and Greenwood (2005). Other work considers potential changes to firm fundamentals following composition changes (e.g., Denis, McConnell, Ovtchinnikov, and Yu, 2003).

prices to measure returns, we also consider the effects of strategic trading on portfolio returns. Based on the annual number of index changes and the weights of the newly added stocks, we find that trading on the day following announcement would improve portfolio performance by roughly 10 basis points per year. The strategy is not riskless, however. It would have produced losses in one of the sample years, and the strategy has a standard deviation of 11 basis points across years.

Scaling the incremental portfolio return from trading at various dates around the effective date by the incremental risk, we find the information ratio is maximized on the effective date, which may explain why roughly half of index fund trading takes place on the effective date. On the other hand, Elton, Gruber, and Busse (2004) find that index fund flows are significantly related to performance but are unrelated to tracking error volatility. Thus, if a fund manager is interested in maximizing assets under management, our evidence suggests the optimal strategy is to trade strategically around the effective date and specifically on the date following the announcement.

The remainder rest of the paper is organized as follows: Section 1 describes the sample, presents evidence on stock returns following S&P composition changes, and discusses potential explanations. Section 2 examines index fund trading around index composition changes and investigates how variation in liquidity across stocks influences price pressure. Section 3 considers the performance implications of strategic trading, and Section 4 concludes.

1. Data and descriptive statistics

1.1. Transaction data

Institutional transaction data are obtained from the Abel Noser Corporation, a consulting firm that helps institutional investors track and evaluate their transaction costs.[2] Each observation in the dataset corresponds to an executed trade. For each trade, the dataset reports the date of the trade, the stock traded, the volume traded, the execution price of the trade, a client identifier code, and a manager identifier code. The client identifier code corresponds to the institutional investor that is subscribing to the Abel Noser services. Clients include both pension plan sponsors (e.g., CalPERS and the YMCA Retirement Fund), as well as money managers (e.g., Fidelity and Vanguard). The money manager code corresponds to either external fund managers hired by the plan sponsor or different portfolio managers within the firm.

The dataset captures all the trades for a portfolio manager in any given month, which allows us to infer which funds are S&P 500 index funds from the funds' trading behavior. We identify index funds by searching for portfolio managers that trade over 450 S&P 500 stocks in a month and also trade no more than 5% of stocks that were not members of the S&P 500. Portfolio managers that meet the criteria for a particular month are flagged as potential index funds. We then analyze the time series behavior of the portfolio manager. If a manager's trades involve S&P 500 stocks over 95% of the time throughout the entire time series, then that portfolio manager is classified as an index fund.[3]

[2]Other studies that have used Abel Noser data include Lipson and Puckett (2007), Goldstein, Irvine, Kandel, and Wiener (2009), Chemmanur, He, and Hu (2009), Hu (2009), and Puckett and Yan (forthcoming).

[3]One concern is that our criteria may include "enhanced" index funds that target the index but try to improve performance through active investing. In practice, it is rare for active index funds to hold over 450 index stocks. Of the 21 enhanced index funds listed in Morningstar, only three specialty funds held enough S&P 500 stocks to meet our criteria.

Table 1 provides summary statistics for the Abel Noser data. The sample begins January 1, 1999 and ends December 31, 2005. We were able to identify 56 S&P 500 index funds and 2,562 other fund managers. On an average day, the non-index fund managers make over 50,000 trades and trade over 420 million shares, representing approximately $127 billion worth of stock. Index funds account for nearly 2.7 million shares and over $100 million in volume per day.

Table 1
Summary statistics.

Panel A shows descriptive statistics for the sample of institutional transaction data from Abel Noser Corporation. Panel B shows descriptive statistics for the sample of institutional holdings data from Thomson Financial. Mutual fund holdings data are taken from the S12 files and merged with the CRSP Mutual Fund Database to obtain Lipper investment objectives for each fund. The broader set of institutional holdings data and information on investor type is taken from the S34 files. Both data sets cover 1999 through 2005.

Panel A: Summary statistics for transaction data

Investor type	Number	Ave. daily number of trades	Ave. daily share volume (millions)	Ave. daily dollar volume ($millions)	Ave. share volume per trade	Ave. dollar volume per trade
Index funds	56	480	2.69	105.84	5,624	220,557
Institutional investors	2,562	52,466	420.01	127,000.00	7,992	241,734

Panel B: Summary statistics for holdings data

Investor type	Number	Aggregate TNA ($billions)	Total stocks held	Average % of stock held	Average % of stock traded	Average % of stock bought
Mutual fund types (S12)						
S&P index funds	60	210.38	573	1.84	0.20	0.02
Mid-cap funds	220	152.25	4352	1.31	0.70	0.10
Small cap funds	359	196.02	5114	5.14	1.90	0.28
Growth	632	739.19	4652	1.92	1.06	0.02
Growth & income	342	607.72	4721	1.40	0.63	−0.02
Balanced	138	164.86	3650	0.43	0.25	−0.01
Capital appreciation	128	167.10	2604	1.41	0.67	0.05
Other	1138	942.38	5509	3.09	1.76	0.17
Institution types (S34)						
Banks	126	1,641.71	6,561	5.36	1.78	0.30
Insurance companies	55	607.88	5014	2.60	0.90	0.03
Investment companies	78	2,623.90	5873	11.19	3.72	0.26
Independent advisors	937	2,756.81	6,883	21.60	8.00	−0.44
Other	74	467.57	4,357	2.83	0.79	0.08

We also obtain quarterly holdings from Thomson Financial for all institutional investors with greater than $100 million dollars in total assets. We collect data on the quarterly holdings of institutional investors from the S34 files. These institutions include banks, insurance companies, investment companies, independent advisors, and others (such as internally managed pension funds, foundations, and endowments). In addition, we obtain holdings data for mutual funds at the fund manager level (from the S12 files). We merge the S12 files with the CRSP Mutual Fund database to obtain information about each mutual fund's Lipper investment objective. Using these investment objectives, we sort mutual funds into the following eight groups: S&P index, mid-cap, small-cap, growth, growth & income, balanced, capital appreciation, and other (sector oriented funds, global funds, and specialty funds).

