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Long-Term Impact of Russell 2000 Index Rebalancing

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The study reported here examined the long-term impact of Russell 2000 Index rebalancing on portfolio evaluation. A buy-and-hold index portfolio outperformed the annually rebalanced index in the 1979–2004 period by an average of 2.22 percent over one year and 17.29 percent over five years. Although short-term momentum and the poor long-term returns of new issues partially explain these returns, index deletions were found to provide significantly higher factor-adjusted returns than index additions. Some small-capitalization fund managers appear to capture a portion of these benefits. The strongest performing funds enhanced their factor-adjusted returns by an average of 1.45 percent per year by holding index deletions and/or avoiding index additions. Among the weakest performing funds, higher returns from holding index deletions were offset by the poor returns of new issues added to the index. Thus, index methodology may provide a structural incentive for portfolio managers to drift from their benchmarks.

Indices provide a performance benchmark for a specific segment of the market. Although many leading indices were not originally developed as investment strategies, today, index funds are increasingly popular investment vehicles. Index providers compete to offer low-cost, representative portfolios that are easy to implement. Yet, an index is not necessarily a passive benchmark. Indices are rebalanced periodically as the characteristics of individual holdings evolve. These changes impose short-term costs on portfolios that mimic the index, but the question of how index reconstitution affects long-term portfolio returns and performance measurement remains largely unanswered.

In the study reported here, we addressed two questions about the long-term effects of index rebalancing: Does index reconstitution influence long-term index returns? And if so, do portfolio managers use these trends to gain an advantage over their benchmarks?

Sharpe (1992) and Fama and French (1993) highlighted the importance of evaluating long-term portfolio performance relative to a benchmark of common size and style factors. Yet, despite the growth and popularity of index investing, the literature has paid little attention to the long-term effects of index construction and design. Studies have focused primarily on the short-term reaction to index changes.[1] This literature generally reports positive price pressure and information effects with index additions and negative effects with index deletions.

Given the critical role that indices serve as benchmarks in the evaluation and compensation of portfolio managers, understanding how index changes may affect long-term portfolio returns relative to the benchmark is important. In a study related to the one we carried out, Keim (1999) showed how investment rules and trading strategies contributed to the long-term performance of a specific small-cap index fund. Keim demonstrated that by excluding very illiquid low-price stocks, the fund avoided excessive trading costs while continuing to provide its investors with returns and risks similar to those of its small-cap benchmark. In our analysis, we compare a buy-and-hold strategy that has minimal transaction costs with an index having periodic reconstitutions. This approach is similar to the one in Siegel and Schwartz (2006), who found that the original companies in the S&P 500 Index in 1957 have provided higher returns and lower risk than the continually updated index.

The annual reconstitution and publicly disclosed construction methodology of Russell indices create a natural event study. We took advantage of this characteristic to examine the long-run performance associated with changes to the small-cap Russell 2000 Index for 1979–2004. We also measured the impact of index changes on long-term mutual fund returns. Specifically, we considered whether

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small-cap equity funds benefit by investing in companies deleted from the Russell 2000 or by avoiding investments in new issues added to the index.

Index Construction and Sample Selection

Index providers use various methodologies to construct and reconstitute equity benchmarks. **Exhibit 1** contrasts the characteristics of seven leading U.S. equity indices—the Russell 2000, Standard & Poor's (S&P) 600, S&P 400, DJIA, NASDAQ 100, S&P 500, and Dow Jones Wilshire 5000. Each index targets a specific segment of the equity market. Index constituents are periodically rebalanced to replace delisted securities or stocks that are no longer representative of the target market segment.

With the exception of the price-weighted DJIA, most equity indices are weighted by total or adjusted market capitalization. Such value-weighted indices are easier to replicate than equal- or price-weighted indices, require less frequent rebalancing, and more closely match the performance of buy-and-hold portfolios. The industry is moving toward adjusting market capitalization for cross-ownership and the float of publicly available shares; in 2005, Standard & Poor's began using float-adjusted capitalization to construct its popular indices. Current debates are questioning whether indices weighted by fundamental factors, such as dividends, might provide better long-term performance than market-weighted indices.[2]

In the study that we report, we examined the long-run performance associated with changes to the Russell 2000, a leading small-cap stock index. The Frank Russell Company initiated the index on 31 December 1978. Its daily index level is calculated from value-weighted portfolio returns under the assumption of dividend reinvestment.

Exploring the Russell 2000 provided several key methodological advantages to our study. First, Russell indices are reconstituted on specific dates each year in a procedure that allows for a natural event study. Second, Russell indices are relatively simple to replicate because their construction methodology is clearly defined and publicly available. (In contrast, Standard & Poor's reconfigures its indices when it believes doing so is necessary and uses a proprietary selection process.) Finally, constituent changes to Russell indices are generally predictable and known well before the reconstitution date.

During most of our sample period, Russell index membership was determined by initially ranking all U.S.-domiciled companies with stock prices greater than $1.00 according to 31 May total market capitalization (from largest to smallest, adjusted for cross-ownership). This method excludes preferred issues, convertible securities, closed-end mutual funds, limited partnerships, "royalty trusts," "bulletin board" securities, "pink sheet" stocks, foreign securities, and American Depositary Receipts. The 1,000 largest companies become the Russell 1000 Index. The next 2,000 largest companies form the Russell 2000, representing approximately 9 percent of the total market value of all U.S. equities or approximately $1.35 trillion.

Because membership is based on 31 May size rankings, index changes are publicly available prior to the 30 June reconstitution date. The Frank Russell Company also releases roster updates throughout the month of June. During this period, the next available company replaces any delisted security. Between reconstitution dates, however, Russell does not replace delisted securities for any reason (merger, acquisition, bankruptcy, or exchange delisting). Spin-offs are added to the

Exhibit 1. Comparison of Major U.S. Equity Indices

Category	Russell 2000	S&P 600	S&P 400	DJIA	NASDAQ 100	S&P 500	Dow Jones Wilshire 5000
Market segment	Small cap	Small cap	Midcap	Large cap	Large cap	Large cap	Broad market
Number of holdings	2,000	600	400	30	100	500	5,000+
Total capitalization	$1.35	$0.52	$1.08	$3.78	$1.81	$11.12	$14.21
Percentage of total U.S. stock market	9%	4%	8%	27%	13%	78%	100%
Weighting	Adjusted market cap	Float-adjusted market cap	Float-adjusted market cap	Price	Modified market cap	Float-adjusted market cap	Market cap
Reconstitution	Annually	As needed	As needed	As needed	As needed/ annually	As needed	As needed
Public selection methodology	Yes	No	No	No	Yes	No	Yes

Note: "Total capitalization" is the combined market value (in trillions) of all equities held by the index on 15 March 2005 as reported by Bloomberg.

index of the parent company if the spin-off falls between the minimum and maximum market capitalization of the index. In September of 2004, Russell began adding IPOs to its indices on a quarterly basis if the company meets the minimum capitalization requirements for inclusion. Eligible IPOs must have gone public within the three months prior to their inclusion.

