The Long-Term Impact from Russell 2000 Rebalancing

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Abstract

This study examines the long-term impact of Russell 2000 index rebalancing on portfolio evaluation. We find that a buy-and-hold index portfolio significantly outperforms the annually rebalanced index by an average of 2.22% over one year and 17.29% over five years. While short-term momentum and the poor long-term returns of new issues partially explain these returns, index deletions provide significantly higher factor-adjusted returns than index additions. Some small-cap fund managers also appear to capture a portion of these benefits. The strongest performing funds enhance their factor-adjusted returns by an average of 1.45% per year by holding index deletions and/or avoiding index additions. Among the weakest performing funds, higher returns from holding index deletions are offset by the poor returns of new issues added to the index, which the strongest performing funds initially avoid. Thus, index methodology may provide a structural incentive for portfolio managers to drift from their benchmark.

Summary

This study illustrates the impact of rebalancing on long-term index performance and portfolio evaluation. An equity index provides a performance snapshot for a specific segment of the market. Index providers must periodically rebalance these benchmark portfolios as the characteristics of individual holdings change. Examining additions and deletions to the Russell 2000 small-cap index from 1979-2004, we find that a buy-and-hold portfolio significantly outperforms the annually rebalanced index by an average of 2.22% over one year and by 17.29% over five years. Part of these excess returns are explained by strong short-term momentum effects. Stocks with good performance grow too big for the small-cap index and continue to have superior performance after being deleted from the index, while stock with poor performance become small enough to enter the index and continue to generate low returns. In the first year after index rebalancing, the deleted stocks outperform the added stocks by 67 basis points per month. Poor long-term returns of new issues also contribute to the lower returns of the added stocks. These stocks lag the deletions portfolio by an average of 42 to 56 basis points per month through year five. Further, the excess returns cannot be explained by the popular risk factors. Using the Fama-French-Carhart four-factor model, we estimate that the stocks deleted from Russell 2000 index outperforms the stocks added to the index by 55 basis points per month after controlling for beta, size, book-to-market, and momentum risks. We also document that some small-cap mutual fund managers capture a portion of these performance benefits. Holding index deletions and/or avoiding index additions enhance risk factor-adjusted returns of the strongest performing funds by an average of 1.45% per year. Among weaker performing funds, the benefits from holding index deletions are offset by the poor returns of new issues added to the index, which the stronger performing funds initially avoid. Our results suggest that index methodology may provide a structural incentive for portfolio managers to drift from their benchmark.

The Long-Term Impact from Russell 2000 Rebalancing

An equity index provides a performance snapshot for a specific segment of the market, such as small-, mid-, or large-capitalization stocks. Index providers must periodically rebalance these benchmark portfolios as the characteristics of individual holdings change. Mergers, acquisitions, spin-offs, initial public offerings, bankruptcies, exchange delistings, and overall market performance may trigger index reconstitution.

This study examines the long-term impact of index rebalancing. Specifically, we address two questions: Does index reconstitution influence long-term index returns? And if so, do portfolio managers use these trends to gain an advantage over their benchmark?

Sharpe (1992) and Fama and French (1993) highlight 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 affords little attention to the long-term effects of index construction and design. Instead, 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.

An index is not necessarily a passive benchmark. The underlying portfolio is often actively rebalanced to assure that the index properly tracks the performance of its market objective. Given the critical role that indexes serve in the evaluation and compensation of portfolio managers, it is important to understand how index changes might impact long-term portfolio returns relative to the benchmark.

In a related study, Keim (1999) shows how investment rules and trading strategies contribute to the long-term performance of a specific small-cap index fund. Keim demonstrates

[1] See 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), and Cai (2007), among others.

that by excluding very illiquid, low-price stocks, the fund avoids excessive trading costs while continuing to provide its investors with similar returns and risks as its small-cap benchmark. Our analysis compares a buy-and-hold index strategy with minimal transactions costs to one with periodic reconstitution. This approach is similar to Siegel and Schwartz (2006) who find that the original companies of the S&P 500 index in 1957 have provided higher returns and lower risk than the continually updated index.

We examine the long-run performance associated with changes to the small-cap Russell 2000 index from 1979-2004. The annual reconstitution and publicly disclosed construction methodology of Russell indexes create a natural event study. We show that a buy-and-hold index portfolio significantly outperforms the annually rebalanced index by an average of 2.22% over one year and by 17.29% over five years. These excess returns are highly robust across the sample period, and unlike many anomalies found in the literature, do not require short sales and are not subject to large transaction costs. The evidence implies that periodic rebalancing can measurably and significantly impact long-run index returns.[2]

The buy-and-hold excess returns result from two unique factors. First, strong momentum effects dominate the short-run performance, especially among firms removed from the index. During the first post-rebalancing year, a value-weighted portfolio of index deletions return an average of 1.52% per month compared to only 0.87% for non-new issue index additions. Although positive throughout the five-year horizon, this differential narrows considerably after the first year. Our evidence echoes the recent findings by Fama and French (2007) that the size premium is almost entirely generated by the small-capitalization stocks that earn extreme positive returns and thus become big-cap stocks. Second, the poor returns of new issues added to the

[2] Booth and Fama (1992) show 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) find 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 impact our study, and it works against us in finding higher returns for the buy-and-hold portfolio than the reconstituted index. Our findings are mainly driven by the changes in the components of the index.

index drive long-term excess returns. New issue additions (e.g., initial public offerings) lag the deletions portfolio by an average of 42 to 56 basis points per month through year five.

We also measure the impact of index changes on long-term mutual fund returns. Specifically, we address whether small-cap equity funds benefit by investing in firms deleted from the Russell 2000 index or by avoiding investments in new issues added to the index. We find that index deletions enhance the risk factor-adjusted returns of the strongest performing funds by an average of 1.45% per year. Although similar returns also accrue to the worst performing funds, it appears that gains from index deletions are offset by the poor performance of investments in new issues added to the index. In contrast, the best performing funds appear to initially avoid the new issues.

These results suggest that index construction methodology may provide a structural bias or incentive for portfolio managers to drift from their benchmark style. Given the recent growth and popularity of index mutual funds and exchange traded funds, our study highlights the importance of understanding the long-term impact of periodic rebalancing on index performance and portfolio evaluation. The rest of the paper is organized as follows. Section I describes the index construction and sample selection methodology. Section II examines the impact of additions and deletions on the long-run performance of the Russell 2000 index. Section III explores the impact of these changes on mutual fund returns. Section IV discusses the application of our results to alternative indices. Section V concludes.