Table 1 also provides summary statistics for the Thomson Financial data. In an average quarter, we are able to obtain holdings data for 60 S&P 500 index funds. Collectively, index funds manage $200 billion in assets and hold 1.84% of an average stock's total shares outstanding. Index funds demand roughly 0.02% of a stock's shares outstanding per quarter, suggesting that index funds grew during our sample period. Growth, growth and income, and "other" are the three largest investment objectives, each with over $600 billion in total assets. In the S34 data, independent advisors are the most numerous in the sample. There are 937 independent advisors compared to 78 investment companies (mutual fund families), although as a group they are similar in size with both managing nearly $3 trillion dollars in total assets.

1.2. S&P 500 Index composition changes

Composition changes to the S&P 500 Index are usually instigated by the need to remove a firm. Stocks may be deleted from the index because they represent an industry that is declining in importance, or if the stock itself is no longer representative of an important industry. Stocks may also be deleted for event-driven reasons such as mergers or bankruptcies. Additions are typically announced along with deletions to maintain 500 stocks in the index. In selecting which stock to add, Standard and Poor's considers the firm's industry, along with firm-specific characteristics such as size, liquidity, and operating performance.

The initial data on S&P 500 Index composition changes are obtained from Jeff Wurgler's website,[4] and we update it with information from Standard and Poor's and Dow Jones Newswire. In recent years, Standard and Poor's has sought to announce composition changes several days before they become effective. In our sample, the mean (median) number of trading days between the announcement and effective dates is 5 (4). There is variation, however, with some added stocks becoming effective on the announcement date and others with over 20 days between announcement and effective dates.

We collect data on 306 index additions from 1999 to 2005. We first eliminate 11 name changes that do not require trading. Next, since we are interested in index fund trading prior to the effective date, we eliminate 34 index changes where the difference between the announcement date and effective date is one day or less. As in Chen, Noronha, and Singal (2004), we also require return data in CRSP for at least 60 trading days before the event

[4] http://pages.stern.nyu.edu/~jwurgler/.

and 90 trading days after the event, which helps eliminate changes that do not require trading such as mergers and acquisitions. This leaves us with 145 additions.

1.3. Stock returns following index composition changes

We begin with an examination of abnormal stock returns around S&P 500 Index composition changes. We compute abnormal returns by placing each added stock into one of six benchmark portfolios based on size and book-to-market.[5] The abnormal returns for an added stock is computed as the buy and hold raw return of the added stock less the buy and hold value-weighted return of its corresponding size and book to market portfolio.

We find that added stocks earn large abnormal returns of 3.92% (t-stat = 11.86%) on the announcement date. Added stocks also earn abnormal returns of 2.76% (t-stat = 3.57) between the announcement and effective date. As suggested by Beneish and Whaley (1996), the gradual price response is consistent with risk arbitragers buying added stocks between the announcement and effective date in order to profitably reverse their position on the effective date when index funds demand liquidity.[6] On the effective date, added stocks continue to increase by another 0.76% (t-stat = 1.68). Lastly, we find that additions experience partial price reversals after the effective date. In the 20 days after the effective date, added stocks earn abnormal returns of −2.27% (t-stat = −2.21). The gradual price increase prior to the effective date and the reversal following inclusion suggests index funds may benefit from trading strategically.

2. Institutional trading around S&P 500 Index additions

2.1. Evidence from transaction data

The natural rebalancing strategy for index funds following composition changes is to buy added stocks and sell deleted stocks on the effective date near the closing price. This allows funds to closely track the index but likely produces high transactions costs due to price pressure. Inducing investors to provide the liquidity necessary to rebalance their portfolios on the effective date likely requires index funds to trade at inferior prices. The return patterns documented in Section 1 suggest that trading away from the effective date may reduce the price impact of trading and improve investment performance. How do index funds respond to this tradeoff between tracking error and price impact? Beneish and Whaley (1996) and Lynch and Mendenhall (1997) find evidence of increased trading volume between the announcement and effective dates, yet this could be driven by hedge funds and other arbitrageurs seeking to profit by the effective date response. In contrast, we examine the specific trades of index funds to investigate whether they are willing to accept tracking error in an attempt to mitigate the effects of price pressure.

[5]We measure market capitalization as measured on the day prior to the announcement date and compare it to the corresponding monthly NYSE breakpoints. Stocks above (below) the median breakpoint are classified as large (small). Book-to-market ratio is calculated using data from Compustat for the fiscal year prior to the composition change and compared to yearly NYSE breakpoints. Stocks in the lowest (highest) three deciles are considered growth (value), and stocks in the middle four deciles are considered neutral. Data on decile breakpoints and the six benchmark portfolios is obtained from Ken French's website.

[6]Aside from potentially revealing fundamental information, the announcement date response itself may reflect the anticipated trading from price insensitive investors.

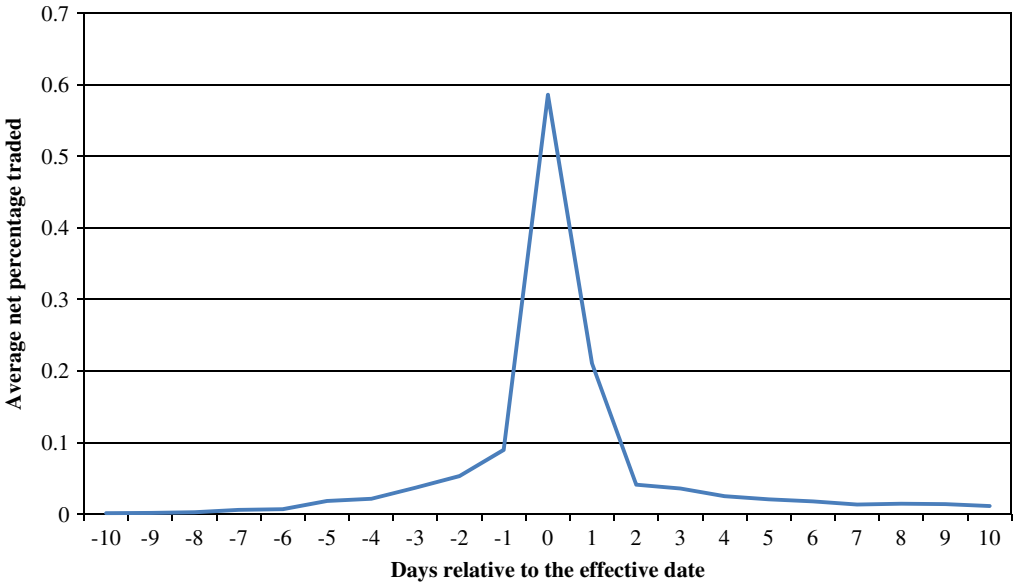

Fig. 1. Index fund trading around changes to the S&P 500 index. The figure shows the average index fund net trading around the 145 additions in the sample from 1999 to 2005. The horizontal axis depicts the event day, where day 0 is the effective date. The vertical axis is net share volume by index funds in the included stock scaled by shares outstanding. The transaction data is from Abel Noser Corporation.