Long-Run Impact of Additions and Deletions

We obtained Russell 1000 and Russell 2000 membership rosters for each reconstitution date directly from the Frank Russell Company. Our analysis included all index constituents as of 30 June 1979 through 2004 that had information available in the CRSP database. During our sample period, an average of 1,999 (out of 2,000 index members) was available from CRSP each year.

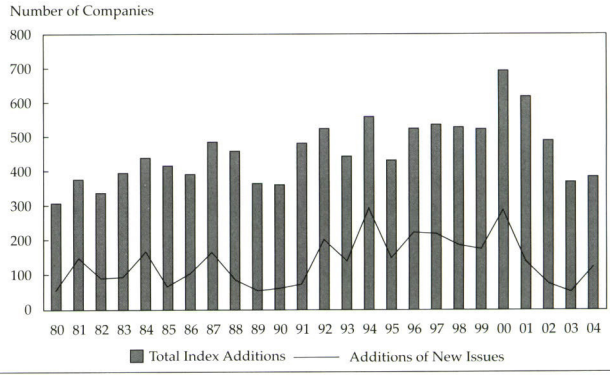
The Russell indices were rebalanced quarterly from 1979 to 1986 and semiannually from 1987 to 1989. To reduce the transaction costs associated with index replication, Russell adopted annual rebalancing on 30 June 1989. (Because we were comparing the performance of a buy-and-hold portfolio with a replicated index, not the actual index itself, more frequent rebalancing in the early years of Russell's history had no effect on our results.)

Figure 1 presents the total number of Russell 2000 membership changes for each reconstitution date. The index realizes considerable annual turnover. Russell replaces an average of 457 companies or nearly 23 percent of the index holdings each year. The annual turnover ranged from a low of 309 companies in 1980 to a high of 690 companies in 2000. Because delisted securities are not replaced between reconstitution dates, the number of additions always exceeds the number of deletions.[3]

Figure 1 also shows the number of new issues (IPOs and spin-offs) picked up by the index each year. IPOs have been widely documented to exhibit poor long-run returns by Ritter (1991) and Loughran and Ritter (1995), among others. An average of 137 companies or approximately 30 percent of the companies added to the index each year are new issues. Most of these new issues were IPOs in the prior year.

The annual reconstitution of the Russell 2000 has garnered attention in the literature. Madhavan (2003) and Chen (2006) examined the persistence of abnormal returns prior to and around the 30 June rebalancing date. Both authors associated inclusion in or deletion from the index with permanent price pressure and liquidity effects. They concluded that index reconstitution imposes significant costs on small-cap portfolios designed to track the index's performance.

Figure 1. Annual Number of Constituent Changes to Russell 2000 at Rebalancing, 1979–2004



Notes: The beginning date is 30 June. For consistency across the sample period, we compared annual index composition changes from 30 June of year $t-1$ to 30 June of year t. New issues are index additions with an initial CRSP listing date in the prior 12 months.

Given the sizable turnover of the index each year, a question naturally arises about the long-term effect of these changes on index performance. To study this issue, we used the methodology outlined by the Frank Russell Company to replicate the index. We measured daily index returns by value weighting individual security returns with dividend reinvestment. Deleted securities were not replaced between reconstitution dates. This approach was designed to minimize the potential impact of survivorship bias while providing returns similar to those that a long-term buy-and-hold investor could expect to receive.

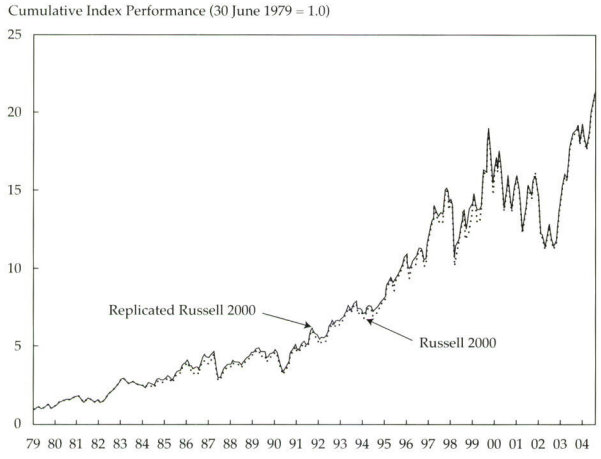
Our procedure deviated from the actual Russell methodology in two ways. First, we could not adjust market values for cross-ownership or privately held shares because this information is not available in the CRSP database. Instead, we computed the daily market value of each company by using the total number of shares outstanding as reported by CRSP. Second, we did not add eligible spin-offs or IPOs to the index between reconstitution dates, which simplified the event study by focusing on index changes in the annual 30 June rebalancing period.

In spite of these methodological differences, as **Figure 2** shows, the replicated index (solid line) closely tracked the actual Russell 2000 (dotted line). The returns of the two portfolios are highly correlated ($\rho = 0.9983$), and the annualized tracking error of the replicated index relative to the Russell 2000 is a mere 0.0978 percent per year. Therefore, we feel confident that the conclusions drawn from this study are not driven by the methodology used to replicate the underlying index.

Table 1 compares a buy-and-hold strategy with no rebalancing with the annually rebalanced Replicated Russell 2000 (Rep Russell 2000 hereafter) for holding periods of up to five years after each reconstitution date. The buy-and-hold portfolio outperformed the rebalanced index by a statistically significant average return of 2.22 percent during the first year after portfolio reconstruction. The strategy generated positive excess returns for 80 percent of the one-year holding periods. Thus, periodic rebalancing can measurably and significantly affect long-run index returns.[4]

One curious data point in Table 1 is the strong (13.04 percent) excess return associated with the 1999 rebalancing. This year coincided with the peak of the technology bubble. Our examination of the

Figure 2. Performance of Russell 2000 Relative to a Replicated U.S. 2,000-Stock Small-Cap Index with Annual Reconstitution, 1979–2004



Notes: Measured as of 30 June each year. The Frank Russell Company provided the actual index returns during this time period. Index returns were measured from daily value-weighted portfolio returns with dividend reinvestment.

