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Index Changes and Losses to Index Fund Investors

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Because of arbitrage around the time of index changes, investors in funds linked to the S&P 500 Index and the Russell 2000 Index lose between $1.0 billion and $2.1 billion a year for the two indices combined. The losses can be higher if benchmarked assets are considered, the pre-reconstitution period is lengthened, or involuntary deletions are taken into account. The losses are an unexpected consequence of the evaluation of index fund managers on the basis of tracking error. Minimization of tracking error, coupled with the predictability and/or pre-announcement of index changes, creates the opportunity for a wealth transfer from index fund investors to arbitrageurs.

When it comes to choosing your index, don't be too passive.

Oliver Ryan
"Does Your Fund's Index Measure Up?"

Modern portfolio theory suggests that holding a well-diversified portfolio of stocks dominates holding a few individual stocks. Because there are thousands of financial securities in the marketplace, however, transaction costs and the burden of monitoring these securities constrain investors from holding a well-diversified portfolio. The advent of the index mutual fund as an investment vehicle afforded investors the opportunity both to diversify at a reasonable cost and to transfer the monitoring function to professional fund managers. Index fund investors expect index fund managers to merely construct a portfolio that mirrors the return and risk of the index at the lowest possible cost. No stock-picking or timing ability is expected. Given that objective, a simple way to constrain the fund manager's propensity to take risk (and, at the same time, evaluate the performance of the fund) is to measure the fund's tracking error—the absolute difference between each month's index return and the fund return summed over the time frame in question.[1] Normally, for large pension fund sponsors, a tracking error in excess of 0.10 percent a year is unacceptable.

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Minimizing tracking error would be relatively simple if indexing firms did not periodically change the compositions of the indices.[2] Index changes become necessary when the status or ranking of a company changes because of such major corporate events as bankruptcy, liquidation, delisting, or merger. Index changes may also occur when a company ceases to meet the indexing firm's criteria for inclusion in the index. To help managers alter indexed portfolios concurrently with changes in the index, Standard & Poor's began in October 1989 to announce index changes before implementing them. Changes to the Frank Russell Company indices are also usually known in advance. The prevailing custom is that managers, to minimize tracking error, make changes to their indexed portfolios on the effective date of the change rather than on the day after announcement.

Although foreknowledge of changes may prepare fund managers, it also allows arbitrageurs to play a timing game. Realizing the constraints placed on indexers vis-à-vis tracking error, arbitrageurs buy the stocks to be added to the index when the addition is announced with the expectation of selling the stocks to indexers at a higher price on the effective date. Similarly, upon announcement, arbitrageurs sell short stocks that are to be deleted from the index and expect to repurchase them from indexers at a lower price, or they may buy the deleted stocks on the effective date and hold them for several weeks until prices recover. Several researchers have found evidence

of arbitrage activity around changes to the S&P 500 Index (Beneish and Whaley 1996; Chen, Noronha, and Singal 2004; Blume and Edelen 2004). Similar evidence exists for the Russell 2000 Index (Madhavan 2003; Biktimirov, Cowan, and Jordan 2004).

Not surprisingly, arbitrage returns are realized at the expense of index fund investors. In current conditions, index fund investors may be unaware of the loss or consider it minor relative to the alternative of removing managerial constraints.

Any one of the major participants—indexing firms (e.g., Standard & Poor's, Frank Russell Company), index fund managers, or index fund investors themselves—could change the current system to mitigate losses. For example, among index fund managers, The Vanguard Group has been proactive in protecting its investors from indices that are amenable to arbitrage. In spring 2003, Vanguard changed its benchmark for small-cap index funds from the Russell 2000 to the MSCI US Small Cap 1750 Index, a less popular index and, therefore, one less subject to index arbitrage. Gus Sauter, former manager of Vanguard's index fund group and currently chief investment officer at Vanguard, confirmed to Hulbert (2004) that "one of the primary motivations [for the change] was to reduce the ability of traders to exploit those index changes at the expense of index funds."

Index Changes and Return Patterns

We briefly describe the process of indexing and the pattern of returns around index changes for the S&P 500 and Russell 2000.

Indices and Index Changes. Although numerous market indices exist, we focus primarily on the S&P 500 and Russell 2000 for two main reasons. First, these indices are constructed in significantly different ways, which allows us to contrast the impact of changes on index fund investors. Second, the S&P 500 and the Russell 2000 are the most popular indices of U.S. equities with the highest amount of passively indexed assets relative to index value.[3] Thus, investors in these two indices are most affected by index changes.

Index changes may be involuntary or voluntary. Involuntary index changes occur when companies cease to exist publicly because of bankruptcies, liquidations, delistings, leveraged buyouts, or mergers. Voluntary changes occur when constituent companies do not meet the indexing firm's criteria for inclusion. For example, Standard & Poor's deletes a company when it ceases to represent its industry or the industry itself ceases to play a major role in the economy. Frank Russell Company deletes companies from its indices based on market capitalization, stock price, and float (number of shares available to the investing public).

To pick a candidate company for inclusion, Standard & Poor's uses four criteria, which are not always strictly enforced: The company must have sufficient liquidity; company ownership must not be concentrated in a single entity or few entities; the company must be profitable; and the company must be a leader in an important U.S. industry. To keep the number of companies in the S&P 500 constant, additions to the S&P 500 occur throughout the year, usually concurrent with deletions.

In contrast, changes to the Russell 2000 occur at fixed intervals. Since 1990, the index has been reconstituted once a year on the last day of June. Since 2004, additions/changes to the Russell indices have occurred at the close on the last Friday in June. As with the S&P indices, companies that cease to exist are deleted from the Russell indices. Unlike the S&P indices, companies are not contemporaneously added to the Russell indices to replace those deleted until the time of reconstitution. Thus, the number of companies in the Russell 2000 continues to fall from July 1 until the next reconstitution in June the following year.[4] Also, in contrast to companies in the S&P indices, companies that fail to continue to meet the inclusion criteria are not deleted from the Russell indices until the time of reconstitution in June.

On the one hand, although the S&P 500 companies may *not* be the largest companies in the economy or the industry, they are chosen on the basis of their importance to the economy or the industry. On the other hand, additions to the Russell 2000 are based entirely on the company's market cap, subject to the company fulfilling certain conditions related to float and stock price.

The differences in choosing replacements have an effect on index arbitrage. Because changes to the S&P 500 are somewhat subjective and largely unpredictable, arbitrageurs can trade on changes only between the date of announcement of the change and the effective date.[5] Changes to the Russell 2000 provide more attractive arbitrage opportunities for two reasons. First, changes to it are almost fully predictable because they are based primarily on market cap. Indeed, many large investors and financial institutions (e.g., Merrill Lynch, Morgan Stanley, Goldman Sachs) begin to predict changes as early as March. Second, the larger number of changes in small-cap indices (in the Russell 2000, 25 percent of the companies change each year) compared with large-cap indices (in the S&P 500, fewer than 5 percent of the companies turn over each year) gives arbitrageurs more opportunities for timing.