Fig. 1 plots the average percentage net trading of index funds for the 145 additions in our sample. For each stock, percentage net trading is computed as the net share volume traded in a stock scaled by the stock's shares outstanding. Consistent with an emphasis on minimizing tracking error, index funds trade significant amounts of stock on the effective date. The index funds in our sample trade roughly 0.60% of a stock's market capitalization on the effective date. The average market capitalization of added stock in the sample is roughly $13.3 billion. Thus the index funds in the sample buy roughly $80 million of added stocks on the effective date.

Fig. 1 also provides evidence that index funds trade around the effective data in an attempt to mitigate transaction costs. The plot reveals a gradual increase in net trading of added stocks from days −5 to −1, which suggests that index funds are buying added stocks before the effective date. Similarly, the gradual decline from day 1 through day 5 indicates that funds continue to buy added stock after the effective date. The results in Fig. 1 provide evidence that some index funds do trade around the effective date in an attempt to mitigate transaction costs.

Table 2 provides more detailed results. The analysis splits trading into three periods: between the announcement date and effective date, the effective date, and 1–5 days after the effective date.[7] The table reports the percentage net trading (multiplied by 100) for both index funds and all other institutional investors in our sample. The table shows that

[7]The number of days between announcement and effective date varies. Thus, the periods in Table 3 do not correspond to specific days in Fig. 1.

Table 2
Trading of index funds and other institutions around index additions.
The table presents the fraction of shares outstanding bought or sold by index funds and by other institutions (in percent*100). The mean (median) represents the average (median) net percentage traded across all included stocks. The standard error of the mean and the *p*-values from signed rank tests are reported in parentheses. The transaction sample is from Abel Noser and spans 1999–2005.

	Sample size	Announcement to effective date −1	Effective date	5 days after effective date
Index funds				
Mean	145	24.43	58.61	33.42
Std. error		(2.72)	(4.18)	(3.29)
Median		12.44	52.40	17.23
Sign *p*-value		(<0.01)	(<0.01)	(<0.01)
Institutions				
Mean	145	−26.59	−24.77	−32.86
Std. error		(7.05)	(5.34)	(6.45)
Median		−11.24	−8.10	−12.07
Sign *p*-value		(<0.01)	(<0.01)	(<0.01)

index funds are substantial net buyers of added stocks before the effective date. Index funds in the sample buy 0.24% of an added stock before the effective date, which corresponds to roughly one-third of all trading between the announcement date and effective date. The last column reveals that index funds are significant net buyers of added stocks after the effective date as well (0.33%). Together, roughly 50% of the purchases of added stocks made by index funds between the announcement and 5 days after the effective date take place either before or after the effective date.

One concern is that index funds purchasing added stocks after the effective date may reflect new investor flows into the fund rather than a delayed response to the event. We address this issue by comparing index fund purchases to a benchmark stock. We measure trading as a percentage of shares outstanding, thus any index stock could serve as a benchmark. We select the next largest stock in the index to help control for the stock's prominence in the index, which may be relevant for tracking error. If a fund receives inflows, then to match the index they should trade the same percentage of the added stock as the benchmark stock.

Table 3 presents the net trading of added stocks, the net trading of the benchmark stock, and the difference in net trading. We extend the analysis to 120 trading days after the effective date to examine the length of time necessary for index funds to fully establish their position in the added stock. The table shows the delayed buying documented in Table 3 is not driven by fund flows. Controlling for fund flows over the 5-day period after the effective date actually increases average net buying (from 0.586% to 0.587%). Table 3 also reveals that abnormal buying extends well past five trading days after the effective date. Net buying is still highly significant after 16–30 trading days and even 31–60 trading days after the effective date, which implies some index funds wait more than 6 weeks to fully rebalance their portfolios following index changes. The results from Fig. 1 and Tables 2 and 3 provide convincing evidence that index funds trade strategically around the effective date to reduce the effects of price pressure.

Table 3
Index fund trading of newly added stocks following index changes.
The table reports the total net order flow across index funds for newly added stocks to the S&P 500 index (in percent of shares outstanding*100). The table also reports total net order flow for a benchmark stock, which is chosen as the next largest stock in the index. The difference is the incremental trading in the newly added stock over the benchmark. The transaction sample is from Abel Noser and covers 1999–2005.

Period	Added stock	*t*-stat	Benchmark	*t*-stat	Difference	*t*-stat
Ann. date to effective date	24.43	8.97	0.19	2.35	24.23	8.90
Effective date	58.61	14.10	−0.01	−0.01	58.62	14.09
1–5 days post eff. date	33.42	10.15	0.18	−0.14	33.23	10.09
6–15 days post eff. Date	11.18	8.83	0.23	3.14	10.94	8.51
16–30 days post eff. date	4.56	5.94	0.01	0.08	4.55	5.87
31–60 days post eff. date	3.55	5.70	0.48	2.89	3.07	4.78
61–120 days post eff. date	1.35	3.17	1.03	5.93	0.32	0.71

2.2. Evidence from quarterly holdings

The results from Table 2 reveal that other institutions are significant net sellers of added stocks both between the announcement date and effective date and on the effective date. To get a better sense for who is providing liquidity to index funds, we use data from Thomson Financial to examine changes in the quarterly holdings of mutual funds around index additions. For each mutual fund (j) and each added stock (i), net trading is defined as

$$\frac{Shares\_Held_{j,i,t}}{Shares\ Outstanding_{j,i,t}} - \frac{Shares\_Held_{j,i,t-1}}{Shares\ Outstanding_{j,i,t-1}},$$

where t ($t-1$) refers to the report date directly after (prior) to the effective date. We then sort mutual funds into one of eight groups based on their Lipper investment objective. We sum net trading across all mutual funds in a given investment objective to assess the aggregate demand by each investment objective.