I. Index Construction and Sample Selection Methodology

Index providers employ various methodologies to construct and reconstitute equity benchmarks. Table 1 contrasts the characteristics of seven leading US equity indexes: the Russell 2000, Standard & Poor's (S&P) 600, S&P 400, Dow Jones Industrial Average (DJIA), Nasdaq 100, S&P 500, and Dow Jones Wilshire 5000. Each index targets a specific segment of the

market, such as small-, mid- or large-cap stocks. 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 indexes are weighted by total or adjusted market capitalization. Value-weighted indexes are easier to replicate, 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, and in 2005 S&P began using float-adjusted capitalization to construct its popular indexes. Recent debates have also questioned whether indexes weighted by fundamental factors such as dividends might provide better long-term performance.[3]

We examine the long-run performance associated with changes to the Russell 2000 index, a leading small-capitalization stock index. The Frank Russell Company initiated the index on December 31, 1978. Daily index levels are calculated from value-weighted portfolio returns assuming dividend reinvestment.

Exploring the Russell 2000 provides several key methodological advantages to our study. First, Russell indexes are reconstituted on specific dates each year using a procedure that allows for a natural event study. Second, Russell indexes are relatively simple to replicate since their construction methodology is clearly defined and publicly available. In contrast, S&P indexes are reconfigured when necessary utilizing a proprietary selection process. Finally, constituent changes to Russell indexes are generally predictable and known well before their effective 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 May 31 total market capitalization (from largest to smallest adjusted for cross-ownership). This ranking excludes preferred issues, convertible securities, closed-end mutual funds, limited partnerships, royalty trusts, bulletin board securities, pink sheet stocks, foreign securities, and American

[3] For example, see "The 'Noisy Market' Hypothesis," by Jeremy J. Siegel, *The Wall Street Journal*, June 14, 2006, p. A14; "Turn on a Paradigm?" by John C. Bogle and Burton G. Malkiel, *The Wall Street Journal*, June 27, 2006, p. A14; Arnott, Hsu, and Moore (2005); and Perold (2007).

Depository Receipts (ADRs). The 1,000 largest companies become the Russell 1000 index. The next 2,000 largest companies form the Russell 2000 index, representing approximately 9% of the total market value of all U.S. equities or approximately $1.35 trillion.

Since membership is based on May 31 size rankings, index changes are publicly available prior to the June 30 reconstitution date. Russell also releases roster updates throughout the month of June. During this period, the next available firm 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 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 initial public offerings (IPOs) to its indexes on a quarterly basis provided the firm meets the minimum capitalization requirements for inclusion. Eligible IPOs must have gone public within the three months prior to their inclusion.

II. The Long-Run Impact of Russell 2000 Additions and Deletions

We obtain Russell 1000 and Russell 2000 membership rosters for each reconstitution date directly from the Frank Russell Company. Our analysis includes all index constituents as of June 30 from 1979 to 2004 with available information on the Center for Research in Security Prices (CRSP) database. During the course of our sample period, an average of 1,999 out of 2,000 index members is available from CRSP each year.

The Russell indexes were rebalanced quarterly from 1979 to 1986 and semi-annually from 1987 to 1989. Russell adopted annual rebalancing on June 30, 1989 in a move to reduce the transaction costs associated with index replication. Since we compare the performance of a buy-and-hold portfolio against a replicated index, and not the actual index itself, more frequent rebalancing in the early years of the Russell's history has no impact 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 firms or nearly 23% of the index holdings each year. The annual turnover ranges from a low of 309 companies in 1980 to a high of 690 companies in 2000. Since delisted securities are not replaced between reconstitution dates, the number of additions always exceeds the number of deletions.[4]

The figure also includes 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 firms or approximately 30% of the companies added to the index each year are new issues. Most of these new issues are initial public offerings over the prior year.

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

Given the sizeable turnover of the index each year, it is also natural to question the long-term effect of these changes on index performance. To study this issue, we replicate the index using the methodology outlined by Russell. We measure daily index returns by value-weighting individual security returns with dividend reinvestment. Deleted securities are not replaced between reconstitution dates. This approach is designed to minimize the potential impact of survivorship bias while providing returns similar to those a long-term buy-and-hold investor could expect to receive.

Our procedure deviates from the actual Russell methodology in two ways. First, we cannot adjust market values for cross ownership or privately held shares since this information is

[4] On average, 126 firms are delisted between annual reconstitution dates. The number of deletions range from a low of 72 firms in 1991 and 1993 to a high of 250 firms in 2000.

unavailable in the CRSP database. Instead, we compute the daily market value of each firm using the total number of shares outstanding as reported by CRSP. Second, we do not add eligible spin-off or IPO firms to the index between reconstitution dates, which simplifies the event study by focusing on index changes from the annual June 30th rebalancing period. In spite of these methodological differences, the replicated index closely tracks the actual Russell index.

Figure 2 overlays the cumulative monthly performance of the replicated index against the Russell 2000 index from June 30, 1979 to December 31, 2004. 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% 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 2 compares a buy-and-hold strategy without rebalancing to the annually rebalanced (replicated) Russell 2000 index for up to five years after each reconstitution date. The buy-and-hold portfolio outperforms the rebalanced index by a statistically significant average return of 2.22% during the first year after portfolio reconstruction. The strategy generates positive excess returns for 80% of the one-year holding periods. Thus, periodic rebalancing can measurably and significantly impact long-run index returns.

One curious data point in Table 2 is the strong 13.04% excess returns associated with the 1999 rebalancing, a year which coincides with the peak of the technology bubble. Removing this observation from the sample lowers the average 1-year excess return to a still statistically significant 1.77%. Our examination of the index membership changes for 1999 did not reveal just one or two strong performers. Instead, we find 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 firms continued to perform well over the following year before the bubble began to burst in 2000. The data also captures the corresponding market correction as the excess return for the two-year holding period of the 1999 rebalancing fell to just 1.28%. Similar patterns

are observed in the data for the 1997 and 1998 rebalancing periods that coincide with the peak of the tech bubble.

The average post-rebalancing buy-and-hold excess return in Table 2 widens to 17.29% after five years and is positive in all 21 of the five-year holding periods. Because the long-term excess returns are measured across overlapping time periods, we must use some caution when interpreting their statistical significance. Yet, a mostly different group of firms determines this performance each period. Since the excess returns capture the difference between a buy-and-hold index and the annually reconstituted index, index additions and deletions for each rebalancing period will create the excess returns over the subsequent period. By definition, a firm 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 firms that bounce back-and-forth between index membership inclusion and exclusion.