Changes and Returns to the S&P 500. Our initial sample of S&P 500 changes consisted of 303 additions and 303 deletions for the October 1989–December 2002 period. We imposed certain criteria for constructing the final sample. First, to focus on a pure-index-change sample devoid of information effects, we excluded companies whose addition to or deletion from the index was caused by a significant contemporaneous event or anticipated likely major corporate event (restructuring, bankruptcy, merger, etc.) based on an inspection of news reports over three months prior to the announcement. Second, we excluded the involuntary deletion of foreign companies in July 2002 as a result of a change in Standard & Poor's policy.[6] The final additions sample consists of 263 companies, and the final deletions sample consists of 72 companies. Although these screens helped generate a clean sample, they may have caused the true impact of index changes on index fund investors to be understated. This and other biases in our estimates are discussed later.

Excess returns—abnormal and cumulative abnormal returns (CARs) measured relative to the S&P 500—for these companies are reported in **Table 1**. The mean abnormal announcement-day return for an addition was 5.12 percent, but the added stock continued to appreciate between announcement and the actual change, accumulating a total abnormal return of 8.37 percent.[7] The results show that there are two components of the abnormal returns from additions—namely, a permanent effect and a temporary effect. The permanent change in the price of added stocks, as reflected in the CAR from the announcement through 60 days after the effective date, provided most of the return (CAR60 = 6.36 percent). The temporary effect, measured by the difference between the CAR from the announcement date up to the effective date and the CAR 60 days after the effective date, was 2.01 percent.

For the deletions sample, the loss upon announcement was a significant 8.48 percent, with an additional loss of 5.62 percent between the announcement date and the effective date. The abnormal return, however, lacks permanence; the negative effect of deletions disappeared completely by 60 days after the effective date. Thus, for deletions, the permanent effect was insignificant but the temporary effect was a large and negative 15.62 percent (–14.10 percent + –1.52 percent).[8]

Changes to the Russell 2000. Because changes to the Russell 2000 can be anticipated, prior research has found an upward price trend in the March–June period for stocks actually added to the index. For example, Madhavan (2003) found that additions to the Russell 2000 experience a cumulative return of more than 20 percent in the March–June period, compared with a loss of about 9 percent for deletions during the same period. The companies added to the index lost approximately 7.7 percent in July, suggesting a temporary price pressure similar to that for S&P 500 changes. His sample covered the 1996–2002 period.

We report in **Table 2** results for a similar process for the Russell 2000 around the time of reconstitution during the 1990–2002 period. Instead of considering the March–June period, however, we considered only the month of June because relying on prior-month returns would have introduced a look-ahead bias (given that changes are not known with certainty until the end of May).[9] Table 2 shows

Table 1. Abnormal Returns around Changes to S&P 500, October 1989–December 2002

Change	Sample Size	Effdate Size[a] (millions)	Anndate CAR	Anndate-to-Effdate CAR	Anndate to Effdate + 20 (CAR20)	Anndate to Effdate + 60 (CAR60)
Additions	263	$8,315	5.12%***	8.37%***	5.95%***	6.36%***
		6,086	0.94***	0.91***	0.69***	0.64***
Deletions	72	498	–8.48***	–14.10***	–4.66	1.52
		310	0.01***	0.04***	0.35**	0.46

Notes: "Effdate" is the effective or implementation date. "Anndate" is the announcement date. "Anndate CAR" is the CAR for the first trading day following the anndate. The "Anndate-to-Effdate CAR" is the CAR from the day following the announcement to the effective date. The first number in each return cell is the mean, and the second number is the proportion of returns that are positive.

[a]The first number is the mean; the second number is the median.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

Table 2. Abnormal Returns around Changes to Russell 2000, 1990–2002

Change	Initial Sample	Final Sample	Company Size[a] (millions)	Return June	Return July	Return August
Additions	7,259	7,244	$369	3.12%**	–1.70%***	–1.30%**
			253	3.96**	–1.13*	–0.70
Deletions	7,149	4,969	415	–1.19	2.70**	1.56
			90	–4.46***	2.31***	–0.24

Notes: See also the notes to Table 1. The first number in each return cell is the abnormal return for the value-weighted portfolio, and the second number is the abnormal return for the equally weighted portfolio.

[a]The first number is the mean; the second number is the median.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

clearly that added companies gained in June, as price pressure built in anticipation of buying by index funds upon reconstitution, and then lost in July and August, as the added companies returned to price levels based on their fundamentals. In a symmetrical pattern, deleted companies lost in June and gained in July and August. In summary, the excess returns in June earned by the companies added to the Russell 2000 were surrendered in the two months following the actual addition. Deleted companies, in contrast, lost in June but appreciated by a total of 4.26 percent in July and August.

Losses to Index Fund Investors

The previous section made clear that price pressure can occur around the effective date of index additions and deletions. Because indexers and index funds are constrained by tracking-error minimization to trade on the effective date of the change, they must bear most of the losses from index changes. In this section, we estimate these losses. We first estimate the loss based on the temporary price pressure. We compute a more precise estimate later by implementing trading strategies based on price patterns observed in this article and other analyses of the effects of index changes.

Approximation. For illustration, we assume that fund managers who are unfettered by tracking-error constraints will trade in accord with the price patterns documented in the previous section. That is, managers will buy additions on the day after their announcement for the S&P 500 and at the end of May for the Russell 2000; they will sell deleted stocks 60 days after the effective date for S&P 500 companies and at the end of August for Russell 2000 companies. Our logic for using different addition and deletion dates for S&P 500 and Russell 2000 changes is based on Greenwood (2004). He found that arbitrageurs realize abnormal returns by waiting until several weeks after the event. In our scenario, fund managers can step into the shoes of the arbitrageurs to capture the abnormal returns by waiting a few weeks after the effective date.

- *S&P 500*. Based on Table 1, an average of 20 additions and 6 deletions occurred every year from 1989 through 2002 for the S&P 500. The temporary price effect was 2.01 percent for additions and –15.62 percent for deletions. Because the size of an average company entering the index was $8.3 billion, according to Table 1, and the size of an average company dropped from the index was $0.5 billion, the estimated loss to investors is calculated as

$$\$8.3 \text{ billion} \times 20 \text{ additions per year} \\ @\ 2.01\% \text{ temporary} = \$3.34 \text{ billion}.$$

$$\$0.5 \text{ billion} \times 6 \text{ deletions per year} \\ @\ 15.62\% \text{ temporary} = \$0.47 \text{ billion}.$$

$$\text{Combined } \$3.81 \text{ billion (loss)} \div \$10{,}000 \text{ billion} \\ (\text{S\&P 500 market cap}) = 0.04\% \text{ per year}.$$

According to our preliminary calculations, then, the loss to index fund investors was about 4 bps a year. In dollar terms, based on the $1.1 trillion indexed to the S&P 500, the loss to index fund investors was $0.44 billion.