During the sample period, the mutual fund industry grew rapidly. For example, the percentage of total equity held by mutual funds increased from 24.7% in 1999 to 28.8% in 2005 (French, 2008). As a result, mutual funds will be net buyers of all stocks during the sample on average. To examine whether mutual fund demand for added stocks is above and beyond their demand for a typical (i.e., non-added) stock, we also compute a flow-adjusted measure of net trading. For each mutual fund, flow-adjusted net trading is computed as the net trading in added stock i less the average net trading across all other stocks traded during the same period. For each index addition, we sum this measure across all mutual funds in a given investment objective.

Table 4 presents the average net trading and flow-adjusted net trading for mutual funds with various investment objectives. As expected, S&P index funds are significant net buyers of added stocks. On average, S&P 500 index mutual funds demand about 1.65% of a stock's total shares outstanding in the quarter of the effective date.[8] Mid-cap and small-cap

[8]We are not able to observe non-mutual index funds, such as pension index funds and bank index funds, which understates the true magnitude of the total demand shock from all index funds.

Table 4
Changes in institutional holdings around index additions.

The table reports the fraction of shares bought or sold by different types of institutional investors around index additions (in percent*100). For each added stock, net trading is computed as the difference in the number of shares held by a fund at the report date immediately after the effective date less the number of shares held by a fund in the report date immediately prior to the effective date, scaled by total shares outstanding. Flow-adjusted net trading is the net trading for the added stock less the average net trading across all other stocks traded by the fund. In Panel A, net trading and flow-adjusted net trading are aggregated across all mutual funds with the same Lipper objective code (as reported in the CRSP Mutual Fund database). In Panel B, net trading and flow-adjusted net trading are aggregated across all institutional investors of similar types (as reported in Thomson Financial). The table reports the average net trading and flow-adjusted net trading for the 145 index additions in our sample from 1999 to 2005. Mutual fund holdings are obtained from the Thomson Financial S12 files; institutional holdings are obtained from the Thomson Financial S34 files.

	Net trading	*t*-stat	Flow-adjusted net trading	*t*-stat
Panel A: Mutual funds (S12)				
S&P index funds	1.65	40.72	1.62	39.46
Mid-cap funds	−0.85	−7.80	−0.98	−8.72
Small cap funds	−0.27	−4.48	−0.44	−7.10
Growth	0.03	0.18	−0.09	−0.56
Growth and income	0.14	1.83	0.16	2.10
Balanced	−0.02	−0.74	−0.03	−1.35
Capital appreciation	−0.04	−0.43	−0.08	−0.98
Other	−0.14	−1.58	−0.31	−3.48
All mutual funds	0.52	2.11	−0.12	−0.50
Panel B: Institutional investors (S34)				
Banks	1.80	11.65	1.49	9.54
Insurance companies	0.07	0.64	0.07	0.65
Investment companies	0.58	2.13	0.43	1.57
Independent advisors	0.17	0.74	0.61	1.00
Other	−0.22	−2.81	−0.26	−3.30
All institutions	2.40	2.41	2.34	2.46

funds are significant net sellers of added stocks. Mid-cap and small-cap funds sell roughly 1.12% of added stocks' shares outstanding, suggesting that these funds provide a large portion of the necessary liquidity demanded by S&P 500 index funds. Moreover, in unreported results we find that over 40% of mid-cap and small-cap funds always sell recently added stock, which suggests that some mid-cap and small-cap funds act as dedicated liquidity providers. The other investment objectives neither demand nor provide significant amounts of liquidity around index changes. In aggregate, mutual funds are significant net buyers of added stocks during the effective date quarter. However, the flow-adjusted demand is not significantly different from zero, suggesting that aggregate mutual fund demand for added stocks is similar to their demand for other non-added stocks during the sample period.

We also look at the S34 files to examine the trading of all institutional investors around the effective date. Unfortunately, the S34 files report fund holdings at the fund family level and therefore we are not able to separate out the trades of index funds. Instead, we report the aggregate net trading and flow-adjusted net trading for the following groups of institutional investors: banks, insurance companies, investment companies (primarily

mutual fund families), independent advisors, and other (such as internally managed pension funds, foundations, and endowments).[9]

Panel B of Table 4 reveals that banks are significant buyers of recently added stocks. Their average demand of 1.8% is more than triple the size of net mutual fund demand, which is consistent with Del Guercio (1996), who finds that banks tend to tilt their portfolio towards stocks in the S&P 500, whereas mutual funds do not. Insurance companies and independent advisors neither demand nor supply liquidity around index changes. Not surprisingly, our results for investment companies are similar to our mutual fund findings (from Panel A). In aggregate, investment companies demand roughly 0.5% of an added stock's shares outstanding. Other institutional investors are significant suppliers of liquidity around index additions. However, the magnitude of their net selling is relatively small compared to the net buying of banks and investment companies. As a result, institutional investors, in aggregate, are net buyers of 2.4% of an added stock's shares outstanding. Controlling for fund flows does not significantly reduce this effect. Since the overwhelming majority of institutional investor holdings are reported in the S34 files, our results are consistent with the view that retail investors provide significant liquidity to institutional investors around index changes (e.g., Kaniel, Saar, and Titman, 2008).

2.3. The supply of liquidity and inclusion returns

In this section, we examine whether the presence of natural liquidity providers, such as small-cap and mid-cap funds, mitigate the price pressure associated with index fund trading. Our primary proxy for the supply of liquidity is the percentage of a stock's shares outstanding held by small and mid-cap funds in the quarter prior to the effective date, which we denote *LS*. An additional proxy the supply of liquidity is *size*, which we measure as the market capitalization of the added stock on the day prior to the announcement date. Retail investors tend to tilt their holdings towards smaller stocks, suggesting that *size* might correlate negatively with a retail investor's ability to provide liquidity. In addition, *size* is negatively correlated with *LS* ($\rho = -0.28$), indicating that small and mid-cap funds are also able to provide more liquidity for smaller added stocks.