To better understand the impact of the buy-and-hold strategy compounded over time, Figure 3 compares the cumulative monthly value of $1.00 invested in the annually rebalanced Russell 2000 index to a buy-and-hold portfolio that delays rebalancing for one year. The buy-and-hold strategy is similar to holding the prior year's rebalanced index (as of June 30) for one year. Over the sample horizon, the delayed rebalancing strategy achieves a nearly 60% higher ending value ($28.42 vs. $17.77) and a geometric average excess return of 1.93% 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 to the annually rebalanced index. The excess returns provided in Table 2 suggest that a longer holding period between rebalancing dates would likely lead to even greater compounded excess returns over the index.

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 index and the rebalanced index, we form portfolios of index deletions and additions for each initial rebalancing date. The constituents of each portfolio are adjusted annually for up to five

years after reconstitution. For example, if the Russell 2000 index is rebalanced on June 30, 1980, then the deletion portfolio on September 1, 1981 includes index deletions from both June 30, 1980 and June 30, 1981. At each subsequent rebalancing date for up to five years, newly deleted (added) companies are added to the deletions (additions) portfolio.

Figure 4 reveals the average five-year cumulative returns of the new issue additions, non-new issue additions, and deletions portfolios. As expected, deleted firms realized higher average returns than added firms across the five-year period. For example, the deletions portfolio outperforms the non-new issue additions by an average of 8.9% over the first year and by 28.1% over five years. This differential widens across each of the five years. The figure also shows the poor long-run performance of new issue additions, which mostly consist of IPOs. On average, the new issues portfolio lags the deletions portfolio by 40.1% over the five-year period.

As previously noted, during most of our sample, Russell index membership is based on annual market capitalization rankings. Although some firms delist between reconstitution dates, many firms are removed from the index when their relative size ranking changes. Some firms drop out from the top of the index for becoming too large, while others drop out from the bottom for becoming too small. On average, firms deleted from the top of the index realized a 69% return over the year prior to reconstitution, compared to a -36% return for firms deleted from the bottom. Relative performance also effects index additions. Large firms may enter from the top of the index following a period of relatively poor performance, while small firms may enter from the bottom of the index following relatively strong performance. Over the prior year, firms entering from the top of the index averaged a -28% return, while firms entering from the bottom of the index averaged a 53% return.

Table 3 provides summary statistics for sub-portfolios of index additions and deletions over the five-year, post-rebalancing period. To classify deletions and non-new issue additions, we use the composition of the large-cap Russell 1000 index. If a firm deleted from Russell 2000 appears in the Russell 1000 next period, we categorize it as deleted from the top of the Russell

2000 portfolio. Otherwise, it is deleted from the bottom of the index. Non-new issue index additions are classified in similar fashion. Because Russell does not replace delisted or bankrupt firms throughout the year, the total number of additions is substantially higher than the number of deletions on the rebalancing date.

In Panel A, firms deleted for becoming too small outnumber firms deleted for becoming too large by almost a 2-to-1 ratio, while small additions outnumber large additions by more than a 3-to-1 ratio. We also find that over time new issues (IPOs, spin-offs, etc.) comprise a substantial portion of all index additions, 36.5% (127/348) in year 1 and 67.6% (650/961) in year 5. Panel B of Table 3 shows the total capitalization of the top and bottom additions and deletions. The top deletions portfolio dominates the size of the bottom deletions portfolio by nearly a 10-to-1 ratio. This evidence suggests that the strong performance of the deletions portfolio in Figure 4 is primarily driven by large firms that continue to perform well after their removal from the index. In contrast, the total capitalization of top and bottom additions is roughly equal in the years after rebalancing.

Evidence provided in Table 4 suggests that several factors may contribute to the long-term excess returns of Russell 2000 index deletions relative to index additions. Initially, the high returns of the deletion portfolios are driven by short-term price momentum among large firms deleted from the index. Top deletions averaged a 1.57% monthly return during the year after reconstitution. After the first year, small deletions appear to exhibit return reversal and have higher average returns than other sub-portfolios. Yet, their small size 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 given their large weight in the portfolio. New issue additions lag the deletions portfolio by an average of 70 to 42 basis points per month over the five years. The top additions suffer some negative price momentum initially, but perform reasonably well after the first year. The bottom additions appear to suffer return reversal as soon as they are added to the index.

Combining these return patterns, the deletions portfolio performs significantly better than the additions portfolio. In year one, the deletions minus additions (DMA) portfolio generates average excess returns of 66 basis points per month or 7.9% annually, which is statistically significant at the 1% level. The DMA portfolio generates a positive return for 61.6% of the monthly observations. The DMA portfolio also provides consistently positive and statistically significant average monthly returns beyond the first post-rebalancing year, ranging from 36 to 28 basis points per month across years two, three, and four. Only the year five excess returns are not statistically significant, despite nearly 55% of the months reporting a positive DMA portfolio return. Although not reported in the table, median monthly returns are also positive across each year. A signed-rank test of the medians returns reveals statistically significant results for all five post-rebalancing years.

Figure 4 and Table 4 identify the significant excess returns between the deletion and addition portfolios. Next, we explore whether this performance is explained by different risk characteristics of the post-rebalancing portfolios. Fama and French (1993) contend that three factors based on market returns, size, and book-to-market ratios account for most of the cross-sectional variation in portfolio returns. Carhart (1997) includes a fourth momentum factor to almost completely explain the performance persistence across equity mutual funds.

Panel A of Table 5 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 deletions minus additions portfolio outperforms the four-factor model by a statistically significant 55 basis points per month or 6.8% annually. After the first year, the factor-adjusted abnormal return becomes slightly lower, but remains positive and statistically significant at the 1% level.

The factor coefficients in Panel A reveal a strong negative loading on the SMB (small minus big) and HML (high book-to-market minus low book-to-market) factors across each year. This result implies that large growth firms heavily influence the returns of the value-weighted DMA portfolio. Not surprisingly, given the strong performance of the deletions portfolio, the

size coefficients from these regressions also become more negative over time. Momentum is also a significant factor in the early performance of the DMA portfolio, as the MOM coefficient is positive and highly significant in years one and two and marginally significant in year three. The momentum factor carries no importance for years four and five.