Table 1. Long-Term Buy-and-Hold Excess Returns of the Replicated Russell 2000, 1979–2004

Rebalancing Year	Holding Period				
	One Year	Two Years	Three Years	Four Years	Five Years
1980	2.85%	0.25%	0.14%	–2.30%	15.94%
1981	–0.40	–1.56	–0.77	18.01	39.18
1982	–1.31	0.67	12.58	24.60	27.64
1983	–1.98	2.90	8.61	13.44	22.92
1984	2.75	5.88	7.17	14.72	16.74
1985	3.00	2.11	6.87	8.92	10.43
1986	–0.57	0.29	–0.93	6.19	18.53
1987	1.43	–0.33	1.94	10.05	12.04
1988	1.01	2.16	6.67	6.92	10.38
1989	1.35	3.89	3.01	6.09	1.18
1990	2.63	1.98	7.67	3.36	12.65
1991	1.03	3.81	0.78	11.12	9.93
1992	5.38	4.96	16.38	19.54	40.28
1993	0.63	7.20	9.64	22.40	25.96
1994	3.06	6.65	17.30	26.14	41.02
1995	0.53	7.11	17.79	26.94	21.71
1996	2.33	4.85	–1.00	5.66	14.22
1997	2.23	7.84	32.90	7.72	7.14
1998	4.40	26.99	2.39	–4.93	1.91
1999	13.04	1.28	–2.18	1.58	0.10
2000	3.32	5.61	7.99	10.30	13.26
2001	5.75	7.36	7.92	11.89	
2002	1.78	2.09	4.05		
2003	1.70	2.26			
2004	–0.40				
N (observations)	25	24	23	22	21
Average	2.22%	4.42%	7.26%	11.29%	17.29%
t-Statistic	3.76	3.93	4.28	6.02	6.55
Median	1.78%	3.36%	6.87%	10.17%	14.22%
% Positive	80.0%	91.7%	82.6%	90.9%	100.0%
Average no. companies	1,874	1,740	1,610	1,491	1,384

Notes: The beginning date is 30 June. The excess returns compute the difference between the returns of a buy-and-hold portfolio and the annually reconstituted index.

membership changes in the index for 1999 did not reveal one or two strong performers. Instead, we found a number of technology, telecommunications, and internet-related stocks that were removed from the index for growing too large after a period of high returns. These companies continued to perform well in the following year before the bubble began to burst in 2000. Removing this observation from the sample lowered the average one-year excess return to (a still statistically significant) 1.77 percent.

The data shown in Table 1 also capture the corresponding market correction; the excess return for the two-year holding period of the 1999 rebalancing fell to just 1.28 percent. Similar patterns are observable in the data for the 1997 and 1998 rebalancing periods, which coincided with the tech bubble.

The average post-rebalancing buy-and-hold excess return widens to 17.29 percent in Table 1 after five years and is positive in all 21 of the five-year holding periods. Because the long-term excess returns were measured across overlapping time periods, some caution must be used when interpreting their statistical significance. Yet, in general, a different group of companies determined this performance each period. Because the excess returns capture the difference between a buy-and-hold portfolio and the annually reconstituted index, index additions and deletions for each rebalancing period create the excess returns over the subsequent period. By definition, a company will not be an index addition or index deletion two years in a row. Thus, over longer holding periods,

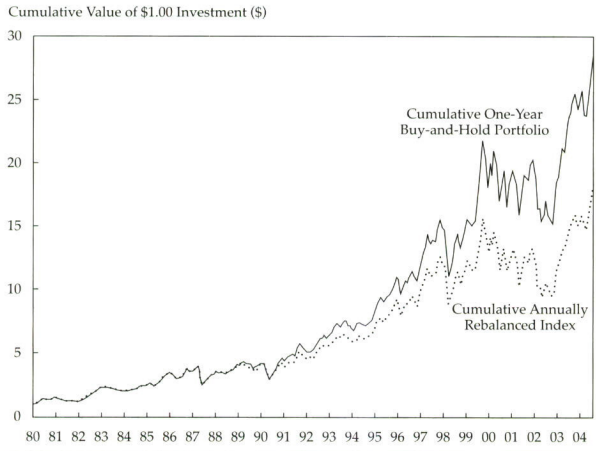
the only potential overlap is from a small number of companies that bounce back and forth between inclusion and exclusion.

To illustrate the effect of the buy-and-hold strategy compounded over time, **Figure 3** compares the cumulative monthly value of $1.00 invested in the annually rebalanced Rep Russell 2000 with the cumulative monthly value of $1.00 invested in a buy-and-hold portfolio that delayed rebalancing for one year. The buy-and-hold strategy is similar to holding the prior year's rebalanced index (as of 30 June) for one year. Over the sample horizon, the delayed rebalancing strategy achieved a nearly 60 percent higher ending value ($28.42 versus $17.77) and a geometric average excess return of 1.93 percent per year. The difference between these two portfolios is similar to the geometrically compounded difference of the first year's buy-and-hold returns compared with the returns of an annually rebalanced index. The excess returns provided in Table 1 suggest that a longer holding period between rebalancing dates would probably lead to even greater compounded excess returns over the index. Our evidence echoes the recent findings by Fama and French (2007) that the size premium is almost entirely generated by small-capitalization stocks that earn extreme positive returns and thus become large-cap stocks.

These positive buy-and-hold excess returns imply that index deletions yield higher long-term average returns than index additions. To capture the differential between the buy-and-hold portfolio and the rebalanced index, we formed portfolios of deletions and additions for each initial rebalancing date. We adjusted the constituents of each portfolio annually for up to five years after reconstitution. For example, if the Rep Russell 2000 was rebalanced on 30 June 1980, then the deletions portfolio on 1 September 1981 included index deletions from both 30 June 1980 and 30 June 1981. At each subsequent rebalancing date for up to five years, newly deleted (added) companies were added to the deletions (additions) portfolio.

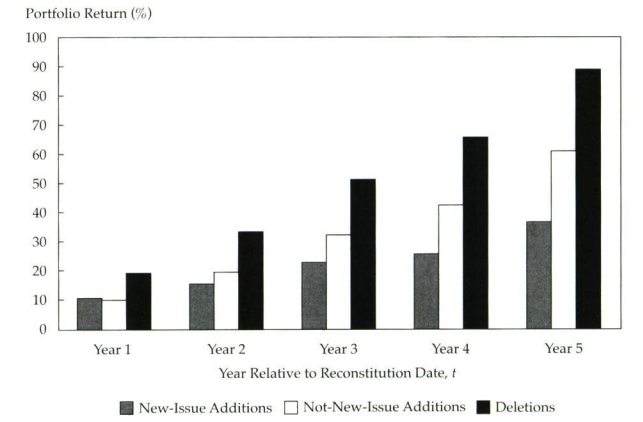
Figure 4 reveals the average five-year cumulative returns of the new-issue additions, not-new-issue additions, and deletions portfolios. As expected, deleted companies realized higher average returns than added companies over the five-year period. For example, the deletions portfolio outperformed the not-new-issue additions by an average of 8.9 percent in the first year and by 28.1 percent over five years. This differential widened with each of the five years. Figure 4 also shows the poor long-run performance of new-issue additions, which consisted primarily of IPOs. On average, the new-issue portfolio lagged the deletions portfolio by 40.1 percent over the five-year period.