- *Russell 2000*. For 1990–2002, the Russell 2000 experienced an average of 550 additions and 375 deletions per year at the time of reconstitution. The difference in returns was 3.12 percent for additions and 4.26 percent for deletions (calculated as the sum of July and August returns). Per Table 2, the average size of the companies added to the index was $369 million and the average size of the companies deleted from the index was $415 million. So, the loss is calculated as[10]

$369 million × 550 additions per year @ 3.12% = $6.33 billion.

$415 billion × 375 deletions per year @ 4.26% = $6.63 billion.

Combined $12.96 billion (loss) ÷ $1,000 billion (Russell 2000 market cap) = 1.30% per year.

Thus, 1.30 percent was lost by index funds indexed to the Russell 2000. In dollar terms, based on the $43 billion indexed to the Russell 2000, the annual loss to index fund investors was $0.56 billion. This estimate increases to $3.43 billion if all assets benchmarked to the Russell 2000 are considered instead of only passively indexed assets.

More Precise Estimate. To calculate the impact of index changes on an index fund, we constructed trading strategies that took advantage of the known patterns in price changes around the effective date. The effect of the trading strategy was separated from the normal operation of an index fund by overlaying the trading strategy on the index fund, which would normally make all changes on the effective date. For example, in the case of S&P 500 additions, the normal strategy is to buy the added stock on the effective date. Based on our evidence, however, the fund manager should buy the stock on the day after the announcement. Thus, the overlay trading, or incremental trading, strategy entails buying the added stocks at the close on the day after announcement and selling on the effective day. The incremental trading strategy combined with the normal operation gives the desired result.

The abnormal return from the trading strategy is weighted by the size of the added company on the effective date relative to the contemporaneous size of the index to arrive at an estimate of the net effect on the total fund return. Mathematically, the impact of the trading strategy is given by

$$\text{Net impact} = \sum_{i=1}^{C} \frac{FirmSize_i}{IndexSize} \times \left[\left(\prod_t (1+R_{it}) \right) - \left(\prod_t (1+R_{mt}) \right) \right], \quad (1)$$

where

C = number of index changes
R_{it} = daily return for stock i on day t
R_{mt} = daily return for the relevant index on day t

■ *S&P 500*. For additions to the S&P 500, we constructed a trading strategy in which an added stock was bought on the day after the announcement and sold on the effective day.[11] Essentially, the strategies we used are those that index funds would reasonably pursue in the absence of the focus on tracking-error minimization. We restricted our analysis to added stocks with at least one day between the announcement and effective dates. Results for all added companies by year and for the entire 1989–2002 period are reported in the left half of **Table 3**. The average net impact of added companies in 1989–2002 was 0.101 percent.

Blume and Edelen (2004) proposed an early trading strategy for indexers. They found that if indexers bought on the day after announcement (rather than on the effective day), they would add 19.2 bps per year with no added risk—but with a substantial increase in tracking error. Our numbers are lower for at least two reasons. First, their sample period was 1995 through 2002, a period in which the price impact was larger than in our period. For that same period, our estimate is 15.2 bps. Second, their trading strategy involved trading at the open on the day after announcement, whereas we prescribed trading at the close on the day after announcement.

We followed a different strategy for deleted companies from the one for added companies. Because we had documented a strong negative temporary effect for deleted stocks—an effect that completely reversed three months later (see Table 1)—the better overlay strategy for an S&P 500 fund to follow would be to buy at the close of the effective date and sell 60 trading days later when prices had recovered, which is equivalent to the index fund selling the deleted stocks 60 days after deletion instead of on the effective date. We report in the right half of Table 3 average risk-adjusted compounded returns and the average relative size of deleted companies on the effective date. Over the 1989–2002 period, the average net impact of deleted companies was 0.022 percent.

Our results imply that a fund indexed to the S&P 500 that bought added stocks following announcement and sold deleted stocks 60 days after the effective date of deletion could earn an additional return of approximately 0.12 percent, or 12 bps, a year. In dollar terms, and given the sizes of the companies, that number translates to $1.32 billion annually.

■ *Russell 2000*. For additions to the Russell 2000, the better strategy is to buy the added stocks at the end of May rather than the end of June. Thus, the incremental strategy consists of buying all added stocks on the last trading day in May and selling them on the last trading day in June. We calculated the net impact in accordance with Equation 1.[12] For deletions, the better course is to sell those stocks at the end of August rather than at the end of June. Thus, the incremental strategy consists

Table 3. Impact of S&P 500 Changes, 1989–2002

	Additions					Deletions				
Period	Adds. per Table 1	No. of Stocks Used	Abnormal Change in Value from Anndate to Effdate	Size Relative to S&P 500	Net Impact on Index Fund Return	Deles. per Table 1	No. of Stocks Used	Abnormal Change in Value from Effdate to Effdate + 60	Size Relative to S&P 500	Net Impact on Index Fund Return
10/89–12/90	14	12	–2.027%	0.051%	–0.012%	1	1	48.017%***	0.000%	0.000%
1991	9	4	7.283	0.157	0.046	1	1	–25.633***	0.001	0.000
1992	6	5	1.436	0.087	0.006	4	4	21.099**	0.001	0.001
1993	6	4	3.028	0.236	0.029	2	2	36.234	0.004	0.004
1994	10	9	3.951	0.250	0.089	6	6	–4.923**	0.048	–0.012
1995	21	19	4.088**	0.128	0.099	9	9	4.934	0.005	0.002
1996	18	16	0.768	0.104	0.013	9	9	3.704	0.007	0.002
1997	23	17	0.250	0.082	0.003	3	3	21.038	0.007	0.005
1998	33	27	4.318*	0.143	0.167	3	3	5.749	0.007	0.001
1999	35	30	21.753***	0.091	0.591	5	5	–8.200	0.007	–0.003
2000	45	39	6.015**	0.116	0.272	19	19	18.357	0.004	0.014
2001	23	18	1.073	0.067	0.013	6	6	15.086	0.008	0.007
2002	20	13	1.273	0.153	0.025	4	4	6.940	0.003	0.001
10/89–12/02	263	213			0.101%**	72	72			0.022%

Notes: Relative size is the ratio of the added stock's market cap on the effective date to the S&P 500 total market cap on the effective date. Net impact on S&P 500 returns was found by first multiplying the abnormal change in value by relative size and then summing across all additions during the year. Reported changes in value from anndate to effdate (raw and adjusted) were weighted by relative size.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

of buying the deleted stocks at the end of June and selling them at the end of August. The abnormal returns and impacts for this portfolio were computed in a manner similar to that for additions. We report the results in **Table 4**.

Table 4 shows that the arithmetic mean abnormal return per year from following both strategies simultaneously was approximately 1.84 percent (0.983 percent for additions and 0.854 percent for deletions). Thus, if a fund indexed to the Russell 2000 had bought additions on 1 June and sold deletions on 31 August of a given year during the 1990–2002 period, it could have earned an abnormal return of about $0.8 billion annually. This estimate increases to $4.86 billion if all assets benchmarked to the Russell 2000 are considered instead of only passively indexed assets.

Biases in Estimation. In estimating losses to index investors from index changes, although we used conservative estimates and conservative methods, our loss estimates are indirect and, therefore, likely to be biased. In this section, we explore the effects on our estimates of two underestimation biases and two overestimation biases.