To investigate whether cross-sectional variation in the supply of liquidity is related to abnormal returns around index additions, we regress inclusion returns on our proxies for the supply of liquidity (*LS* and *size*), as well as additional control variables. We measure inclusion returns at three horizons: the announcement date, the effective date, and from the announcement date through the effective date (inclusive). The magnitude of inclusion returns should be related to both the slope of the demand curve and the size of the demand shock. Wurgler and Zhuravskaya (2002) show that the slope of the demand curve is related to the level of arbitrage risk, which they argue proxies for the availability of close substitutes for a given stock.

Following Wurgler and Zhuravskaya (2002), we estimate *arbitrage risk* as the root mean squared error from a market model regression using daily data over the 270 to 20 days prior to the announcement. In addition to *arbitrage risk*, illiquid stocks may also have

[9]The variable that distinguishes between different types of institutional investors is not reliable from 1998 and beyond. To circumvent this problem, we use the type code variable for each fund family from the last quarter of 1997. Any fund family that was included in the dataset after the last quarter of 1997 is not included in the analysis.

steeper demand curves (at least in the short run). We estimate *illiquidity* as in Amihud (2002) using the 21 trading days prior to the announcement date. Lastly, to estimate the size of the demand shock (*LD*), we measure the total percentage of shares outstanding held by index funds for all stocks currently included in the S&P 500. We reduce the effects of outliers by using the percentage held for the median stock as our estimate for *LD*. S*ize*, *LS,* and *LD* are transformed using natural logs to reduce skewness. Finally, all independent variables are standardized to have zero mean and unit variance to facilitate direct comparisons of the coefficients.

Panel A of Table 5 first presents the univariate relation between inclusion returns and our proxies for the supply of liquidity. Our measure of liquidity supply is strongly negatively related to effective date returns and *size* is positively related to effective date returns. Moreover, cumulative abnormal returns measured from the announcement date through the effective date are strongly significantly related to *size*. Neither *LS* nor *size* are

Table 5
The supply of liquidity and inclusion returns.

This table presents the results of regression on inclusion returns on proxies for the supply of liquidity and additional control variables. Inclusion returns are measured over three different horizons: Announcement (Effective) Date Return is the abnormal returns on the announcement (effective) date, and Announcement to Effective Date return is the abnormal return from the announcement date through the effective date (inclusive). Abnormal returns are computed as the return of the added stock less the return on a matching portfolio based on size and book-to-market. *Arbitrage risk* is the root mean squared error from a market model regression 250 to 20 days prior to announcement. *Illiquidity* is Amihud's (2002) measure of illiquidity for the added stock measured one month prior to the announcement date. *Liquidity Demand* (*LD*) is the percentage of shares outstanding held by index funds for the median sized stock in the S&P 500 computed using the holdings report date immediately prior to the effective date. *Liquidity Supply* (*LS*) is the percentage of an added stock's shares outstanding held by small- and mid-cap funds in the report date immediately prior to effective date. Size is the market capitalization of the added stock on the day prior to the announcement. *LD*, *LS*, and *Size* are expressed in natural logarithms. All independent variables are standardized to have zero mean and unit variance. Heteroscedasticity robust *t*-statistics are in parentheses.

	Announcement date return		Effective date return		Announcement to effective date return	
Panel A: Univariate analysis						
Liq. supply (*LS*)	−0.19		−0.93		−0.98	
	(−0.56)		(−2.25)		(−0.97)	
Size		−0.04		1.16		3.05
		(−0.12)		(2.78)		(3.03)
Adjusted R^2	−0.48%	−0.70%	2.75%	4.5%	−0.04%	5.49%
Panel B: Multivariate analysis						
Arbitrage risk	1.23	1.04	1.17	0.62	4.67	3.53
	(3.68)	(3.21)	(2.73)	(1.45)	(4.59)	(3.56)
Illiquidity	1.19	1.47	−0.95	−0.34	−1.07	0.50
	(3.67)	(4.08)	(−2.27)	(−0.72)	(−1.08)	(0.45)
Liq. demand (*LD*)	0.34	0.21	0.28	−0.07	1.34	0.60
	(1.06)	(0.68)	(0.69)	(−0.16)	(1.37)	(0.62)
Liq. Supply (*LS*)	−0.49		−1.59		−2.99	
	(−1.40)		(−3.55)		(−2.80)	
Size		0.48		0.90		2.68
		(1.32)		(1.84)		(2.37)
Adjusted R^2	13.76%	13.62%	10.31%	4.37%	13.44%	11.99%

significantly related to announcement returns, which suggests the market may not anticipate the mitigating effect that natural liquidity suppliers have on price pressure of index fund trades.

Panel B of Table 5 reports the results of the multivariate regressions. Consistent with Wurgler and Zhuravskaya (2002), we find that *arbitrage risk* is strongly related to inclusion returns. *Illiquidity* is also strongly related to announcement date returns, but this relationship appears to reverse after the announcement date. Our measure of index fund liquidity demanded (*LD*) is positively related to inclusion returns but none of the coefficients are reliably different from zero. Most interestingly, our proxies for liquidity supplied (*LS*) remain highly related to effective date returns. In addition, cumulative abnormal returns measured from the announcement date through the effective date are strongly related to both *LS* and *size*. Specifically, a one standard deviation increase in *LS* corresponds to a 2.99% reduction in the returns for an added stock from the announcement date through the effective date. The results suggest that the presence of natural liquidity providers can alleviate some of the price pressure around index additions.

2.4. Determinants of strategic trading by index funds

The results from Table 2 suggest that roughly 50% of index fund trading occurs away from the effective date. In this section, we investigate the determinants of cross-sectional variation in strategic trading around composition changes. Specifically, we estimate logit regressions for strategic trading on a number of stock and fund characteristics. The dependent variable takes a value of 1 if the fund engages in pre- or post-event trading and 0 otherwise. Pre-event trading is defined as trading between the announcement and effective date, and post-event trading is defined as having abnormal net buying one to five trading days after the effective date.