Figure 3. Cumulative Performance of the Annually Rebalanced Russell 2000 vs. a One-Year Buy-and-Hold Strategy, 1979–2004



Note: The beginning date is 30 June.

Figure 4. Average Five-Year Cumulative Returns of Russell 2000 New-Issue Additions, Not-New-Issue Additions, and Deletions Portfolios, 1979–2004



Note: The beginning date is 30 June.

As noted, during most of our sample, Rep Russell 2000 membership was based on annual market-capitalization rankings. Although some companies delisted between reconstitution dates, many companies were removed from the index when their relative size rankings changed. Some moved out from the top of the index for becoming too large; others dropped out from the bottom for becoming too small. On average, companies deleted from the top of the index realized a 69 percent return over the year prior to reconstitution, in contrast to the 36 percent return over that year for companies deleted from the bottom. *Relative* performance also affects index additions. Large companies may enter into the top of the index following a period of relatively poor performance, and small companies may enter into the bottom of the index following relatively strong performance. Over the prior year, companies entering into the top of the index averaged a –28 percent return whereas companies entering the bottom averaged a 53 percent return.

Table 2 provides summary statistics for subportfolios of index additions and deletions over the five-year post-rebalancing period. To classify deletions and not-new-issue additions, we used the composition of the large-cap Russell 1000 Index. If a company that was deleted from the Russell 2000 appeared in the Russell 1000 in the next period, we categorized it as being deleted from the top of the Russell 2000 portfolio. Otherwise, it was deleted from the bottom of the index. Not-new-issue index additions were classified in similar fashion. Because Russell does not replace delisted or bankrupt companies throughout the year, the total number of additions is substantially higher than the number of deletions on the rebalancing date.

In Panel A of Table 2, companies deleted for becoming too small outnumber companies deleted for becoming too large by almost 2 to 1 whereas additions to the bottom outnumber additions to the top by more than 3 to 1. Also, over time, new issues (IPOs, spin-offs, etc.) came to constitute a substantial portion of all index additions—in Year 1, 36.5 percent (127/348), and in Year 5, 67.6 percent (650/961).

Panel B of Table 2 shows the total capitalization of the portfolios of top and bottom additions and deletions. The top deletions portfolio dominates the bottom deletions portfolio in size by nearly a 10-to-1 ratio. This evidence suggests that the strong performance of the deletions portfolio shown in Figure 4 was primarily driven by large companies that continued to perform well following their removal from the index. In contrast, the total capitalization of top and bottom additions is roughly equal in the years after rebalancing.

Table 2. Average Portfolio Market Capitalization and Number of Companies in the Subportfolios, 1979–2004

Years since Rebalancing, *t*	Deletions			Additions			
	Top	Bottom	All	Top	Bottom	IPO	All
A. Average number of companies in portfolio							
1	85	155	240	68	221	127	348
2	118	205	323	88	286	274	560
3	137	231	368	96	314	410	724
4	146	244	390	99	319	535	854
5	151	251	402	99	311	650	961
B. Average portfolio market capitalization ($ billions)							
1	120.5	16.9	137.4	48.7	48.7	45.4	142.8
2	195.6	22.7	218.2	60.7	68.5	95.1	224.3
3	249.0	26.7	275.7	65.4	80.6	144.4	290.4
4	279.6	28.6	308.1	66.3	85.9	192.6	344.9
5	312.5	30.5	343.0	67.8	89.9	239.2	396.9

Notes: The beginning date is 30 June. "Deletions" are all *nondelisted* companies removed from the index during the prior *t* years, with *t* between 1 and 5. A deletion from the top is a stock that became included in the Russell 1000 Index after being deleted from the Rep Russell 2000. "Additions" are all companies added to the index during the prior *t* years, with *t* between 1 and 5. IPO additions are index additions with an initial CRSP listing date during the prior *t* years, with *t* between 1 and 5.

Evidence provided in **Table 3** suggests that several factors may contribute to the long-term excess returns of index deletions relative to index additions. Initially, the high returns of the deletions portfolios were driven by short-term price momentum among large companies deleted from the index. Deletions from the top averaged a 1.57 percent monthly return during the year after reconstitution. After the first year, deletions from the bottom appear to exhibit return reversal, with higher average returns than the other subportfolios. Yet, their small market cap minimizes their overall impact on the value-weighted portfolio.

Among index additions, the poor long-run performance of new issues is a dominant factor, especially in light of their large weight in the portfolio. In the study period, new-issue additions lagged the deletions portfolio by an average of 42–70 bps per month over the five years. The additions to the top suffered some negative price momentum initially but performed reasonably well after the first year. The additions to the bottom appear to have suffered return reversal as soon as they were added to the index.

Combining these return patterns, we see in the last columns of Table 3 that the deletions portfolio performed significantly better than the additions

Table 3. Average Monthly Returns of Additions and Deletions Subportfolios, 1979–2004

Years since Rebalancing	*N* (months)	Deletions			Additions				All Deletions Minus All Additions		
		Top	Bottom	All	Top	Bottom	IPO	All	Mean	*t*-Statistic	Percent Positive
1	294	1.57	1.15	1.52	0.84	0.89	0.82	0.85	0.66	3.77***	61.6%***
2	282	1.07	1.43	1.13	1.13	0.66	0.57	0.76	0.36	2.24**	55.7*
3	270	1.19	1.58	1.21	1.24	0.88	0.75	0.91	0.29	1.68*	57.0**
4	258	0.96	1.31	0.99	1.02	0.69	0.55	0.69	0.28	1.73*	56.2*
5	246	1.15	1.38	1.17	1.07	1.03	0.75	0.87	0.28	1.62*	54.9

Notes: The beginning date is 30 June. See the notes to Table 2. Significance levels for the percentage positive were determined by using the Wilcoxon signed rank test of differences.

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

portfolio. In Year 1, the deletions-minus-additions (DMA) portfolio generated average excess returns of 66 bps per month (or 7.9 percent annually), which is statistically significant at the 1 percent level. The DMA portfolio generated a positive return for 61.6 percent of the monthly observations. The DMA portfolio also provided consistently positive and statistically significant average monthly returns beyond the first post-rebalancing year; these returns were 28–36 bps per month for Years 2, 3, and 4. Only the Year 5 excess returns, despite nearly 55 percent of the months reporting a positive DMA portfolio return, are not statistically significant. Median monthly returns (not reported in Table 3) were also positive for each year. A signed rank test of the median returns produced statistically significant results for all five post-rebalancing years.