- *Underestimation bias: Price drift during April and May*. Previous work has indicated that stocks likely to be added to and dropped from the Russell 2000 experience price drift in April, May, and June. But our analysis considered only the month of June. Not including the price drift during the earlier months biases the loss estimate downward.

We chose not to include April and May in our calculations because of the uncertainty associated with the changes and the cost of implementing the dynamic trading strategy. Because the final list of changes is based on market capitalizations on the last trading day of May, any earlier time used for ranking will generate an inaccurate list of changes. Suppose a list of additions is generated at the end of March based on market cap.[13] Assume that long positions are taken accordingly. Because stock prices are volatile, rankings on later days could change, generating a different list of probable additions. So, some long positions would need to be closed and new ones created on a continuing basis until the end of May.

In addition to the trading costs of this dynamic trading strategy, a problem is that a potential addition will cease to be an addition only when the stock price falls (relative to other stocks). The implication is that the trading strategy will also incur a loss on the position on top of the additional costs. Losses could be large and could add volatility to the strategy.

The costs associated with a dynamic trading strategy can be controlled by not choosing stocks too close to the breakpoints, but beginning the strategy in March or April would introduce significant uncertainty and ad hoc decision making.

Nevertheless, there are potential gains from starting early. So, not including earlier months probably leads to an underestimate of losses.

- *Underestimation bias: Involuntary deletions*. We sought a pure sample (one devoid of other effects) of index changes so that the loss estimates would be credible. In the process of creating a pure sample, however, many sources of potential losses to index investors may not have been explicitly considered.

One factor we did not consider in our calculations was the effect of involuntary deletions—such as bankruptcies, mergers, liquidations, and spinoffs. Approximately 75 percent of all deletions from the S&P 500 and 25 percent of all deletions from the Russell 2000 are involuntary. Because such deletions typically are accompanied by important company-specific news, we chose to exclude them from our sample to isolate the index effect from the information effect.

Although the actual deletion of companies as a result of major corporate events is involuntary, the timing of deletion from the index is voluntary. Therefore, fund managers can delete a company from the portfolio without waiting for the corporate event (such as a merger) to become effective.[14] As a matter of fact, involuntary deletions are more transparent than voluntary deletions, and they provide additional opportunities for arbitrageurs and fund managers to beat the index. Nonetheless, in many cases, it is difficult to estimate the impact of companies that cease to trade concurrently with the effective date of deletion.

Companies close to bankruptcy provide some noisy information about potential losses because they continue to trade even after the effective date. Pan Am is an example. The announcement of Pan Am's deletion was 8 January 1991 after the close of markets, with 9 January 1991 as the effective date. Its closing price on 8 January 1991 was $0.75. It closed at $0.375 the next day (the effective day) and recovered to close at $0.75 on 10 January 1991. Over the next 60 trading days, its lowest closing price was $0.625, 67 percent above the effective-day closing price. Another example is Carter Hawley Hale Stores. The deletion announcement was made on 11 February 1991, with 12 February 1991 as the effective date. The stock closed at $1.625 on 11 February 1991, fell to $1.125 on the effective date, and recovered to close at $1.375 the following day. Over the next 60 trading days, its lowest closing

Table 4. Impact of Russell 2000 Changes, 1990–2002

		Additions				Deletions			
Year	30 June Index Market Cap (billions)	Sample Size	June Abnormal Return	Adds. on 30 June Market Cap (billions)	Net Impact on Index Fund Return	Sample Size	July–August Abnormal Return	Deles. End of June Market Cap (billions)	Net Impact on Index Fund Return
1990	$ 199.16	410	2.717%	$ 36.95	0.504%	267	3.944%	$ 39.19	0.776%
1991	218.32	524	3.668	62.20	1.045	419	7.025	38.96	1.254
1992	293.02	575	1.896	89.98	0.582	475	1.756	44.59	0.267
1993	408.32	496	–0.558	110.36	–0.151	406	3.595	71.49	0.629
1994	490.74	608	1.211	151.76	0.375	483	4.126	80.71	0.679
1995	598.51	464	3.202	131.13	0.701	306	4.798	94.19	0.755
1996	807.37	559	0.371	233.99	0.108	385	–0.484	147.91	–0.089
1997	982.89	572	5.659	262.52	1.511	387	4.639	162.45	0.767
1998	1,154.80	586	1.932	314.01	0.525	318	–0.369	230.00	–0.073
1999	1,101.89	567	7.386	311.88	2.090	335	5.329	276.28	1.336
2000	1,269.61	740	13.860	521.07	5.688	414	1.372	366.53	0.396
2001	1,083.29	659	–0.792	274.50	–0.201	410	5.396	291.66	1.453
2002	921.30	484	0.002	171.80	0.000	356	12.354	220.32	2.954
1990–2002					0.983%**				0.854%***

Notes: The abnormal return times the portfolio's market cap on the effective date divided by the Russell 2000 market cap on the effective date is the impact on the index fund's return, where effective date is the last trading day in June. The mean and standard deviation of time-series averages of annual abnormal returns were used for assessing statistical significance.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

price was $1.625, 44 percent above the effective-day price. These examples illustrate the potential underestimation of the loss to index fund investors because deletions with confounding events were not included in our sample.

The deletion of foreign companies in July 2002 provides another illustration of companies that continue to trade after deletion. These companies were explicitly excluded from our analysis because the deletions were a one-time event unlikely to be repeated in the future. According to one estimate, however, purchasing the added companies and selling the deleted companies at the open on the day after announcement could have added 0.58 percentage points to an index fund's return relative to the S&P 500 return for 2002.[15]

In addition to constituting a large portion of the changes to the S&P 500, the companies deleted involuntarily are also much larger in size than the companies voluntarily deleted from the index. Thus, exclusion of involuntary deletions from our analysis, although necessary and warranted, introduced a downward bias in the loss estimate.

■ *Overestimation bias: Mismatched trades, transaction costs, and volatility*. The trading strategies we based on S&P 500 changes and Russell 2000 changes call for buying added companies before the effective date and selling deleted companies after the effective date. Because these trades take place at different times, several issues arise.

The first concern relates to volatility. Do the different positions result in higher risk for the portfolio? As tabulated later, we found the monthly standard deviation of the index fund portfolio with the recommended strategy to be almost the same as that of the S&P 500. The monthly standard deviation of the Russell 2000 fund was marginally higher, 5.363 percent instead of 5.318 percent. These results show no significant increase in risk.[16]

The second concern relates to trading costs. The trading strategies we propose do not actually result in additional trading costs. The added stock is bought only once, and the deleted stock is sold only once, but the trades occur at different times. Therefore, we have no reason to believe that the trading costs are significantly different from those of ordinary indexing.

The third concern relates to availability of investment money. The added companies have to be bought before deleted companies are sold, which requires an additional outlay of funds. One way to circumvent the funding constraint would be to sell short the appropriate index in the cash market—perhaps with exchange-traded funds—and use the short-sale proceeds to buy the added stocks.[17] In addition to easing the funding constraint, short selling might also help align the portfolio with the index, which would reduce overall risk and tracking error.