We consider three fund-specific independent variables: *Fund Volume*, *Trade Size*, and *Lagged Strategic Trading*. *Fund Volume* is a proxy for the size of the fund and is measured as the total dollar volume for all stocks traded by the fund in the 21 trading days prior to the index change. After controlling for total volume, *Trade Size*, measured as the average dollar volume during the 21 days before the event, measures the fund's propensity to break up trades into smaller amounts to mitigate price pressure, which may reflect a greater emphasis on reducing transaction costs. Finally, we include a dummy variable, *Lagged Strategic Trading*, which equals 1 if the index fund has traded strategically for previous composition changes and 0 otherwise. This variable allows us to examine whether certain funds persistently engage in strategic trading.

In addition to fund characteristics, we analyze several stock characteristics defined in Section 2.3. We conjecture that price pressure may be a greater concern for less liquid stock and include *illiquidity*. Similarly, we include *arbitrage risk* to explore whether the slope of the demand curve influences index fund trading. We include an NYSE dummy variable to control for the fact that specialist markets may be better than dealer markets at mitigating the price effects of a demand shock (Elliott and Warr, 2003). The results in Table 5 suggest that price pressure tends to be less severe for stocks with large amounts of natural liquidity providers, and as a result index funds may have less of an incentive to engage in strategic trading for these stocks. Conversely, if there is a large expected demand for the added stock, index funds may have a greater need to trade strategically. We include *LS* and *size* to proxy for the expected supply of liquidity and *LD* to proxy for the expected liquidity demand.

Table 6
Determinants of strategic trading around index additions.

The table reports the results from logit regressions on whether index funds trade strategically around index composition changes. Pre-Event trading is defined as trading between the announcement date and the effective date, and Post-Event trading is defined as abnormal purchases of the included stock 1–5 days after the effective date. The dependent variable is 1 if the fund traded pre- or post-event. *Lagged Strategic Trading* is a dummy variable equal to 1 if the index fund previously traded strategically in the past. *Fund Volume* is the sum and *Trade Size* is the average of the dollar volume of all trades made by the index fund in the month prior to the announcement date. *Liquidity Demand* (*LD*) is the percentage of shares outstanding held by index funds for the median sized stock in the S&P 500 computed as of the holdings report date immediately prior to the effective date. *Liquidity Supply* (*LS*) is the percentage of an added stock's shares outstanding held by small and mid-cap funds as of the report date immediately prior to effective date. *Size* is the market capitalization of the added stock on the day prior to the announcement. *LS*, *LD*, and *Size* are expressed in natural logarithms. *Iliquidity* is Amihud's (2002) measure of illiquidity measured one month prior to the announcement date. *Arbitrage risk* is the root mean squared error from a market model regression 250 to 20 days prior to announcement. *Z*-scores based on standard errors clustered by index fund are reported in parentheses. Marginal effects are evaluated at the mean of the independent variable.

Coefficients	Determinants of pre- and post-event trading		
Lagged strategic trading	1.13	1.08	
Z score	(4.61)	(4.38)	
Marginal effect	0.27	0.26	
Fund volume (*$B*)	2.62	2.56	
Z score	(5.31)	(−5.10)	
Marginal effect	0.65	0.64	
Trade size (*$M*)	−0.21	−0.20	
Z score	(−2.06)	(−1.98)	
Marginal effect	−0.05	−0.05	
Liquidity demand (*LD*)	0.29		0.25
Z score	(0.56)		(0.65)
Marginal effect	0.07		0.06
Liquidity supply (*LS*)	0.07		0.07
Z score	(1.65)		(1.67)
Marginal effect	0.02		0.02
Illiquidity (*$B*)	0.34		0.27
Z score	(3.23)		(2.76)
Marginal effect	0.08		0.07
Size	0.57		0.42
Z score	(5.64)		(3.64)
Marginal effect	0.14		0.10
NYSE listed	−0.23		−0.13
Z score	(−1.90)		(−1.37)
Marginal effect	−0.06		−0.03
Arbitrage risk	−6.82		−4.32
Z score	(−0.97)		(−0.78)
Marginal effect	−1.70		−1.07
Pseudo-*R*-squared	21.89	20.69	9.24

The logit regression results are presented in Table 6, where standard errors for the *Z*-scores are clustered by fund.[10] Unconditionally, of the 2,279 fund/addition observations,

[10]We include year dummies to capture any time trend. To conserve space, the coefficients on the intercept and year dummies are not reported in the table. However, the year dummies confirm the pattern of increasing strategic trading discussed in the previous section. Using 2002 as the omitted year, the year coefficients for 1999 through

44.67% involve strategic trading. The results in Table 6 indicate that fund characteristics help explain variation in strategic trading around index composition changes. Large funds are more likely to trade strategically. The coefficient on *Fund Volume* is positive and significant; interpreting the marginal effect at the average level of the independent variables suggests an additional $1 billion dollars of fund trading over the previous month increases its likelihood of trading strategically by 65%. After controlling for fund size, funds that trade in smaller average amounts are significantly more likely to trade strategically, which is consistent with a greater emphasis on reducing price pressure and a lower concern for tracking error. Also, funds that have previously traded strategically are significantly more likely (28%) to continue doing so. The results suggest certain funds emphasize minimizing tracking error while others consistently take actions to mitigate the price pressure associated with index changes.

At the stock level, funds are significantly more likely to trade illiquid stocks strategically. We also find that funds are more likely to trade large stocks early. Since large stocks tend to have fewer natural liquidity suppliers, this finding is consistent with the supply of liquidity influencing the trading behavior of index funds. This interpretation, however, is inconsistent with the positive coefficient on *LS*. However, when we exclude *size* from the regression, the coefficient on *LS* becomes negative and marginally significant (p-value = 0.08). There is little evidence that index fund trading is influenced by *arbitrage risk* or *LD*. Taken together, there is evidence that index funds respond to firm-specific variables, such as *illiquidity* and *size*. However, the majority of strategic trading is explained by fund-specific factors such as fund size. The regression on fund variables alone has a pseudo-R^2 of 20.69%, whereas for stock-specific variables the pseudo-R^2 is 9.25% (both specifications include year dummies).