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

III. Index Changes and Long-Term Mutual Fund Returns

The Russell 2000 index is a common benchmark for small-cap equity funds. Since 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 obtained from the CRSP Survivor Bias-Free U.S. Mutual Fund Database. Our initial sample includes all surviving and non-surviving funds with positive total net assets and at least 75% of fund assets invested in common stocks (including warrants) for each calendar year from 1979-2004. We remove international equity funds to focus on funds holding mainly U.S. equities.[5] Each fund year begins on July 1 and ends on June 30 of the following year to coincide with the reconstitution date of the Russell 2000 index. As is common

[5] We remove funds with the following objective codes: Wiesenberger fund codes of INT (international equity) and C&I (Canadian and international); ICDI fund codes of GE (global equity) and IE (international equities); and Strategic Insight fund codes relating to international equities (ECH, ECN, EGG, EGS, EGT, EGX, EID, EIG, EIS, EIT, EJP, ELT, EPC, EPX, ERP, ESC, FLG, and GLE). We also exclude any fund-year observation if the objective code is missing from all three sources.

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) find that over half of all mutual funds have misclassified style objectives given the attributes of their performance. Thus, following Davis (2001) and Chan, Chen, and Lakonishok (2002), we identify small-cap funds according to the characteristics of each fund's recent performance. Specifically, we assign fund-year observations with 36 months of continuous prior returns to size categories on the basis of three-factor regression coefficients over the preformation period. We classify funds with positive SMB coefficients as small-cap and exclude funds with negative SMB coefficients. The final sample includes 865 unique small-cap funds.

Table 6 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 returns for each small-cap equity fund from July 1979 through December 2004 are regressed against factors for market return, size, book-to-market, momentum, index changes, and new issues. The reported t-statistics are determined by dividing the average coefficient value by its cross-sectional standard error.

The models contain two different sets of index change factors. The first, DMA_t, is the value-weighted monthly return of all Russell 2000 deletions minus the return of all index additions during the prior *t* years. Thus, DMA_t is equivalent to the time-series of monthly returns for year *t* of Table 4. The second factor, Non-IPO DMA_t, is the value-weighted monthly return of index deletions minus non-new issue additions during the last *t* years. The new issues factor, IPO_t, is the value-weighted monthly return of new issue additions during the last *t* years less the monthly risk-free rate. Since the factors for different *t* are highly correlated, we include them in the regressions one at a time.

Table 6 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 basis point per month. The size, style, and momentum coefficients are positive and statistically significant. Rows (2) thru (6) confirm the impact of index changes on small-cap fund performance. The significantly positive coefficients on the DMA factors imply these funds hold positions in the deleted firms following their removal from the index. The DMA coefficients also increase as the time lag between the buy-and-hold index portfolio and the current index. This result is consistent with mutual funds that continue to hold stocks deleted from the index and/or avoid stocks added to the index even several years after benchmark reconstitution.

Rows (7) thru (11) in Table 6 further decompose the DMA factor by isolating the performance of new issues (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 5 over the first two post-rebalancing years. Two years after index rebalancing, the DMA factors become less related to the momentum factor.

To better understand how index reconstitution influences long-term fund returns, in Table 7 we further separate the small-cap funds into winners and losers by comparing each fund-year return to the Russell 2000 index. Funds that outperform the index over at least 70% of their fund-year observations are labeled as winners, while funds that outperform the index less than 30% of their fund-year observations are labeled losers. All other funds are classified as neutral. This 70-30 rule assures that winners or losers are consistent performers over the funds available history.

For example, to be classified as a winner, a fund with three years of history must exceed the index all three years, while a fund with a seven year history needs 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 Russell 2000 index. The intercept for the winner funds in row (1) is a positive and statistically significant 26 basis points per month or 3.12% annually. Including the DMA factor in row (2) lowers the average intercept to 14 basis points. This difference implies that index deletions enhance the factor-adjusted performance of winner funds by an average of 1.45% per year. The significantly positive DMA coefficients in rows (3) through (6) suggest that these winner mutual funds continue to hold the deleted stocks and/or do not buy the added stocks for several years after index reconstitution. However, the intercepts in rows (3) to (6) become closer to that of row (1), suggesting that the performance impact of these stocks also becomes smaller. Furthermore, the DMA coefficients are similar across the five regressions, suggesting 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) 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. However, the positive coefficient on the IPO factor in rows (9) through (11) suggests 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 the neutral and loser funds, respectively. This indicates that the winner funds invest more cautiously in new issues.

The regression results for the 159 small-cap funds that consistently lag the Russell 2000 are provided in Panel C of Table 7. The intercept for the loser funds in row (1) is a negative and statistically significant 60 basis points per month or 7.44% annually. Yet, loser funds also benefit from holding index deletions. After including the DMA factors in rows (2) through (6), the

average loser fund lags the four-factor model by 69 to 87 basis points, suggesting the DMA portfolio augments excess returns by an average of 14 basis points per month.

In contrast to the winners, the DMA and non-IPO DMA coefficients in Panel C are initially lower during the first year, but 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 C raises the intercept from -0.69 in row (2) to -0.56 in row (7). Thus, new issues lower the performance of these funds by 13 basis points per month or 1.56% during the first year. The average coefficients on the IPO factor in rows (7) thru (11) are positive and statistically significant. Much to the detriment of their long-term performance, fund losers also substantially increase their exposure to new issues over time. For example, during year 5 investments in new issue additions lower fund returns by an average of 42 basis points per month (-0.87 versus -0.45) or more than 5.0% per year. This sharply contrasts with only 10 basis points 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 C. In year 1, fund winners report 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 receive greater benefit from the strong initial performance of the deleted firms. However, fund losers report higher DMA and non-IPO DMA coefficients than fund winners for years 2 thru 5. These differences are statistically significant at the 5% 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 fund losers increase their exposure to the deleted stocks after the first post-rebalancing year. It is possible

that these fund managers chase the performance of the strongest performing stocks but capture little of the initial positive momentum. Finally, fund winners show 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.

IV. Application to Alternative Indexes

Our analysis to this point has focused exclusively on the long-term performance of additions and deletions to the Russell 2000 index. Our results demonstrate that short-term momentum and the poorly performing new issues can substantially impact long-term index returns. Since these attributes are not unique to the Russell 2000, to what extent might we observe similar long-term performance effects in other leading stock indexes? Several factors likely play an important role, such as index construction methodology, the frequency of index rebalancing, and the benchmark style tracked by the index.