Another criticism of reliance on mismatched buys and sells is that the design of the strategy is based on limited evidence, especially in the case of the Russell 2000. Greenwood (2004) provided corroborating evidence based on changes in the Nikkei 225, however, that waiting for a few weeks can generate excess returns.

■ *Overestimation bias: Comparison of S&P 500 and Russell 2000*. Although a comparison of these two popular indices is valuable in highlighting the effect of index changes, it gives the impression that, from an investor standpoint, the S&P indices are superior. Such a conclusion is not necessarily valid, however, because the S&P 500 is a large-cap index whereas the Russell 2000 is a small-cap index. A natural bias arises from the fewer changes that are necessary for a large-cap index and the smaller impact of each index change.

In the case of a small-cap index, a company may be deleted because it becomes too big *or* too small. In contrast, most voluntary deletions from a large-cap index occur only because a company becomes too small. The annual number of changes for the S&P 500 is under 5 percent, whereas the number of changes for the S&P 600 is, at 13 percent, approximately three times as many. Because each index change is a candidate for index arbitrage, fewer changes mean smaller losses for index investors.

The second source of bias is the impact of deletions on the index. Because deletions from a large-cap index occur only from decreased company size, the size of the company being changed is small relative to the index. From Table 1 and the discussion, one can see that the relative size of deletions was approximately 0.01 percent of the S&P 500 from October 1989 through December 2002. Deletions from a small-cap index occur for increased and decreased company size, which generally results in a relatively large average company size for voluntary deletions. For the Russell 2000, the average size of a deleted company is about 0.05 percent of index value. Not only is the relative size of deletions five times larger in small-cap indices, but the number of voluntary deletions for a small-cap index as a percentage of total deletions is also larger (about 75 percent) than the number for a large-cap index (25 percent). Note that involuntary deletions are not included in this consideration because of confounding events. Finally, the price impact of large-cap index changes may be smaller because the stocks that belong to a large-cap index have greater liquidity than the stocks in a small-cap index.

Although a comparison between two small-cap indices or two large-cap indices might be preferable, neither the S&P 500 nor the Russell 2000 has a similar-sized index with a comparable level of indexing. Thus, a comparison of the S&P 500 with the Russell 2000 is appropriate and highlights the effects of differences in index construction and index changes. A superficial comparison of indices with similar capitalizations is discussed in the next section.

Corroborating Evidence

Our results thus far demonstrate that index fund investors lose when index funds trade on the effective date of index reconstitution, with losses to Russell 2000 investors somewhat greater in percentage terms than those to S&P 500 investors. Another valid question is whether the way in which indices are reconstituted matters. To answer this question, we compared large-cap and small-cap indices from three major indexing firms: Standard & Poor's, Frank Russell Company, and Morgan Stanley Capital International. Although the number of stocks, market cap, and other characteristics of these indices differ, we believe that a comparison is reasonable because all large-cap indices (and small-cap indices) compete for the same customers.

In **Table 5**, we report the main characteristics, annual returns, and associated risks of these indices. The risk and return analysis begins in 1995 because it is the earliest year for which total return data for all indices are available. Panel B shows that the large-cap indices exhibited similar average returns and risk for the 1995–2002 period. The small-cap indices tell a different story. The Russell 2000 earned a lower return than the S&P 600 in all years except 1999 and underperformed the MSCI 1750 in all years. Overall, the average annual return to the Russell 2000 was more than 3 percentage points less than the returns to the other two small-cap indices. At the same time, the risk of the Russell 2000 was not less than that of either the MSCI 1750 or the S&P 600.

In Panel C of Table 5, we indicate whether returns were significantly different by computing the fraction of months when the index returns of the S&P and MSCI were higher than the corresponding Russell returns. That is, S&P 500 and MSCI 300 returns were compared with the Russell 1000 return, and the S&P 600 and MSCI 1750 returns were compared with the Russell 2000 return. For the large-cap indices, we found that the fraction of months for which the S&P 500 return was larger than the Russell 1000 return was not significantly different from 0.50.

Comparison of the small-cap indices is more interesting. The S&P 600 had a higher return than the Russell 2000 for 62.5 percent of the months, which is significantly greater than 50 percent. To determine whether the excess return is related to the Russell reconstitution, we examined whether the returns were different around the reconstitution date. Excluding the months from May to August, we found that the S&P 600 outperformed the Russell 2000 only 51.6 percent of the time. It had a higher return than the Russell 2000, however, for 84.4 percent of the time from May to August and 93.8 percent of the time during June and July, both of which are significantly higher than 50 percent.

On the one hand, the differences in returns for the Russell 2000 and S&P 600 indices and the concentration of those differences in the months around reconstitution are consistent with the loss introduced by the arbitrage activity that occurs with predictable index changes in the Russell 2000 and the success of the Russell 2000 as evidenced by the high level of indexing to it. On the other hand, the Russell 1000 does not severely underperform its competing large-cap indices, even with predictable and numerous changes, because the amount of indexing to it is low. Moreover, the subjective nature of index changes in the S&P indices limits the losses from arbitrage for those who index to them, with the result that the popular S&P 500 does not earn returns that are significantly different from other large-cap indices.

The losses from index, particularly small-cap index, changes are well known to mutual fund managers. For example, Vanguard switched to the MSCI 1750 in the spring of 2003 to attenuate losses because of timing by arbitrageurs.

We can conclude from the discussions so far that index fund investors are better served when indexing firms introduce uncertainty into the process of index changes and when indices are not popular. Russell 2000 investors suffer significantly higher losses primarily because of the objective criteria used for its construction. In addition, a reduction in the turnover associated with index changes and possibly a reduction in the length of the pre-announcement period would further limit the ability of arbitrageurs to game index funds.[18]

Limitations of Tracking Error

The evidence in the previous section makes it quite clear that index fund investors lose because of the activities of arbitrageurs. These results are consistent with those of Frino, Gallagher, and Oetomo (2005), who found that passive Australian funds would