Figure 4 and Table 3 identified the significant excess returns when the additions portfolio was subtracted from the deletions portfolio. Next, we explore whether this performance is explained by various risk characteristics of the post-rebalancing portfolios. Fama and French (1993) argued that three factors, based on the market return, company size, and the company's book-to-market ratio, account for most of the cross-sectional variation in portfolio returns. Carhart (1997) added a fourth factor, a momentum factor, and the resulting four factors almost completely explain the performance persistence of equity mutual funds.

Panel A of **Table 4** shows that the positive excess returns of the DMA portfolio are highly robust to the four-factor model. During the first post-rebalancing year (Row 1), the DMA portfolio outperformed the four-factor model by a statistically significant 55 bps per month (or 6.8 percent annually). After the first year, the factor-adjusted abnormal return became slightly lower but remained positive and statistically significant at the 1 percent level.

The factor coefficients in Panel A reveal a strong negative loading on SMB (small minus big) and HML (high book-to-market ratio minus low book-to-market ratio) for each year. This result implies that large growth companies heavily influenced the returns of the value-weighted DMA portfolio in the study period. Not surprisingly, given the strong performance of the deletions portfolio, the size coefficients from these regressions also became more negative over time. Momentum was also a significant factor in the early performance of the DMA portfolio; the MOM coefficient is positive and highly significant in Years 1 and 2 and marginally significant in Year 3. The momentum factor carries no importance for Years 4 and 5.

Panel B of Table 4 reveals that index deletions still dominated index additions even after we excluded new issues (IPOs). The regression intercepts, which are relatively unchanged from those reported in Panel A, are all positive and statistically significant. Panel C confirms the poor long-run performance of new issues added to the index. The intercepts from the four-factor regressions are negative for all five years and highly significant during Years 2–5.

Index Changes and Long-Term Mutual Fund Returns

The Russell 2000 is a common benchmark for small-cap equity funds. Because index additions and deletions have the potential to materially and significantly affect long-term index returns, we next explore the impact of these changes on mutual fund performance. Specifically, we address whether small-cap equity funds benefit from holding securities deleted from the index or suffer from investing in new issues added to the index.

The mutual fund data are from the CRSP Survivor-Bias-Free U.S. Mutual Fund Database. Our initial sample included all surviving and nonsurviving funds with positive total net assets and at least 75 percent of fund assets invested in common stocks (including warrants) for each calendar year in the 1979–2004 period. We removed international equity funds to focus on funds holding mainly U.S. equities.[5] Each fund-year begins on 1 July and ends on 30 June of the following year (to coincide with the reconstitution date of the Russell 2000). As is common practice in the literature, monthly fund returns are reported net of operating expenses. Measuring fund returns before expenses would not materially alter the results.

Kim, Shukla, and Tomas (2000) found that more than one-half of all mutual funds, given the attributes of their performance, have misclassified style objectives. Thus, following Davis (2001) and Chan, Chen, and Lakonishok (2002), we identified small-cap funds according to the characteristics of each fund's recent performance. Specifically, we assigned fund-year observations with 36 months of continuous prior returns to size categories on the basis of three-factor regression coefficients in the preformation period. We classified funds with positive SMB coefficients as small cap and excluded funds with negative SMB coefficients. The final sample consists of 865 unique small-cap funds.

Table 5 reports the average coefficients from time-series regressions of monthly mutual fund returns based on the Fama and MacBeth (1973) methodology for the full sample. The available

Table 4. Time-Series Regressions of Monthly DMA Returns on Market, Size, Book-to-Market, and Momentum Factors, Data for 1979–2004
(*t*-statistics in parentheses)

Post-Rebalancing Year, *t*	Intercept	$R_m - R_f$	SMB	HML	MOM	Adjusted R^2
A. DMA portfolio						
1	0.55	–0.06	–0.34	–0.23	0.32	0.34
	(3.55)	(–1.53)	(–7.18)	(–4.00)	(9.77)	
2	0.37	–0.04	–0.41	–0.33	0.17	0.28
	(2.52)	(–1.15)	(–8.96)	(–6.16)	(5.23)	
3	0.42	–0.02	–0.42	–0.33	0.07	0.23
	(2.61)	(–0.61)	(–8.49)	(–5.64)	(1.98)	
4	0.45	–0.01	–0.56	–0.32	–0.03	0.42
	(3.33)	(–0.36)	(–13.41)	(–6.37)	(–1.02)	
5	0.34	0.03	–0.64	–0.14	–0.01	0.56
	(2.77)	(0.97)	(–17.21)	(–3.01)	(–0.25)	
B. DMA portfolio excluding IPOs						
1	0.55	–0.04	–0.32	–0.45	0.34	0.39
	(3.41)	(–1.06)	(–6.26)	(–7.47)	(9.81)	
2	0.35	0.01	–0.42	–0.55	0.15	0.37
	(2.32)	(0.32)	(–8.80)	(–9.74)	(4.49)	
3	0.39	–0.02	–0.35	–0.64	0.06	0.36
	(2.36)	(–0.38)	(–6.91)	(–10.35)	(1.61)	
4	0.42	0.04	–0.48	–0.64	–0.02	0.45
	(2.77)	(0.98)	(–10.38)	(–11.52)	(–0.51)	
5	0.24	0.10	–0.57	–0.47	–0.02	0.48
	(1.68)	(2.88)	(–13.07)	(–8.88)	(–0.50)	
C. IPO portfolio						
1	–0.31	1.22	0.93	–0.60	–0.02	0.89
	(–1.71)	(27.12)	(16.62)	(–9.05)	(–0.51)	
2	–0.48	1.23	0.89	–0.39	–0.09	0.92
	(–3.35)	(35.17)	(20.07)	(–7.33)	(–2.80)	
3	–0.49	1.20	0.93	–0.31	–0.07	0.94
	(–4.21)	(42.02)	(25.90)	(–7.15)	(–2.86)	
4	–0.49	1.87	0.91	–0.22	–0.04	0.95
	(–4.86)	(46.90)	(29.09)	(–5.85)	(–1.70)	
5	–0.46	1.17	0.92	–0.16	–0.03	0.96
	(–4.76)	(49.80)	(31.60)	(–4.46)	(–1.43)	

Notes: The beginning date is 30 June. The dependent variable in Panel A is monthly return of the DMA portfolio; in Panel B, the dependent variable is the deletions portfolio minus the non-IPO additions portfolio; in Panel C, the dependent variable is the IPO additions portfolio minus the risk-free rate, R_f. The market return, R_m, is the CRSP value-weighted index return including distributions. SMB is the average return of small companies minus the average return of large companies; HML is the average return on companies with high book-to-market ratios minus the average return on companies with low book-to-market ratios; MOM is the return of high-momentum stocks (measured by prior one-year return) minus the return of low-momentum stocks.