We conjecture that any index which adds or deletes firms based on their relative size and performance are susceptible to both positive and negative momentum effects. For example, small- or mid-cap equity indexes must routinely remove many of the strongest performing firms if their market capitalization becomes unrepresentatively large. These indexes may also replace the growing firms 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 index are potentially susceptible to these momentum effects. If large index deletions continue to outperform large index additions after rebalancing, then we may observe lower long-term index returns compared to a buy-and-hold index strategy. Thus, small-cap and mid-cap money managers may benefit by continuing to hold firms recently deleted from their corresponding benchmark index.

In contrast, large-cap indexes, such as the S&P 500, Dow Jones Industrial Average, or Nasdaq 100, never remove firms for performing too well or growing too large. Yet, their selection methodologies will occasionally result in replacing poor performers that become too

small or "unrepresentative" for inclusion in a large-cap index. In the case of the Dow and the S&P 500, index replacements are hand-selected by an internal committee. These replacements are often firms which are experiencing solid operating performance and positive momentum. We propose that by replacing poor performers with strong performers, large-cap indexes may actually boost their long-term returns relative to a buy-and-hold index strategy. If so, large-cap fund managers face greater difficulty managing a portfolio that outperforms their benchmark.

While momentum effects may influence long-term returns of other indexes as described above, several factors potentially reduce the quantifiable impact of index rebalancing in practice, especially among large-cap indexes. First, most equity indexes are capitalization weighted, so larger firms have a greater impact on index performance. By the time a poor performing constituent is removed from an index, its overall portfolio weight is likely very small relative to the larger holdings. Second, large-cap indexes are typically experience fewer constituent changes than small and mid-cap indexes. For example, the average turnover of S&P 500 index during our sample period was approximately 5% per year, compared with nearly 23% turnover for the Russell 2000. Finally, indexes generally require different degrees of seasoning before a recent IPO is added to its membership. Russell currently considers new issues for inclusion in its indexes 3 months after the IPO date, while S&P requires a minimum of 6-12 months of seasoning along with four consecutive quarters of positive reported earnings.

V. Summary and Conclusion

Indexes provide a performance benchmark for a specific segment of the market. Although many leading indexes 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. These portfolios are rebalanced periodically as the characteristics of individual holdings evolve. While these changes impose short-term costs on portfolios that mimic the index, the question of how index reconstitution impacts long-term portfolio returns and performance measurement remains largely unanswered.

Our study is among the first to evaluate the long-term performance of index composition changes. We examine annual additions and deletions of the small-cap Russell 2000 index from 1979-2004. We find that a buy-and-hold index portfolio significantly outperforms the annually rebalanced Russell 2000 by an average of 2.22% during the first year and by 17.29% for up to five years after reconstitution. More importantly, these excess returns are highly robust across the sample period and do not require short sales or large transaction costs. These results imply that rebalancing can measurably impact long-run index returns.

We attribute a portion of these excess returns to two unique factors: strong short-term momentum among index deletions and poor long-term returns of new issue additions. Yet, these attributes are not necessarily confined to the Russell 2000 index. We conjecture that indexes which add or delete firms based on performance are more susceptible to momentum effects. For example, small- or mid-cap equity indexes must routinely remove firms following strong returns as their market capitalization becomes too large. Large-cap indexes, like the S&P 500, never remove firms for performing too well, but they often replace poor performers with companies selected for their strong future prospects. Our study illustrates the importance of understanding the impact of 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 improve their factor-adjusted returns by an average of 1.45% per year by holding firms deleted from the Russell 2000 index. Among poor performing funds, the benefits from holding firms deleted from the index are offset by poor returns of new issues added to the index, which the stronger performing funds generally avoid. These results suggest

that index construction methodology may provide a structural incentive for portfolio managers to drift or deviate from their benchmark style. To the extent that portfolio managers are evaluated based on their index-adjusted returns, this study highlights the importance of understanding how index rebalancing can also affect inferences of a fund manager's ability. Fund managers who outperform their benchmark may not necessarily have exhibited skill at discovering underlying inefficiencies in the market, but rather exploited structural inefficiencies in the construction of their benchmark.

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Table 1. A Comparison of Major US Equity Indexes

Index	Russell 2000	S&P 600	S&P 400	DJIA	Nasdaq 100	S&P 500	DJ Wilshire 5000
Representation	Small Cap	Small Cap	Mid Cap	Large Cap	Large Cap	Large Cap	Broad Market
Number of Holdings	2000	600	400	30	100	500	5000+
Total Capitalization	$1.35 (9%)	$0.52 (4%)	$1.08 (8%)	$3.78 (27%)	$1.81 (13%)	$11.12 (78%)	$14.21 (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: The table compares leading US equity indexes. Representation refers to the market segment targeted by the index. The number of holdings is the maximum number of firms comprising a particular index. Total capitalization is the combined market value (in trillions) of all equities held by each index on March 15, 2005 as reported by Bloomberg. Weighting indicates the methodology used to construct the index portfolio. Reconstitution is the frequency by which index composition changes.

Table 2. Long-Term Buy-and-Hold Excess Returns of the Russell 2000 Index

Rebalancing	Holding Period				
Year	1 Year	2 Years	3 Years	4 Years	5 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	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. Firms	1,874	1,740	1,610	1,491	1,384

Note: The sample includes all Russell 2000 index constituents as of June 30 from 1979 to 2004 with available information from CRSP. Value-weighted portfolio returns with dividend reinvestment are measured across each period. The excess returns compute the difference between the returns of a buy-and-hold index portfolio and the annually reconstituted index across the respective holding period.

Table 3. Average Portfolio Market Capitalization and Number of Firms in the Russell 2000 Index Addition and Deletion Sub-Portfolios

	Deletions			Additions			
Years (*t*) since rebalancing	Top	Bottom	All	Top	Bottom	IPO	All
Panel A: Average number of firms in the 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
Panel 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

Note: The sample includes all Russell 2000 index constituents with available information from CRSP as of June 30 from 1979 to 2004. Deletions include all non-delisted firms removed from the index during the last *t* years, with *t* between one and five. Firms are deleted from the top because they grow too large for the index. Firms are deleted from the bottom because they become too small for the index. We distinguish between top and bottom deletions by whether or not the stock is included in the Russell 1000 index after being deleted from Russell 2000. Additions include all firms added to the index during the last *t* years, with *t* between one and five. IPO additions include index additions with an initial CRSP-listing date during the last *t* years, with *t* between one and five. Firms are added from the top because they become small enough to be included in the index. Firms are added from the bottom because they grow big enough to be included in the index. We distinguish between top and bottom additions by whether or not the stock is in the Russell 1000 index before being added to Russell 2000. Portfolio market capitalization averages are reported in 2004 dollars.