3. The performance and tracking error implications of strategic trading

We next investigate how index funds' strategic trading impacts their investment performance. Specifically, we compare the actual returns earned by the index funds in our sample that trade strategically to the counterfactual returns that these funds would have earned if they traded entirely on the close on the effective date. In computing counterfactual returns, we assume that funds can buy the added stock at the close of the effective date without pushing prices further. In this way, our measure provides a lower bound of the price improvement to strategic trading.

More formally, for each trading day on or before the effective date, we compute abnormal returns as

$$\left[\frac{(CP_{ED}-XP_t)}{XP_t}-\frac{(SP_{ED}-SP_t)}{SP_t}\right], \tag{1}$$

where CP_{ED} is the closing price for the added stock on the effective date, and XP_t is the volume-weighted average purchase price for the index funds in our Abel Noser dataset that traded the added stock on event day t. Similarly, SP_{ED} and SP_t are the closing prices for

(*footnote continued*)
2005 are −0.27, −0.36, omitted, 0.39, 0.60, 1.62, and 1.66. The last two coefficients are statistically significant, with t-statistics of 3.63 and 3.99.

the S&P 500 Index on the effective date and event date t.[11] We adjust for S&P 500 price movements based on the assumption that index funds raise the capital needed to buy added stocks by reducing their positions in their other holdings.[12] To gain some intuition for this measure, consider an index fund that decides to buy an added stock one day prior to the effective date. To raise capital for this purchase, the index fund sells a portion of its S&P 500 holdings for \$100 (SP_t) and buys the added stock at \$50 (XP_t). If the index fund had waited until the close of the effective date, it could have sold the same portion of the S&P 500 for \$101 (SP_{ED}), but it would have had to pay \$52 (CP_{ED}) to purchase the added stock. In this example, the abnormal return to strategic trading would be 3%.

Similarly, for late trading, which we define as trading that occurs between one and 5 days after the effective date, we compute abnormal returns as

$$\left[\frac{(XP_t - CP_{ED})}{CP_{ED}} - \frac{(SP_t - SP_{ED})}{SP_{ED}}\right]. \tag{2}$$

We value weight the abnormal return on each event day by the total dollar volume traded on that day to create the aggregate abnormal return for early (or late) trading.

The results of the analysis are presented in Table 7. Equally weighting across each index addition, we find that index funds earn abnormal returns of 2.10% by trading before the effective date and 1.54% by trading after the effective date, both of which are statistically significant at the 1% level. Trading on the effective date (but not at the close of trading), earns index funds 0.22%.

In addition to this equally weighted approach, we also value weight each index addition by the percentage of total early (or late) trading that occurred in that stock. This approach gives more weight to index additions in which the magnitude of strategic trading was larger. Using this approach, we find that the actual dollar volume traded by index funds prior to the effective date was \$5.04 billion. However, if these funds had waited to purchase the stock at the closing price on the effective date, it would have cost \$5.38 billion to buy the same amount of shares. Thus, the index funds in our sample saved \$341 million by trading early, or \$2.34 million dollars per index change. Similarly, late trading resulted in an average price improvement of \$0.91 million per index change. The results indicate that strategic trading around composition changes can have a meaningful effect on fund performance.

Although many index funds trade in strategic ways around index composition changes, we still observe that roughly 50% of index fund trading volume occurs on the effective date. One potential explanation is that index funds are reluctant to trade away from the effective date due to the increased tracking error associated with such strategies. We investigate this issue by examining the tradeoffs between beneficial transaction prices and tracking error volatility. Specifically, we consider the returns and tracking error volatility associated with several possible trading strategies from the day after the announcement through 10 trading days after the effective date.

[11] Stocks prices are adjusted for various distributions (e.g., stock splits, dividends, etc.), so that comparisons can be made between event day and effective date prices.

[12] An alternative assumption would be to assume they raise the capital by selling the deleted stock. However, incorporating deletions is complicated by the fact that most deletions were the result of mergers, tender offers, bankruptcies, etc. Moreover, the typical deleted stock is significantly smaller than the typical added stock. This difference would be covered by index funds reducing their positions in other S&P 500 stocks.

Table 7
Performance implications of strategic trading by index funds around index additions.

The table reports the performance implications for index funds trading away from the closing price on the effective date for S&P 500 Index additions. Pre-Event trading is defined as transactions that take place between the announcement date and effective date. The Effective Date describes transactions that take place on the effective date prior to the close, and the Post-Event period is defined as 1–5 days after the effective date. Equal-weighted Percentage Savings is the average (across the 145 index additions) percentage difference between index funds' value-weighted transaction price and closing price on the effective date less the S&P 500 return over the same period. Actual Dollar Value Traded is the total amount traded by index funds in $Millions. Value Using Effective Date Closing Price is an implied cost under the assumption that index funds rebalanced their holdings entirely at the closing price on the effective date. Total Dollar Savings shows the aggregate savings from trading away from the closing price on effective date. Savings Per Index Change shows the (value weighted) average savings in $millions across the sample of 145 index changes.

	Event period		
	Pre-event	Effective date	Post-event
Equal-weighted percentage savings (%)	2.10	0.22	1.54
t-statistic	(3.22)	(1.65)	(4.11)
Actual dollar value traded ($M)	5,036	11,446	4,925
Value using effective date closing price	5,377	11,513	5,057
Total dollar savings	341	66	132
Average savings per index change ($M)	2.34	0.46	0.91
t-statistic	(2.18)	(1.71)	(3.40)

We compute abnormal returns associated with each trading strategy. For strategic trading before or on the effective date, abnormal returns are computed using Eq. (1); for trading after the effective date, abnormal returns are computed using Eq. (2).[13] We scale the abnormal returns for each index addition by its weight in the S&P 500, which is measured as the market capitalization of the added stock on the announcement date divided by the market capitalization of the S&P 500. This approach allows us to assess how strategic trading affects the overall fund performance. For example, if buying an added stock following the announcement date results in an abnormal return of 200 basis points, and the stock represents 1% of the total market capitalization of the S&P 500, then the transaction would contribute two basis points to the fund's aggregate abnormal return. Summing across each index change in a given year provides an estimate of the impact of strategic trading on total annual fund performance.