Table 5. Average Coefficients from Time-Series Regressions of Small-Cap Mutual Fund Monthly Returns on Factors, Data for 1979–2004
(*t*-statistics in parentheses)

Row	Intercept	$R_m - R_f$	SMB	HML	MOM	DMA_t	Non-IPO DMA_t	IPO_t	Prior Year, *t*
1	–0.12	1.05	0.35	0.09	0.03				
	(–6.62)	(125.87)	(32.02)	(5.64)	(4.21)				
2	–0.21	1.05	0.38	0.10	0.01	0.06			1
	(–10.80)	(125.89)	(32.38)	(6.59)	(1.50)	(10.00)			
3	–0.22	1.04	0.41	0.12	0.01	0.11			2
	(–11.52)	(128.91)	(33.16)	(8.19)	(1.40)	(15.13)			
4	–0.17	1.04	0.39	0.12	0.02	0.08			3
	(–8.92)	(129.78)	(31.90)	(7.87)	(2.95)	(10.68)			
5	–0.18	1.03	0.42	0.13	0.03	0.12			4
	(–8.93)	(129.57)	(31.62)	(8.67)	(4.23)	(12.02)			
6	–0.23	1.03	0.47	0.12	0.02	0.19			5
	(–10.39)	(128.93)	(34.06)	(7.91)	(3.65)	(16.75)			
7	–0.15	1.00	0.34	0.12	0.01		0.05	0.04	1
	(–7.86)	(91.62)	(27.64)	(7.64)	(1.43)		(8.51)	(5.70)	
8	–0.14	0.97	0.34	0.15	0.02		0.08	0.05	2
	(–7.32)	(82.13)	(24.48)	(9.88)	(2.21)		(12.21)	(6.45)	
9	–0.06	0.90	0.27	0.16	0.03		0.07	0.12	3
	(–2.95)	(69.02)	(17.81)	(10.90)	(3.55)		(9.44)	(10.58)	
10	–0.04	0.87	0.24	0.15	0.03		0.06	0.15	4
	(–1.75)	(54.27)	(13.47)	(10.56)	(3.74)		(6.43)	(10.69)	
11	–0.02	0.82	0.21	0.15	0.03		0.07	0.19	5
	(–0.70)	(47.63)	(11.45)	(10.15)	(3.88)		(7.66)	(12.67)	

Notes: The beginning date is 30 June. The dependent variable is the available monthly returns net of expenses for each fund minus the risk-free rate. DMA_t is the value-weighted monthly return of a portfolio that bought all stocks deleted from the Rep Russell 2000 in the prior *t* years and sold all stocks added to the index in the prior *t* years. Non-IPO DMA_t is the value-weighted monthly return of a portfolio that bought all stocks deleted from the index in the prior *t* years and sold all not-new issues added to the index in the prior *t* years. IPO_t is the value-weighted monthly return of a portfolio that bought all new issues added to the index in the prior *t* years and sold the risk-free asset. The *t*-statistics were determined by dividing the average coefficient value by its cross-sectional standard error. See also the notes to Table 4.

returns for each small-cap equity fund from July 1979 through December 2004 were regressed against factors for market return, SMB, HML, MOM, index changes, and new issues.

The models contained two sets of index change factors. The first, DMA_t, is the value-weighted monthly return of all Rep Russell 2000 deletions minus the return of all additions during the prior *t* years. Thus, DMA_t is equivalent to the time series of monthly returns for year *t* given in Table 3. The second factor, Non-IPO DMA_t, is the value-weighted monthly return of index deletions minus not-new-issue additions during the previous *t* years. The new-issue factor, IPO_t, is the value-weighted monthly return of new-issue additions during the previous *t* years minus the monthly risk-free rate. Because the factors for different values of *t* are highly correlated, we included them in the regressions one at a time.

Table 5 presents average parameter values from time-series regressions for the complete fund sample. The negative intercept in Row 1 suggests that the average small-cap fund lags the four-factor model by a statistically significant 12 bps per month. The size, style, and momentum coefficients are positive and statistically significant. Rows 2–6 confirm the impact of index changes on small-cap fund performance. The significantly positive coefficients on the DMA factors imply that these funds held positions in the deleted companies following their removal from the index. The DMA coefficients also increase as the time lag between the buy-and-hold portfolio and the current index increases. This result is consistent with mutual funds continuing to hold stocks deleted from the index and/or avoiding stocks added to the index even several years after benchmark reconstitution.

Rows 7–11 in Table 5 further decompose the DMA factor by isolating the performance of IPOs, which the literature has widely documented to exhibit poor long-term performance. The significantly positive coefficient on the IPO factor reveals that the average small-cap fund invests in new issues added to the index. Funds also increase their exposure to these new issues over time.

The DMA and non-IPO DMA factors in Rows 2 and 7 also appear to capture much of the momentum effects present in the sample. For example, the MOM coefficient falls from a highly significant 0.03 in Row 1 to an insignificant 0.01 in Row 2. This result is consistent with the strong momentum effects of the DMA portfolio reported in Table 4 over the first two post-rebalancing years. In this study, two years after index rebalancing, the DMA factors became less related to the momentum factor.

To clarify how index reconstitution influences long-term fund returns, in **Table 6**, we separated the small-cap funds into winners and losers by comparing each fund-year return with that of the Rep Russell 2000. Funds that outperformed the index for at least 70 percent of their fund-year observations were labeled "winners," and funds that outperformed the index for less than 30 percent of their fund-year observations were labeled "losers." All other funds were classified as neutral. This 70–30 rule assures that winners or losers are consistent performers over the funds' available histories. For example, to be classified as a winner, a fund with three years of history had to exceed the index in all three years and a fund with a seven-year history had to outperform in at least five years.

Panel A reports the average parameter values of the time-series regressions for 179 small-cap funds that consistently beat the Rep Russell 2000. The intercept for the winner funds in Row 1 is a positive and statistically significant 26 bps per month (or 3.12 percent annually). Including the DMA factor in Row 2 lowered the average intercept to 14 bps. This difference implies that index deletions enhance the factor-adjusted performance of winner funds by an average of 145 bps per year. The significantly positive DMA coefficients in Rows 3–6 suggest that these winner mutual funds continued to hold the deleted stocks and/or did not buy the added stocks for several years after index reconstitution. The intercepts in Rows 3–6, however, approach that of Row 1, which suggests that the performance effect of these stocks also decreased. Furthermore, the DMA coefficients are similar for the five regressions, which suggests that the winner funds do not overly invest in the deleted stocks after the initial momentum effects disappear.