Table 4. Average Monthly Returns of Russell 2000 Index Addition and Deletion Sub-Portfolios

Years (t) 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[a]	61.6%[a]
2	282	1.07	1.43	1.13	1.13	0.66	0.57	0.76	0.36	2.24[b]	55.7%[c]
3	270	1.19	1.58	1.21	1.24	0.88	0.75	0.91	0.29	1.68[c]	57.0%[b]
4	258	0.96	1.31	0.99	1.02	0.69	0.55	0.69	0.28	1.73[c]	56.2%[c]
5	246	1.15	1.38	1.17	1.07	1.03	0.75	0.87	0.28	1.62	54.9%

[a] significant at the 1% level
[b] significant at the 5% level
[c] significant at the 10% level

Note: The sample includes all Russell 2000 index constituents with available information from CRSP as of June 30 from 1979 to 2004. Deletions include all non-delisted firms removed from the index during the last t years, with t between one and five. Firms are deleted from the top because they grow too large for the index. Firms are deleted from the bottom because they become too small for the index. We distinguish between top and bottom deletions by whether or not the stock is included in the Russell 1000 index after being deleted from Russell 2000. Additions include all firms added to the index during the last t years, with t between one and five. IPO additions include index additions with an initial CRSP-listing date during the last t years, with t between one and five. Firms are added from the top because they become small enough to be included in the index. Firms are added from the bottom because they grow big enough to be included in the index. We distinguish between top and bottom additions by whether or not the stock is in the Russell 1000 index before being added to Russell 2000. All portfolio returns are value-weighted with dividend reinvestment. Significance levels for the percent positive are determined using the sign test.

Table 5. Time-Series Regressions of Monthly Index Deletions Minus Additions (DMA) Portfolio Returns on Market, Size, Book-To-Market, and Momentum Factors

Post-Rebalancing Year *(t)*	Intercept	$R_m - R_f$	SMB	HML	MOM	Adj. R^2
Panel 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)	
Panel 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)	
Panel 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)	

Note: The sample includes all Russell 2000 index constituents with available information from CRSP as of June 30 from 1979 to 2004. Deletions include all non-delisted firms removed from the index during the prior *t* years (t = 1 to 5). Additions include all firms added to the index during the prior *t* years. Portfolio returns are value-weighted with dividend reinvestment. The dependent variables are monthly returns of the deletions minus additions (DMA) portfolio (Panel A), the deletions minus non-IPO additions portfolio (Panel B), or the IPO additions portfolio (Panel C) minus the risk free rate (R_f). The market return (R_m) is the CRSP value-weighted index return including distributions (VWRETD). SMB is the average return of small firms minus large firms; HML is the average return on high book-to-market stocks minus low book-to-market stocks; and MOM is the return of high momentum (measured by prior 1-year return) stocks minus low momentum stocks. The factor definitions are given in Fama and French (1993) and Carhart (1997). T-statistics are in parentheses.

Table 6. Average Coefficients from Time-Series Regressions of Monthly Mutual Fund Returns on Market, Size, Book-To-Market, Momentum, Index Deletion, and Index Addition Factors, 1979-2004

	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)	

Note: The fund data come from the CRSP Survivor Bias-Free U.S. Mutual Fund Database. The sample includes 865 domestic small-cap funds holding at least 75% of assets in equities. Small-cap fund years are identified as those with positive SMB coefficients from three factor regressions over the previous 36 months. The table reports average coefficients from time-series regressions for each uniquely identified fund. The dependent variable equals the available monthly returns net of expenses for each fund minus the risk free rate (R_f). The market return (R_m) is the CRSP value-weighted index return including distributions (VWRETD). SMB is the average return of small firms minus large firms; HML is the average return on high book-to-market stocks minus low book-to-market stocks; and MOM is the return of high momentum (measured by prior 1-year return) stocks minus low momentum stocks. The factor definitions are given in Fama and French (1993) and Carhart (1997). DMA_t is the value-weighted monthly return of a portfolio that buys all stocks deleted from the Russell 2000 in the prior *t* years and sells all stocks added to the index in the prior *t* years. Non-IPO DMA_t is the value-weighted monthly return a portfolio that buys all stocks deleted from Russell 2000 in the prior *t* years and sells all non-new issues added to the index in the prior *t* years. IPO_t is the value-weighted monthly return of a portfolio that buys all new issues added to Russell 2000 in the prior *t* years and sells the risk-free asset. The t-statistics (in parentheses) are determined by dividing the average coefficient value by its cross-sectional standard error.

Table 7. Average Coefficients from Time-Series Regressions of Monthly Mutual Fund Returns Categorized by Performance on Market, Size, Book-To-Market, Momentum, Index Deletion, and Index Addition Factors, 1979-2004