Fig. 2 plots the results. On average, index funds are able to enhance their annual performance by 10.5 basis points by trading the day after the announcement date. However, trading following the announcement does generate significant variation in returns. Across years, the variation in abnormal returns is 11.3 basis points. Dividing the return improvement by the tracking error volatility indicates that this strategy produces an information ratio of 0.93. Alternative investment strategies, such as trading the day before or the day after the effective date result in significantly lower outperformance (roughly 4 to 5 basis points) but also generally less tracking error volatility. Trading entirely on the

[13] In some cases, announcement date (+1) is equivalent to effective date ($-x$). For example, if there are 4 days between the announcement date and the effective date, then announcement (+1) is the same day as effective date (−3). In these cases, the effective date (−3) results exclude all funds where the difference between the announcement date and effective date was 4 days or less.

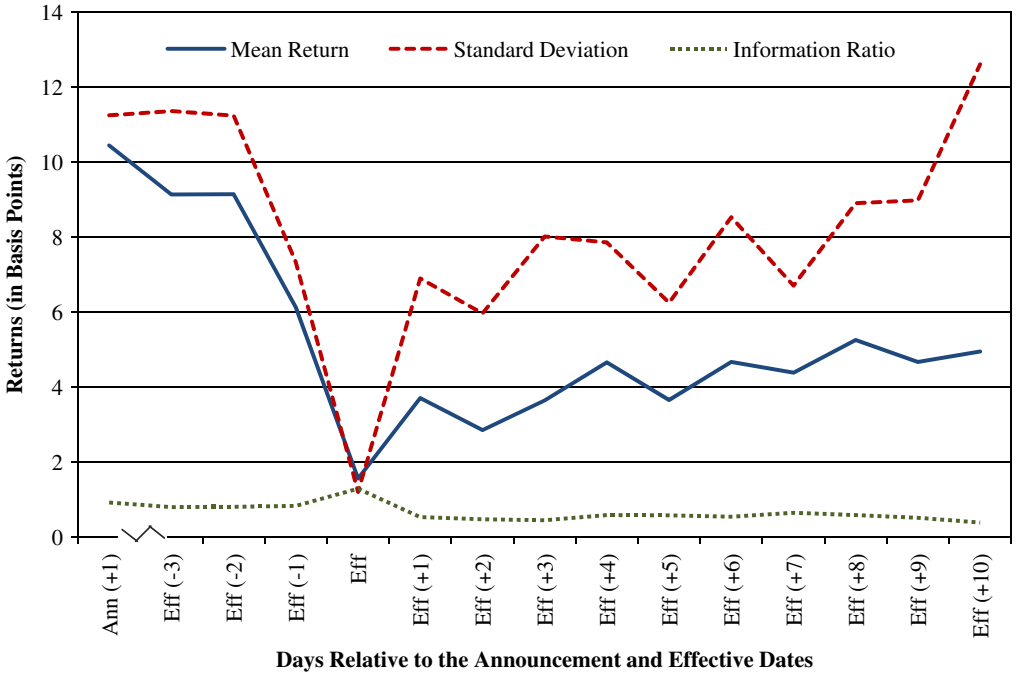

Fig. 2. Strategic trading around index composition changes and tracking error. The figure reports abnormal returns and tracking error volatility associated with trading on different dates around index inclusion. Returns are calculated using value-weighted purchase transaction prices and compared to the effective date closing price. Abnormal returns are measured by subtracting the return on the S&P 500 index. Each abnormal return is scaled by its weight in the S&P 500 index and summed across all index additions in a given year. Mean Return refers to the average abnormal returns across the 7 years in the sample (1999–2005). Standard Deviation is a measure of tracking error volatility and is the standard deviation of the yearly abnormal returns. The Information Ratio is a measure of risk-adjusted performance and is defined as the ratio of Mean Return divided by the Standard Deviation.

effective date but prior to the close generates the smallest abnormal returns of 1.6 basis points, yet the strategy also results in the smallest tracking error volatility and an information ratio of 1.30.[14]

The results suggest that the optimal trading strategy for index funds depends on how the fund weights the benefits of higher expected returns with the costs of greater tracking error. The information ratio (abnormal return over tracking error volatility) is maximized by trading on the effective date, which may explain why roughly half of index fund trading takes place on the effective date. On the other hand, Elton, Gruber, and Busse (2004) find that index fund flows are significantly related to performance but are unrelated to tracking error volatility. Thus, if a fund manager is interested in maximizing assets under management, our evidence suggests the optimal strategy is to trade strategically around the effective date and specifically on the date following the announcement.

[14]Information ratios in excess of one are rare. Goodwin (1998) analyzes 48 actively managed mutual funds benchmarked to the S&P 500 and finds that they have an average information ratio of 0.11 with a standard deviation of 0.37.

4. Conclusion

S&P 500 index composition changes have a large and partially temporary effect on the prices of added stocks, which suggests funds that track the index may be able to improve performance by trading strategically around composition changes. In this study, we examine transaction level data from index funds and investigate their willingness to accept tracking error in order to trade at more favorable prices. We find index funds purchase stocks beginning with the announcement of composition changes and do not fully establish their positions until weeks after the effective date. Intuitively, strategic trading is more evident among large funds and for large and illiquid stocks, which is consistent with a greater emphasis on price pressure.

We also document that the source of liquidity following index composition changes has important capital market implications. The types of stocks that are typically added to the index, specifically firms that have grown large through a period of strong performance, leads to the presence of natural liquidity providers such as small- and mid-cap funds. We find stocks with a larger fraction of shares held by small- and mid-cap mutual funds experience significantly smaller inclusion price effects.

Strategic trading by index funds can have a beneficial impact on performance. We use transaction prices to measure returns and find that funds trading on the day following announcement are able to improve portfolio performance by roughly 10 basis points per year. On the other hand, the strategy is not riskless and leads to tracking error for the fund. Scaling the incremental portfolio return for various trading strategies by the incremental risk, we find the information ratio is maximized on the effective date, which may explain why roughly half of index fund trading takes place on the effective date. However, given that fund flows are more sensitive to performance than tracking error (e.g., Elton, Gruber, and Busse, 2004), our evidence suggests the optimal strategy for managers interested in maximizing assets under management is to trade strategically around the effective date.

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