Table 5. Risk and Return of Various Indices

	S&P 500 (large cap)	Russell 1000 (large cap)	MSCI 300 (large cap)	S&P 600 (small cap)	Russell 2000 (small cap)	MSCI 1750 (small cap)
A. Index characteristics						
Basis for change	Index committee, unpredictable	Objective and predictable	Objective and predictable	Index committee, unpredictable	Objective and predictable	Objective and predictable
Frequency of change	Anytime, frequent	Once a year	Two times a year	Anytime, frequent	Once a year	Two times a year
Median market cap ($ millions)	9,108	3,789	NA	629	469	NA
Highest market cap ($ millions)	311,066	311,066	NA	4,865	2,064	NA
Lowest market cap ($ millions)	902	489	NA	64	42	NA
Number of changes (%)	4.6 (1977–2002)	15.4 (1983–2000)	NA	12.9 (1995–2002)	27.9 (1990–2002)	21.5 (1999–2002)
B. Returns and risk by year						
1995						
Return	37.58	37.77	38.56	29.93	28.45	31.48
Std. dev.	7.83	7.84	7.87	9.48	8.20	8.43
1996						
Return	22.95	22.45	23.18	21.32	16.48	19.02
Std. dev.	11.82	11.62	12.05	10.99	10.67	10.95
1997						
Return	33.36	32.85	34.60	25.58	22.36	24.34
Std. dev.	18.16	17.16	18.16	13.84	12.99	13.26
1998						
Return	28.58	27.02	33.40	–1.30	–2.55	0.58
Std. dev.	20.29	19.96	20.42	21.12	20.15	20.58
1999						
Return	21.04	20.91	22.95	12.41	21.26	21.94
Std. dev.	18.08	17.67	18.67	13.33	14.23	13.88
2000						
Return	–9.12	–7.79	–13.86	11.80	–3.02	8.67
Std. dev.	22.22	23.16	24.45	26.48	29.89	25.29
2001						
Return	–11.92	–12.45	–13.94	6.53	2.49	3.21
Std. dev.	21.38	21.85	22.59	22.65	23.17	22.66
2002						
Return	–22.06	–21.65	–22.86	–13.50	–20.48	–18.37
Std. dev.	26.04	25.75	26.28	24.67	25.15	23.85
Average for period						
Return	12.55	12.39	12.75	11.60	8.12	11.36
Std. dev.	18.23	18.13	18.81	17.82	18.06	17.36
C. Difference in returns: Fraction of months when the index return was higher than the Russell return (1995–2002)						
All months	0.542		0.542	0.625**		0.604*
May–August	0.531		0.563	0.844***		0.656
Months other than May–August	0.547		0.531	0.516		0.578
June and July	0.563		0.688	0.938***		0.750*
Months other than June and July	0.538		0.513	0.563		0.575

NA = not available.

Notes: Market caps are as of the end of December 2003. Returns are annual. Daily total return data were obtained from the indexing firms. Standard deviation was calculated for each calendar year based on daily returns.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

Sources: Information about market caps for the Russell indices is from Quinn (2004) and for the S&P indices, from Standard & Poor's. Information about the number of changes is from our calculation for the S&P 500; from Gardner, Kondra, and Pritamani (2001) for the Russell 1000; from Table 2 for the Russell 2000; from Standard & Poor's for the S&P 600; and from Morgan Stanley Capital International for the MSCI 1750.

benefit from using less-rigid rebalancing and investment strategies. In this section, we focus on the benefits and costs of the tracking-error constraint.

Tracking Error as a Low-Cost Agency Solution. Given that arbitrageurs can time the index fund managers' moves, why do index fund managers focus on tracking-error minimization and why do investors instruct fund managers to minimize tracking error? A major justification has its roots in the principal–agent problem. When investors delegate investment decision making to fund managers, they accept that these managers' propensity to assume risk to enhance performance may diverge from their own. One way to constrain managerial risk taking is to bind fund managers to an objective of minimizing tracking error against a benchmark. Operationally, a close bind translates to a full index replication strategy, because sampling or enhanced indexing, the other common indexing strategy, is likely to increase tracking error. Thus, tracking error appears to be a simple but effective way of reducing investor–manager conflicts and evaluating performance.

Inadequacy of Tracking-Error Focus. Theoretical arguments suggest that a policy of focusing on tracking error may be suboptimal. Roll (1992) demonstrated that optimizing portfolios with respect to tracking error and its variance is not the same as optimization in a Markowitz mean–variance framework and results in inefficient portfolios. Clarke, Krase, and Statman (1994) went even further to argue that not only is the tracking-error framework of evaluation not grounded in Markowitz mean–variance theory, it is also part of a mental accounting framework related to aversion to regret.

Pope and Yadav (1994) showed that, from the standpoint of usefulness in evaluations, tracking error is subject to estimation bias from negative serial correlation whenever the investment horizon is longer than the data frequency interval used in estimation—which is, presumably, always the case for index fund investors. More recently, Jorion (2003) demonstrated that constraining managers with tracking-error volatility results in their ignoring total portfolio risk and holding inefficient portfolios. Therefore, despite its potential to mitigate an agency problem between investors and index fund managers, the use of tracking-error minimization alone as an evaluative tool may not ultimately be in the best interests of index fund investors.

Nevertheless, the use of tracking error continues to be popular. Index fund managers may be aware of the unattractiveness of prices on the effective date, but Chen et al. (2004) reported that the trading volume on the effective date is several times the normal daily volume.[19] This finding suggests that index fund managers continue to change their portfolios on the effective date with a view to minimizing tracking error.

Indeed, if index fund managers did not change their portfolios on the effective date, their tracking errors would be much higher. In **Table 6**, we report estimates of tracking error and standard deviation of tracking error for index funds that followed the strategy we suggested in Tables 3 and 4. We also compared standard deviations of returns for the index funds with those of the S&P 500 and the Russell 2000.

Not surprisingly, with the implementation of these strategies, the absolute tracking error was 0.15 percent for a fund indexed to the S&P 500 and much higher, at 2.26 percent, for a fund indexed to

Table 6. Estimated Volatility and Excess Returns for Indexed Funds

Index	Total Index Return	Total Additional Return	Absolute Tracking Error	Std. Dev. of Tracking Error	Std. Dev. of Index	Std. Dev. of Index Fund
S&P 500[a]	11.296%	0.141%***	0.147%	0.025%	4.038%	4.040%
Russell 2000[b]	9.770	1.869***	2.259	0.426	5.318	5.363

Notes: For each day, the index fund return was enhanced by the abnormal returns earned by qualified additions and deletions in Tables 3 and 4. These daily returns were compounded to the end of the month (year) to obtain the return on the index fund for the month (year). The difference between the annual index fund return and the annual index total return is the "Total Additional Return." The tracking error is the sum of the absolute differences between the monthly index return and the monthly index fund return.

[a]Average of 13.25 years, October 1989–December 2002.
[b]Average for 1990–2002.

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

the Russell 2000. But the higher tracking error was accompanied by additional returns of, respectively, 0.14 percent and 1.87 percent. Equally important is that the standard deviation of the S&P 500 was almost the same as that for the index fund pursuing the strategy we suggest. The yearly results (not reported here) are consistent with the overall average results in Table 6, which suggests that managers following the strategies we advocate would not be assuming excessive risk in any given year. The evidence indicates that following the strategies we advocate would have resulted in generally positive alpha without altering risk.

Although principals (index fund investors) would probably welcome higher returns without significantly higher fund volatility, the additional return cannot be earned without increasing tracking error. Thus, the tracking-error focus, while restricting the risk-taking propensities of fund managers, also limits their ability to provide benefit for their principals. Another measure of index fund performance is required. Until a new measure becomes available, however, the prudent approach would be to eschew the use of tracking-error minimization as the only evaluative tool. Positive deviations from the benchmark (positive alpha) should be permitted when not accompanied by increased risk for the fund portfolio, or use of the Sharpe ratio should be extended to index funds. This recommendation is consistent with that of Roll (1992).

