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Russell 2000 Reconstitution Effects Revisited

Introduction

The costs to investors of passive investing and the relative merits of transparent index reconstitution rules are important investment management topics and subjects of perennial interest to researchers and investors alike. This is particularly true regarding the Russell 2000 Index, the preeminent benchmark index for the U.S. small capitalization equity market.¹ This paper updates prior research on the impact of index reconstitution on the performance of the Russell 2000 Index and reviews related work.

Russell last investigated the impacts of reconstitution on index performance in Cariño and Pritamani (2007). That study examined the period 2000 to 2006 and found a marked decrease in index impacts over the period 2003 to 2006 as compared to the period 2000 to 2002. Considering index performance from reconstitution until August 31, the average impact on Russell 2000 Index performance over the period 2000 to 2002 was estimated to be -3.03%. The estimated impact was reduced to -0.94% when the returns of stocks added to and deleted from this index were controlled for size, sector and momentum effects. Turning to the period 2003 to 2006, the estimated impact was +0.07% before factor correction and -0.16% after correction, a reduction of more than 80% in factor-corrected impacts.

Cariño and Pritamani (2007) observed that index methodology and exchange trading improvements may have helped reduce reconstitution impacts on index performance.² However, no tests of the statistical significance of the difference in index impacts was conducted, so it was not clear that the reductions in estimated impacts were indeed the result of any systematic effect. This study uses the same analytical approach and adds nine years of reconstitution data to cover the period 2000 to 2015. We also use a bootstrapping procedure to conduct statistical significance tests on changes in underlying security prices.

Our results for the period 2000 to 2006 are close to those of Cariño and Pritamani. For example, we find average impacts before factor correction from reconstitution day to August 31 over the period 2000 to 2002 to be -3.06%, compared to -3.03%. We find average impacts from reconstitution day to August 31 over the period 2003 to 2015 to be -0.05%. When impact is corrected for factor effects, the magnitude increases to -0.18%, surprisingly close to the Cariño and Pritamani estimate of -0.16% average impact over the period 2003 to 2006.

Statistical significance testing shows that the average differences in index impacts between the periods 2000 to 2002 and 2003 to 2015 are almost all highly statistically significant, regardless of the length of the post-reconstitution window and the level of factor correction employed. These results support the Cariño and Pritamani hypothesis that index and exchange improvements may have reduced the impact of reconstitution trading on index performance.³ These results are also consistent with the findings of Petajisto (2011) and Chang, Hong and Liskovich (2015).

These results support the Cariño and Pritamani hypothesis that index and exchange improvements may have reduced the impact of reconstitution trading on index performance.

¹ See, for example, "A big issue for the small-cap Russell 2000," Chris Dieterich, *Barron's*, Feb. 28, 2015

² Index methodology improvements included the quarterly listing of IPO issues and the introduction of provisional reconstituted indexes in advance of the official indexes. Also, introduction of the NASDAQ "closing cross" trading mechanism for NASDAQ-traded securities greatly reduced risk of trading at the close of reconstitution. All of these innovations were introduced in 2004.

³ Relevant to the hypothesis that index methodology improvements may have reduced reconstitution impacts, Russell also introduced banding in its indexing methodology, starting in 2007.

We further test for the statistical significance of estimated impacts themselves. These results are particularly interesting for the period 2003 to 2015. Index impacts for five- and ten-day event windows are all highly statistically significant regardless of the level of factor correction. The reconstitution day to July 31 and August 31 windows, however, reveal a different pattern. Raw index impacts without any factor correction are not found to be statistically different from zero. Adding size correction leads to the July event window impacts becoming statistically significant. However, adding both size and sector correction to the August event window impacts is not sufficient for obtaining statistical significance of estimated impacts. August event window index impacts are found to be statistically significant only when size, sector and momentum corrections are used together.

This pattern of results appears to validate the Cariño and Pritamani (2007) study design. First, the results are consistent with the distinction between short-term price-pressure effects that partially reverse, resulting in smaller long-term effects, in that all short-term effects are highly statistically significant but longer-term effects are not. Second, the ability of increasing levels of factor correction to increase the statistical significance of longer-term effects speaks to the effectiveness of the characteristics-based factor-correction method used.