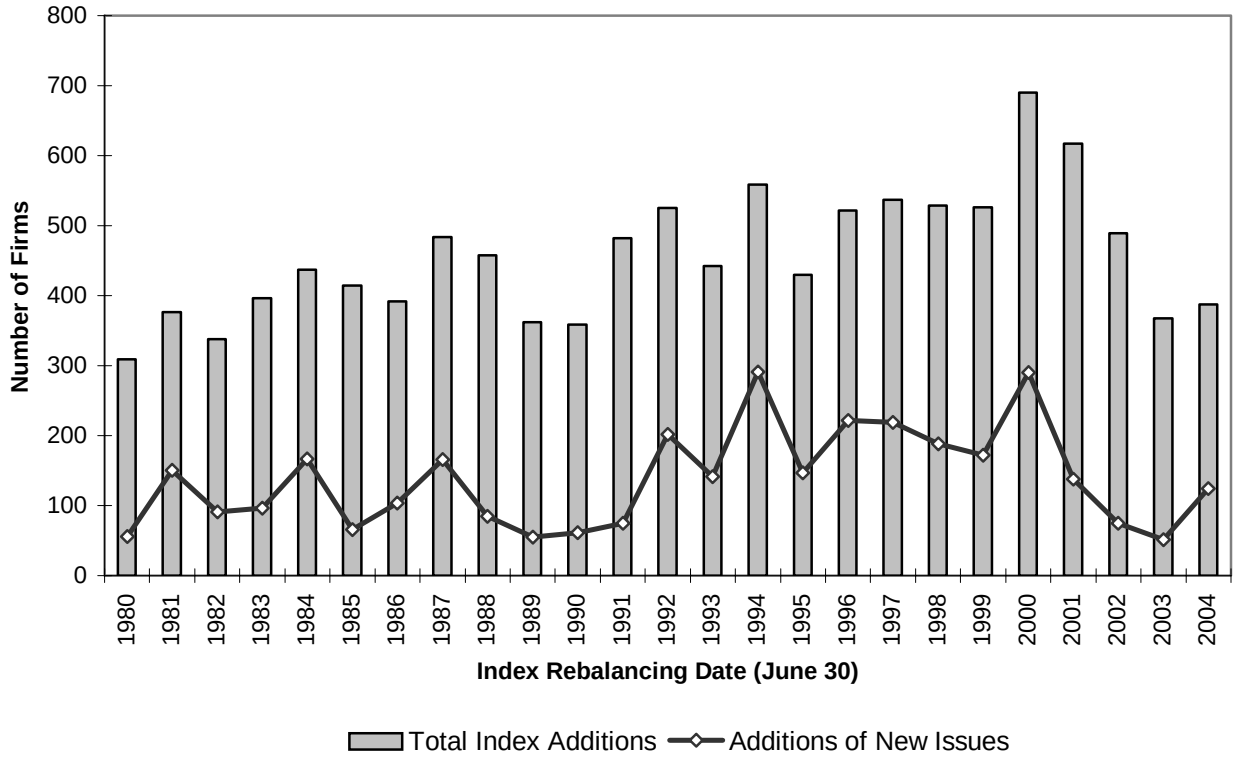
	Intercept	$R_m - R_f$	*SMB*	*HML*	*MOM*	DMA_t	*Non-IPO* DMA_t	IPO_t	*Prior Year (t)*
Panel A: "Winner" small-cap equity funds (N=179)									
(1)	0.26[a]	1.01[a]	0.32[a]	0.13[a]	0.03[b]				
(2)	0.14[a]	1.01[a]	0.35[a]	0.15[a]	0.00	0.10[a]			1
(3)	0.17[a]	1.01[a]	0.37[a]	0.16[a]	0.01	0.11[a]			2
(4)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

[a] significant at the 1% level
[b] significant at the 5% level
[c] significant at the 10% level

Note: The fund data come from the CRSP Survivor Bias-Free U.S. Mutual Fund Database. The sample includes 865 domestic small-cap funds holding at least 75% of assets in equities. Small-cap fund years are identified as those with positive SMB coefficients from three factor regressions over the previous 36

months. The table reports average coefficients from time-series regressions for each uniquely identified fund. The dependent variable equals the available monthly returns net of expenses for each fund minus the risk free rate (R_f). The market return (R_m) is the CRSP value-weighted index return including distributions (VWRETD). SMB is the average return of small firms minus large firms; HML is the average return on high book-to-market stocks minus low book-to-market stocks; and MOM is the return of high momentum (measured by prior 1-year return) stocks minus low momentum stocks. The factor definitions are given in Fama and French (1993) and Carhart (1997). DMA_t is the value-weighted monthly return of a portfolio that buys all stocks deleted from the Russell 2000 in the prior *t* years and sells all stocks added to the index in the prior *t* years. Non-IPO DMA_t is the value-weighted monthly return a portfolio that buys all stocks deleted from Russell 2000 in the prior *t* years and sells all non-new issues added to the index in the prior *t* years. IPO_t is the value-weighted monthly return of a portfolio that buys all new issues added to Russell 2000 in the prior *t* years and sells the risk-free asset. Funds that outperform the Russell 2000 index over at least 70% of their fund-year observations are labeled as winners, while funds that outperform the index less than 30% of their fund-year observations are labeled losers. All other funds are classified as neutral. The statistical significance of the coefficients are determined by the t-statistics (unreported) that equal the average coefficient value divided by its cross-sectional standard error.

Figure 1. Annual Number of Constituent Changes to Russell 2000 Index at Rebalancing.