Improving Index Construction

Arbitrageurs are able to front-run index fund managers and create wealth transfers from index fund investors to themselves when

- index changes are transparent and known sufficiently in advance of the effective date,
- the index is heavily used by passive index funds, *and*
- fund managers are constrained to trade on the effective day by tracking error or other performance metrics.

All three conditions must be met for fund investors to lose from index changes.

We have considered how relaxation of the tracking-error constraint can improve performance. In this section, we discuss other choices that fund managers can make to minimize these losses and ways in which indexing firms can make indices less susceptible to arbitrage.

Silent Indices. According to Gastineau (2002), "a silent index is an index developed and maintained for the use of a single exchange-traded fund or a single traditional mutual fund" (p. 10). The constituents of a silent index would be publicly known, and its construction would be based on a defined set of rules, but unlike a typical index, changes to the index would not be made public until after they were effective.

Construction and creation of silent indices would not necessarily be onerous. Although several silent indices might have the same initial composition, index changes could still be different. For example, if a new stock (like a Google) was to be added to the index, it could be added at various times—spaced by a week among different indices—but would be kept secret. Without prior knowledge of index changes, arbitrageurs could not front-run a fund. Thus, a fund based on silent indices would avoid most of the losses that we have highlighted.

The main concern about silent indices is their lack of transparency. Current U.S. SEC regulations do not allow any index to be silent. All indices must be published, and all changes must be publicly available to all market participants at the same time. Lack of transparency in silent indices would also create marketing issues for the indexing firm because it would introduce uncertainty in the minds of investors. Moreover, creating a silent index might put pressure on indexing firms and fund managers to keep other information—such as the basis for index changes, periodicity of changes, even the type of index—silent so that potential arbitrageurs are unable to predict changes in the index.

Assuming that a silent index could be implemented, it might be the most effective method of neutralizing index arbitrage in the long term. All indices have limitations, but in the short term, a silent index with a slight variation to meet SEC regulations might work best.

Open but Rarely Used Indices. An open index—such as the S&P 500 or Russell 2000—is one with a publicly available list of constituent companies, and changes to its composition are freely available. We define a rarely used index as one to which passive indexing does not exceed 1 percent of the market value of all stocks in the index.[20] Examples are the Russell 1000, MSCI 300, and MSCI 1750. The 1 percent cutoff ensures that the demand created by indexers does not have a significant impact on prices. An examination of the returns of rarely used indices in Table 5 shows that such indices do not suffer significant losses because of arbitrage.

An index of this kind has two limitations. First, a fund indexed to any open index is likely to experience some losses because of index arbitrage. Second, when the index becomes popular, fund managers must switch to another index that fits the definition of "open but rarely used." Transition to a

new index is costly, however, in terms of managerial time and effort, transaction costs, and realization of taxable capital gains when existing profitable positions are sold and replaced with new stocks.

Adapting Strategy to Popular Indices. With popular indices and minimization of tracking error as an objective, the only way to avoid index arbitrage is by negating transparent index changes that are pre-announced or predictable.

■ *Number of index changes*. The number of index changes in a given period depends on both the frequency with which changes are made and the criteria driving those changes.[21] A study by Frank Russell Company staffers (Gardner, Kondra, and Pritamani 2001) found that simply changing from annual reconstitution to quarterly reconstitution would have increased the annual number of changes in the Russell 2000 from 546 (27 percent of all companies) to 899 (45 percent of all companies) over the 1983–2000 period—an increase of 65 percent. Because each index change may be associated with an opportunity for index arbitrage, a larger number of changes can translate into a larger loss for index fund investors. But the frequency of index changes can be increased without increasing the number of changes through a judicious choice of other criteria. For example, changes in the S&P 500 are more frequent than changes in the Russell 2000, but the total number of changes as a fraction of the total number of stocks in the S&P 500 is not as large as for the Russell 2000 or the Russell 1000.

■ *Predictability of index changes*. The second important factor in gaming by arbitrageurs relates to the predictability of index changes. Because subjective criteria are used for changes to S&P indices, predicting which companies will be added to or deleted from the indices is generally difficult.

Because the criteria for changes to the Russell indices (and some other indices) are specified unambiguously, arbitrageurs can easily and accurately predict changes. It would apparently be in the interest of investors if these indexing firms used a random procedure to select some, but not all, of the companies eligible (based on current criteria) for addition or deletion. Introducing limited subjectivity into the selection process would reduce predictability and the turnover associated with index changes every year.

■ *Pre-announcement of changes*. The third factor contributing to losses to index fund investors is the lag between the announcement of a change and its effective date. The lag is of interest only for changes that are unpredictable, as with the S&P 500. Indexing firms claim that the pre-announcements are required to "ease order imbalances" that are likely to result from large transactions initiated by indexers. But the lag does allow arbitrageurs to step in and trade ahead of the indexed funds. This problem has no obvious solution except to minimize the lag to the extent possible.

■ *Summary*. A popular index cannot really avoid losses to index funds because of index arbitrage, but the indexing firm can attempt to minimize those losses by reducing the turnover and predictability of changes. Open and popular indices should use an opaque process of index changes without necessarily using any pre-announcement period. If a pre-announcement period is unavoidable, it should be as short as possible. With these characteristics, the major indices would be similar to a silent index.

Recent Changes by the Frank Russell Company. In an attempt to limit arbitrage activities and to make it easier for index funds to manage tracking error, Frank Russell Company has made several changes to the reconstitution process. First, effective in 2004, it changed the reconstitution day from the last trading day in June to the last Friday in June. Second, it posted "provisional" returns for the new index for a two-week period prior to the reconstitution. Third, it used the NASDAQ Closing Cross price for reconstitution to price NASDAQ-listed securities. Finally, it began adding IPOs every quarter instead of only at the time of annual reconstitution.

The change from the last trading day in June to the last Friday in June made managing the reconstitution easier for index fund managers from an operational standpoint. The change has had no effect on index arbitrage. The posting of provisional returns based on the new index is informative but does not change tracking error. Thus, as long as index fund managers are responsible for minimizing tracking error, the posting of provisional returns does not affect their trading at the close on the effective day. The move to quarterly IPO additions has no effect on index arbitrage other than to spread these additions and related index arbitrage to four known dates instead of a single known date.

The use of the NASDAQ Closing Cross is useful for fund managers attempting to exactly match the index. It will probably reduce volatility of prices on the effective day, and it might induce managers to trade at the close instead of throughout the day. It should have no significant effect on index arbitrage, however, because it does not affect the incentives of fund managers.

The Russell 2000 reconstitution in 2004 had a much smaller impact on returns than did reconstitutions in earlier years. Some observers credit this effect to changes instituted by the Frank Russell Company. But based on our analysis, it is premature

to suggest that losses to passive fund investors have ceased. Indeed, index arbitrage in 2005 was as significant and pervasive as in earlier years, except 2004. Thus, whether changes to Russell indices' reconstitution have had a significant impact on index arbitrage is not clear.

Conclusion

Growth in the popularity of index funds is a testament to portfolio theory and the virtues of diversification. According to Frank Russell Company, about $2,000 billion in assets were benchmarked to major indices as of June 2003—an indication that indices are an important component of the financial landscape.