Small-cap fund winners in Rows 7 and 8 of Panel A also do not appear to initially make significant investments in new issues added to the index; the average coefficient on the IPO factor is insignificant in both rows. The positive coefficients on the IPO factor in Rows 9–11 suggest, however, that fund winners increase their exposure to new issues in the third year after their initial addition to the index. Yet, these coefficients are far lower than those reported in Panels B and C for, respectively, the loser and the neutral funds. The implication is that the winner funds invest more cautiously in new issues.

The regression results for the 159 small-cap funds that consistently lagged the index are provided in Panel B of Table 6. The intercept for the loser funds in Row 1 is a negative and statistically significant 60 bps per month (or 7.44 percent annually). Yet, loser funds also benefited from holding index deletions. After including the DMA factors in Rows 2–6, we see that the average loser fund lagged the four-factor model by 69–87 bps, suggesting that the DMA portfolio augmented excess returns by an average of 14 bps per month.

In contrast to the winners, the DMA and non-IPO DMA coefficients in Panel B for the losers are initially lower during the first year, but they increase as the rebalancing date becomes farther away. This result implies that the fund losers do not benefit as much as fund winners from the initial positive momentum of the DMA portfolio. Instead, fund losers increase their exposure over time to stocks deleted from the index during much earlier years.

The poor performance of investments in new issues also appears to offset the benefits of holding the DMA portfolio for the fund losers. For example, including the IPO factor in Panel B raised the intercept from –0.69 in Row 2 to –0.56 in Row 7. Thus, new issues lowered the performance of these funds by 13 bps per month (or 1.56 percent during the first year). The average coefficients on the IPO factor in Rows 7–11 are positive and statistically significant. Much to the detriment of their long-term performance, fund losers also substantially increased their exposure to new issues over time. For example, during Year 5, investments in new-issue additions lowered fund returns by an average of 42 bps per month (–0.87 in Row 6 versus –0.45 in Row 11), which is more than 5.0 percent per year. This result contrasts sharply with the only 10 bps per month of lower returns from IPOs in Year 5 for the winner funds in Panel A.

As a final test, we examined the difference in the average coefficients on the DMA, non-IPO DMA, and IPO factors between the fund winners in Panel A and fund losers in Panel B. In Year 1, fund

Table 6. Average Coefficients from Time-Series Regressions of Small-Cap Mutual Fund Monthly Returns Categorized by Performance on Factors, Data for 1979–2004

Row	Intercept	$R_m - R_f$	SMB	HML	MOM	DMA_t	Non-IPO DMA_t	IPO_t	Prior Year, t
A. Winner small-cap equity funds (N = 179)									
1	0.26***	1.01***	0.32***	0.13***	0.03**				
2	0.14***	1.01***	0.35***	0.15***	0.00	0.10***			1
3	0.17***	1.01***	0.37***	0.16***	0.01	0.11***			2
4	0.23***	1.01***	0.35***	0.14***	0.02*	0.08***			3
5	0.23***	1.00***	0.37***	0.15***	0.03**	0.09***			4
6	0.22***	1.00***	0.40***	0.15***	0.03**	0.13***			5
7	0.17***	1.02***	0.35***	0.15***	–0.01		0.08***	–0.01	1
8	0.20***	1.02***	0.36***	0.16***	0.01		0.08***	–0.01	2
9	0.27***	0.95***	0.30***	0.17***	0.02		0.06***	0.05**	3
10	0.29***	0.94***	0.28***	0.16***	0.03**		0.03*	0.06**	4
11	0.32***	0.88***	0.24***	0.17***	0.03**		0.04**	0.11***	5
B. Loser small-cap equity funds (N = 159)									
1	–0.60***	1.17***	0.45***	–0.04***	0.06***				
2	–0.69***	1.17***	0.48***	–0.01	0.04***	0.05***			1
3	–0.74***	1.16***	0.53***	0.02	0.03*	0.14***			2
4	–0.69***	1.16***	0.53***	0.03	0.05***	0.13***			3
5	–0.69***	1.15***	0.56***	0.04	0.06***	0.18***			4
6	–0.87***	1.14***	0.66***	0.02	0.05***	0.35***			5
7	–0.56***	1.08***	0.38***	0.03***	0.05***		0.04**	0.08***	1
8	–0.53***	1.02***	0.37***	0.07***	0.04**		0.11***	0.11***	2
9	–0.43***	0.94***	0.30***	0.08**	0.06***		0.10***	0.18***	3
10	–0.39***	0.86***	0.24***	0.06**	0.05***		0.09***	0.24***	4
11	–0.45***	0.83***	0.26***	0.07***	0.05***		0.19***	0.26***	5
C. Neutral small-cap equity funds (N = 527)									
1	–0.11***	1.02***	0.34***	0.11***	0.02**				
2	–0.18***	1.02***	0.36***	0.12***	0.00	0.06***			1
3	–0.20***	1.02***	0.38***	0.14***	0.00	0.10***			2
4	–0.15 ***	1.01***	0.37***	0.13***	0.01	0.07***			3
5	–0.16 ***	1.01***	0.40***	0.15***	0.02**	0.12***			4
6	–0.19 ***	1.01***	0.44***	0.14***	0.02*	0.16***			5
7	–0.14 ***	0.98***	0.32***	0.14***	0.00		0.05***	0.04***	1
8	–0.14 ***	0.94***	0.33***	0.16***	0.01		0.08***	0.06***	2
9	–0.06 ***	0.87***	0.25***	0.18***	0.02*		0.07***	0.12***	3
10	–0.04	0.84***	0.23***	0.17***	0.02*		0.05***	0.15***	4
11	0.00	0.79***	0.18***	0.17***	0.02**		0.05***	0.19***	5

Notes: The beginning date is 30 June. The dependent variable is the available monthly returns net of expenses for each fund minus the risk-free rate. "Winners" are funds that outperformed the index for at least 70 percent of their fund-year observations. "Losers" are funds that outperformed the index for less than 30 percent of their fund-year observations. "Neutral" are all other funds. The statistical significance of a coefficient was determined by the *t*-statistic (unreported) that equaled the average coefficient value divided by its cross-sectional standard error. See also the notes to Table 4 and Table 5.

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

winners reported a higher coefficient than fund losers on both the DMA (*t*-statistic of 2.17) and non-IPO DMA (*t*-statistic of 2.19) factors, indicating that winners received greater benefit from the strong initial performance of the deleted companies. Fund losers reported higher DMA and non-IPO DMA coefficients, however, than fund winners for Years 2–5. These differences are statistically significant at the 5 percent level or higher for three out of the four years for the DMA factor and two years for the non-IPO DMA factor. This result suggests that these fund losers increased their exposure to the deleted stocks after the first post-rebalancing year. Possibly, these fund managers were chasing the performance of the strongest performing stocks but captured little of the initial positive momentum.