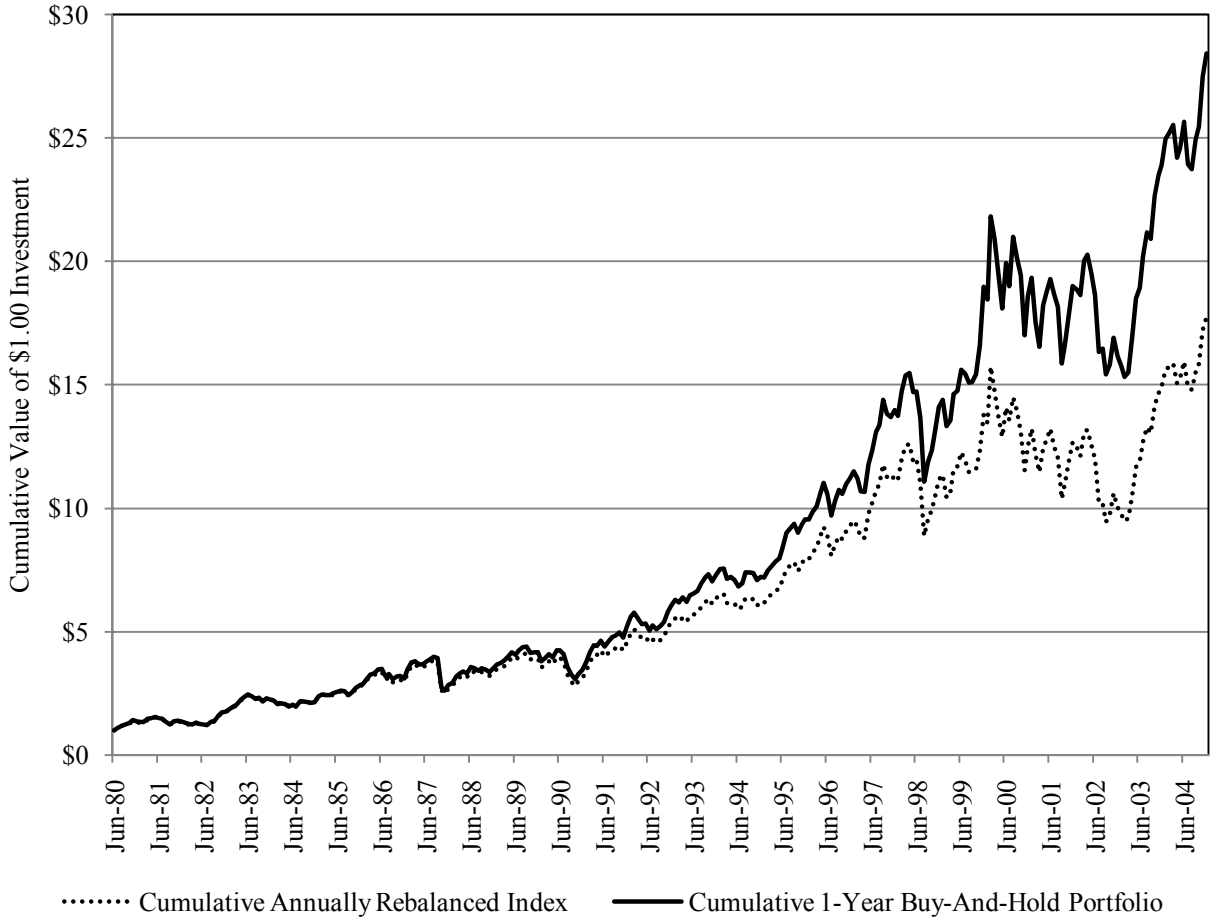


Note: The figure presents the annual number of changes to the Russell 2000 index as of each June 30 reconstitution from 1979 to 2004. The index was originally reconfigured quarterly from 1979-1986 and semi-annually from 1987-1989. The Frank Russell Company adopted annual index rebalancing on June 30, 1989. For consistency across the sample period, we compare annual index composition changes from June 30 of year *t*-1 to June 30 of year *t*. New issues include index additions with an initial CRSP-listing date over the prior 12 months.

Figure 2. Performance of Russell 2000 Index Relative to a Replicated Index with Annual Reconstitution.

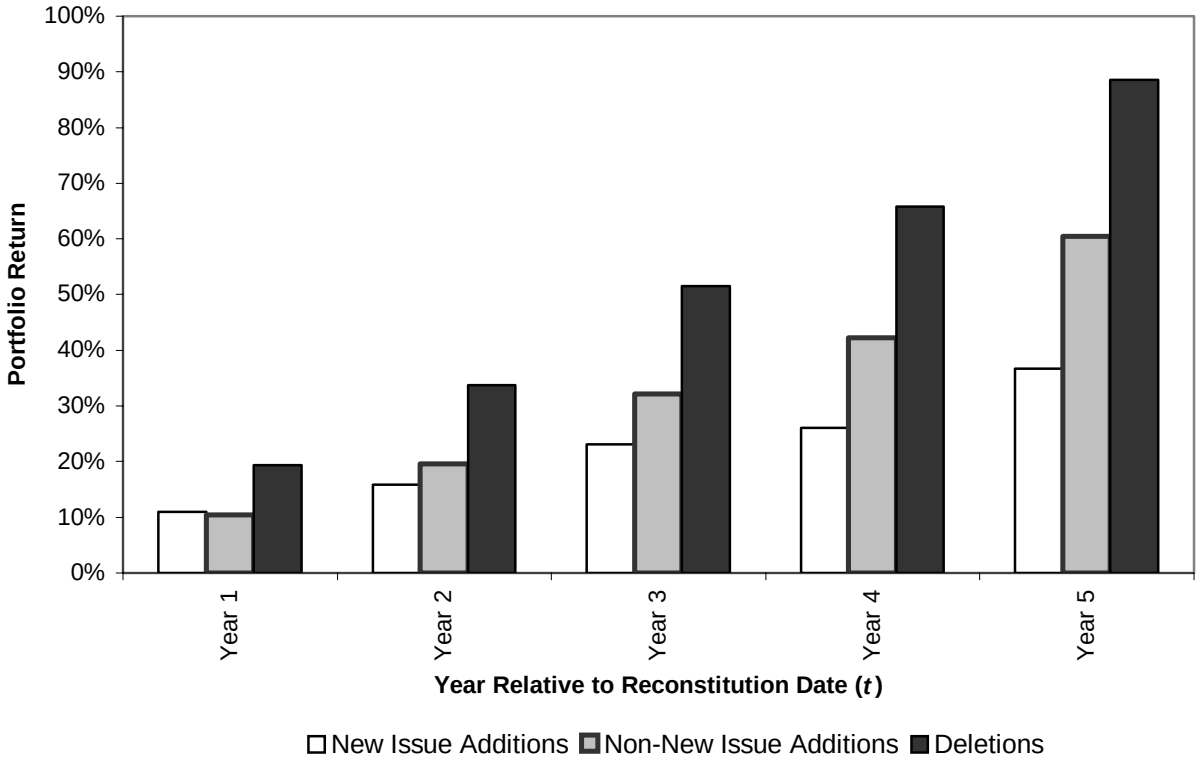
Note: The figure compares the monthly performance of the Russell 2000 Index relative to the replicated index from June 30, 1979 to December 31, 2004. To be included in the replicated portfolio, firms must have available information on the CRSP tapes. The Frank Russell Company provided the actual index returns during this time period. Index returns are measured from daily value-weighted portfolio returns with dividend reinvestment. Like the Russell 2000 Index, the replicated index is reconstituted annually on June 30. Over the 306 months of the sample period, the annualized tracking error of the replicated index versus the Russell 2000 is 0.098%.

Figure 3. Cumulative Performance of the Annually Rebalanced Russell 2000 Index versus a 1-Year Buy-and-Hold Index Strategy.



Note: The figure compares the cumulative monthly value of $1.00 invested in the annually rebalanced Russell 2000 index to a buy-and-hold portfolio that delays annual rebalancing for one year from June 30, 1980 to December 31, 2004. To be included in the replicated portfolio, firms must have available information on the CRSP tapes. Returns are measured from daily value-weighted portfolio returns with dividend reinvestment. The buy-and-hold portfolio invests in the prior year's rebalanced index on June 30 and holds the portfolio for one year. Over the measurement period, the delayed rebalancing portfolio grows to a cumulative ending value of $28.42 compared to $17.77 for the replicated index.

Figure 4. Average Five-Year Cumulative Returns of Russell 2000 Index New Issue Additions, Non-New Issue Additions, and Deletions Portfolios.



Note: The sample includes all Russell 2000 index constituents as of June 30 from 1979 to 2004 with available information from CRSP. Deletions include all non-delisted firms removed from the index during the last *t* years, with *t* between one and five. Additions include all firms added to the index during the last *t* years, with *t* between one and five. New issues include index additions with an initial CRSP-listing date over the last *t* years, with *t* between one and five. All portfolio returns are value-weighted with dividend reinvestment. After the initial index rebalancing date, firms are added to and deleted from the three portfolios at each subsequent index rebalancing date so that the portfolios always represent the difference of composition between the buy-and-hold index portfolio and the current index.