Investors drawn to the broad diversification and low turnover that characterize index mutual funds no doubt expect the fund portfolios to be invested in the companies constituting the index in the proper proportions at any given time. But fund managers rewarded for performance have an incentive to assume more risk than contracted for by their investors. To address this agency problem, fund managers implicitly or explicitly contract to minimize the size and volatility of tracking error. Accordingly, the performance of index fund managers is usually measured in terms of both the cost of managing the fund and its tracking error.

We showed that index fund investors lose a significant amount because of the predictability and timing of index changes coupled with fund managers' objective of minimizing tracking error. The loss to an investor in the Russell 2000 may be about 130 bps a year and can be as high as 184 bps a year, and S&P 500 investors may lose as much as 12 bps a year. Consistent with this finding, we found that the Russell 2000 underperformed other small-cap indices by more than 3 percentage points a year in the 1995–2002 period, even though comparable indices did not entail greater risk. Moreover, the underperformance was concentrated in months surrounding the annual reconstitution of the index.

No type of index is a perfect solution to index arbitrage. We suggested steps that can be taken by index fund managers, index fund investors, and indexing firms to minimize the losses.

Managers of index funds can minimize losses by not trading on the effective date because the price pressure is the greatest at that time. To provide the necessary flexibility to fund managers, investors should rely on overall risk and return of the portfolio for performance evaluation instead of focusing on tracking error. Indeed, we found that the risk of funds that used the strategies we outlined would not be greater than the risk of the benchmark index, although the return would be higher. Finally, small individual investors can protect themselves by choosing index funds on the basis of not only expenses and loads but also the likelihood of the fund being timed by arbitrageurs.

Indices could be designed to limit front running of index funds. The best long-term solution is a silent index (Gastineau 2002, 2004), but it is not permissible under current SEC regulations. In the short term, investors can look to an open index that is not heavily followed. The limited indexing will curtail gains to index arbitrageurs. But once an open but not heavily used index becomes popular, changing indices can create significant costs for the index fund.

Changes by indexing firms to remove the cause of loss to investors would be the most effective way of protecting fund investors from index arbitrage. Because advance knowledge of changes allows arbitrageurs to time those changes, we recommend that indexing firms reduce the predictability and advance knowledge of index changes as much as possible. In addition, the turnover associated with index changes should be reduced to limit both the opportunity for arbitrage and the transaction costs associated with index changes.

Ultimately, whether any of the alternatives we recommend is an improvement over the status quo is an empirical issue. It is worth exploring different indices and methods of index changes if these methods have the potential to mitigate losses to index fund investors. We hope this article spawns more discussion of the alternatives available to index fund investors, index fund managers, and indexing firms for limiting losses because of arbitrageurs.

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This article qualifies for 1 PD credit.

Notes

1. Tracking error has no universally accepted definition. Tracking-error calculations may be based on daily returns, monthly returns, quarterly returns, volatility, correlations, and so on. Two common measures, *TE*1 and *TE*2, are as follows (see Ammann and Zimmermann 2001):

$$TE1 = \sqrt{\sum_k^n \left(R_{pk} - R_{Bk}\right)^2 \Big/ (n-1)}$$

and

$$TE2 = \sigma\left(R_p\right)\sqrt{1-\rho_{pB}^2},$$

where R is the return for tracking portfolio p or benchmark portfolio B over n periods, k is an index that goes from 1 to n, and ρ_{pB} is the correlation between returns to the tracking portfolio and the benchmark portfolio. Our definition in the text is one of the simplest.
2. Other important reasons for tracking error and expenses are reinvestment of dividends and cash management to meet investor purchases and redemptions. Fund managers are adept at minimizing the impact of dividends and cash flows by using index futures.
3. We distinguish between "passively indexed" and "benchmarked" in our computations. For example, around $264 billion in assets were benchmarked to the Russell 2000 in 2003 (Smith and Haughton 2003) compared with around $43 billion passively indexed to it during that year (Merrill Lynch 2005). We used the passively indexed estimate in our tests.
4. The exception is that in 2004, Frank Russell Company commenced adding IPOs to the index on a quarterly basis. We consider this change later.
5. Until September 1989, there was no lag between announcement and the actual change to S&P indices. Changes were announced after the close of trading and became effective at the open on the next day.
6. Our sample selection process is similar to that in Chen et al. (2004).
7. Announcement-day return refers to the return for the trading day following announcement because all announcements are made after the close of markets.
8. This result is similar to those in Chen, Noronha, and Singal (2004) and in Dash (2002), a study conducted by Standard & Poor's.
9. A negative bias was introduced by our excluding the months of March, April, and May because the change list is known with a high degree of confidence as early as March in any year. The probability of addition/deletion for a company on the list is not 1.0, however, which introduces an additional risk factor into a portfolio of additions or deletions formed earlier than 31 May.
10. That the mean size of deleted companies is larger than the mean size of added companies implies that several companies deleted from the Russell 2000 moved up to the Russell 1000 Index and, similarly, several companies added to the Russell 2000 are those that moved down from the Russell 1000.
11. Because announcements take place after the exchanges have closed, we essentially bought at the closing price on the day after the announcement. Thus, we lost the announcement-day return. This factor helps explain why the numbers in Table 3 look considerably different from those in Table 1.
12. The net impacts reported were obtained by multiplying the abnormal returns and total market cap of additions or deletions and dividing by the total market cap of the Russell 2000 as of 30 June.
13. The analysis is identical for deletions.
14. We thank a referee for pointing this out.
15. As pointed out previously, trading at the open on the day after announcement can generate additional gains. We thank a referee for providing us with an estimate of loss resulting from the deletion of foreign companies.
16. Year-by-year results are available from the authors.
17. Short-sale proceeds are not usually available for reinvestment, so the actual savings from this strategy might be marginally smaller than those assumed here.
18. One would expect gains to arbitrageurs to dissipate with competition. There may be several explanations of why this does not happen in the case of index reconstitution. First, not all arbitrage opportunities are eliminated by competition. For example, arbitrageurs still profit from merger arbitrage, post-earnings-announcement price drift, and price momentum. Second, in the case of index changes, some market participants—namely, indexers—are focused on tracking-error minimization rather than maximizing profit; hence, they trade at the closing price on the date of reconstitution.
19. Some observers have suggested that the actual trading volume on the effective day is much less than what would be expected if all index fund managers traded on that day. A quick check for all additions to the S&P 500 in the latter half of 2002 revealed, however, that the trading volume is sufficiently large to support all managers trading on that day. The trading volume on the effective date is 9–20 percent of the number of shares outstanding for NYSE stocks and 20–25 percent for NASDAQ stocks (without adjusting the volume for the upward bias in NASDAQ's reported volume). These percentages compare favorably with the ratio of 11.3 percent indexed value to total value for the S&P 500.
20. The 1 percent cutoff is arbitrary and could be lower or higher.
21. As mentioned previously, we assumed that the turnover associated with each index change is the same.

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