Finally, fund winners have a significantly lower coefficient on the IPO factor than fund losers in all five regressions, indicating that the winners tend to avoid the poor performance associated with new issues.

Possible Application to Other Indices

Our analysis focused exclusively on the long-term performance of additions and deletions to the Russell 2000. The results demonstrate that short-term momentum and the poorly performing new issues can substantially affect long-term index returns. Because these attributes are not unique to the Russell 2000, we considered to what extent we might observe similar long-term performance effects in other leading stock indices. We expect several factors—index construction methodology, the frequency of index rebalancing, and the benchmark style tracked by the index—might have important effects.

Any index that adds or deletes companies on the basis of their relative size and performance is susceptible to both positive and negative momentum effects. For example, small-cap and mid-cap equity indices must routinely remove many of the strongest performing companies if the market capitalization of a company becomes unrepresentatively large. These indices may also replace the growing companies with ones that recently experienced a period of weak stock performance. We speculate that the mid-cap S&P 400 and small-cap S&P 600 indices would be susceptible to these effects. For them, if large index deletions continue to outperform large index additions after rebalancing, then we would observe lower long-term index returns than those of a buy-and-hold strategy. Thus, small-cap and mid-cap money managers might benefit by continuing to hold companies recently deleted from their benchmark index.

In contrast, large-cap indices, such as the S&P 500, DJIA, and NASDAQ 100, never remove companies for performing too well or growing too large. Yet, their selection methodologies occasionally result in replacing poor performers that become too small or "unrepresentative" for inclusion in a large-cap index. In the case of the DJIA and the S&P 500, index replacements are selected by an internal committee. The replacements are often companies that are experiencing solid operating performance and positive momentum. We propose that by replacing poor performers with strong performers, large-cap indices might actually boost their long-term returns relative to a buy-and-hold strategy. If so, large-cap fund managers face more difficulty than other managers in managing a portfolio that outperforms their benchmark.

Several factors may reduce the quantifiable impact of index rebalancing in practice, especially among large-cap indices. First, most equity indices are capitalization weighted, so the larger companies have a greater effect on index performance. By the time a poorly performing constituent is removed from an index, its overall portfolio weight is likely to have become small relative to the larger holdings. Second, large-cap indices typically experience fewer constituent changes than small-cap and mid-cap indices. For example, the average turnover of the S&P 500 during our sample period was approximately 5 percent per year, in contrast to nearly 23 percent turnover for the Russell 2000. Finally, the indices usually require various degrees of seasoning before a recent IPO is added to its membership. The Frank Russell Company currently considers new issues for inclusion in its indices 3 months after the IPO date, whereas Standard & Poor's requires a minimum of 6–12 months of seasoning and four consecutive quarters of positive reported earnings.

Conclusion

Our study is among the first to evaluate the long-term performance of index composition changes. We examined annual additions and deletions of the small-cap Russell 2000 from mid-1979 through 2004. We found that a buy-and-hold portfolio significantly outperformed an annually rebalanced Rep Russell 2000 by an average of 2.22 percent during the first year and by 17.29 percent for up to five years after reconstitution. More importantly, we found these excess returns to be highly robust across the sample period and they did not require short sales or entail large transaction costs. These results imply that rebalancing can measurably affect long-run index returns.

We attribute a portion of these excess returns to two unique factors: strong short-term momentum on the part of index deletions and poor long-term returns on the part of new-issue additions. These attributes are not necessarily confined to the Russell 2000, however, so we conjecture that all indices that add or delete companies on the basis of performance are susceptible to momentum effects. For example, small- and mid-cap equity indices must routinely remove companies following strong returns as their market capitalization becomes too large. Large-cap indices often replace poor performers with companies selected for their strong future prospects. Our study illustrates the importance of understanding the effect of all periodic rebalancing on index performance and portfolio evaluation.

We also show that index rebalancing influences mutual fund returns. The strongest performing small-cap equity funds improved their factor-adjusted returns by an average of 145 bps per year by holding companies deleted from the Rep Russell 2000. Among poorly performing funds, the benefits of holding companies deleted from the index were offset by poor returns of the new issues added to the index, which the stronger performing funds generally avoided. These results suggest that index construction methodology may provide a structural incentive for portfolio managers to drift or deviate from their benchmark styles. To the extent that portfolio managers are evaluated on the basis of their index-adjusted returns, this study highlights the importance of understanding how index rebalancing can also affect inferences about a fund manager's ability. Fund managers who outperform their benchmarks may not necessarily have exhibited skill at discovering underlying inefficiencies in the market; they may have exploited structural inefficiencies in the construction of their benchmarks.

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This article qualifies for 1 CE credit.

Notes

1. See, among others, Harris and Gurel (1986); Shleifer (1986); Jain (1987); Dhillon and Johnson (1991); Beneish and Gardner (1995); Beneish and Whaley (1996); Lynch and Mendenhall (1997); Denis, McConnell, Ovtchinnikov, and Yu (2003); Elliott and Warr (2003); Hegde and McDermott (2003); Becker-Blease and Paul (2006); Chen, Noronha, and Singal (2006); Elliott, Van Ness, Walker, and Warr (2006); Cai (2007).
2. See Siegel (2006); Bogle and Malkiel (2006); Arnott, Hsu, and Moore (2005); and Perold (2007).
3. On average, 126 companies are delisted between annual reconstitution dates. The number of deletions ranged from a low of 72 companies in 1991 and 1993 to a high of 250 companies in 2000.
4. Booth and Fama (1992) showed that a portfolio of stocks with constant weights (instantaneously rebalanced) provides higher returns than the average of each stock's buy-and-hold returns (not rebalanced). Similarly, Erb and Harvey (2006) found that the returns of a regularly rebalanced portfolio of commodity futures are higher than the average and median buy-and-hold returns of the commodity futures in the portfolio. In both studies, the higher return of the rebalanced portfolio is a result of the portfolio's low variance. This effect may also have occurred in our study; if so, it worked *against* our finding higher returns for the buy-and-hold portfolio than for the reconstituted index. Our findings are driven mainly by the changes in the components of the index.
5. We removed funds with the following style-objective codes: Wiesenberger fund codes of INT (international equities) and C&I (Canadian and international); ICDI fund codes of GE (global equities) and IE (international equities); Strategic Insight Mutual Fund Research and Consulting fund codes for international equities (ECH, ECN, EGG, EGS, EGT, EGX, EID, EIG, EIS, EIT, EJP, ELT, EPC, EPX, ERP, ESC, FLG, and GLE). We also excluded any fund-year observation if the code was missing from all three sources.

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