Background

There have been numerous studies of the impact of index reconstitution on Russell 2000 Index performance. These include Weigel and Weigel (1992), Madhavan (2003), Chen, Noronha and Singal (2006), and, subsequent to Cariño and Pritamani (2007), Petajisto (2011) and Chang, Hong and Liskovich (2015).⁴

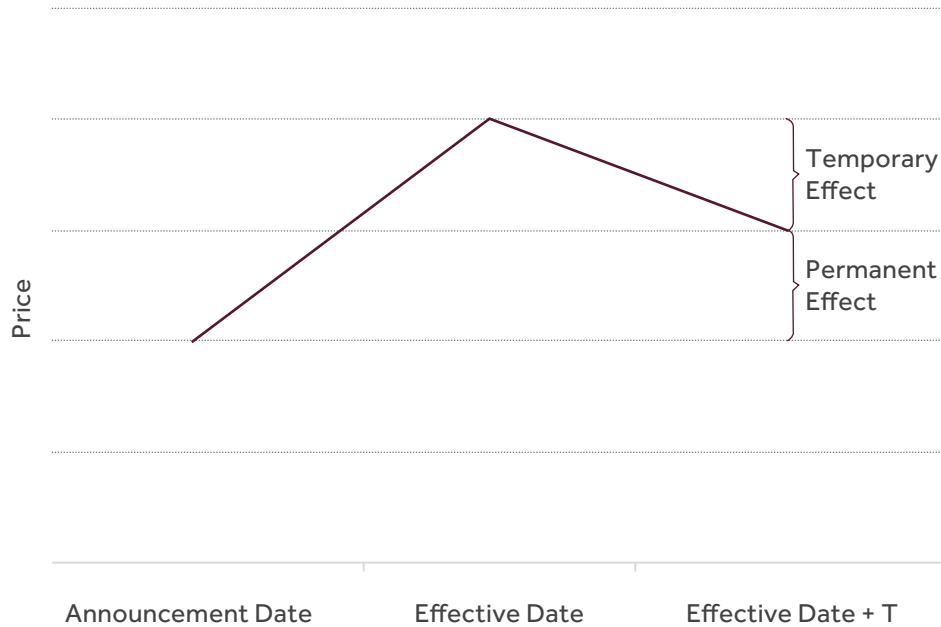
Weigel and Weigel (1992) analyze the performance of stocks added to or deleted from the Russell 2000 Index in 1990 and 1991. They find evidence of price pressure and offer suggestions for passive investors in order to minimize investment impacts.

Madhavan (2003) develops an analysis of reconstitution impacts on Russell 2000 Index performance, based on a simple framework for identifying temporary and permanent price effects. Figure 1 depicts stylized price movement of a stock added to an index that has generally been observed. Temporary effects are considered to be due to price pressures resulting from transitory imbalances in the supply and demand for stocks that are added to or deleted from the index. The temporary effect is measured as the change in stock price from reconstitution day (the effective date of changes to the index, usually near the end of June) to the end of July. Temporary price effects are assumed to be strongest around the time of reconstitution trading and to reverse afterward. The permanent effect is measured as the change in price over a longer period of time, from the end of May (prior to the effective date) to the end of July. This effect is the price increase (in the case of an addition to the index) that is not subsequently reversed and is assumed to be the result of index membership changes. May 31 is chosen as the reference date for permanent effects, because the Russell index methodology uses company market capitalizations and other data as of this date to determine index membership. Cariño and Pritamani (2007) adopt this framework and, like Madhavan, choose May 31 as the starting date for measuring permanent effects. Multiple post-reconstitution-day windows are, however, employed.

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⁴ See Cariño and Pritamani (2007) for further references to prior work on the price impacts of index changes.

Figure 1: Illustration of temporary and permanent price effects. From Cariño and Pritamani (2007).



The temporary (price-pressure) effect is of greater interest to index-based investors than the permanent effect, because index funds tend to purchase stocks added to the index on the effective date. Other investors, anticipating this demand, might purchase those stocks in advance of the effective date and sell them on the effective date, thereby supplying liquidity to the index funds. If the price has risen above the level needed to equilibrate the demand from index funds, and subsequently falls, then a fund that purchased the stock on the effective date may incur a loss, due to the temporary imbalance between supply of and demand for the stock. Measurement of the temporary effect and its impact on index return is therefore of interest to index-based investors.

Madhavan (2003) studied the period 1996 to 2002 and found strong temporary price effects for stocks added to the Russell 2000 Index and strong permanent price effects for those deleted from it. Deletions appeared to have little temporary price effect. Madhavan concluded that index-based investors pay a high liquidity premium to purchase stocks newly added to the index.

Chen, Noronha and Singal (2006) studied S&P 500 and Russell 2000 Index changes over the period 1990 to 2002. Based on an alternative trading strategy, they estimated that reconstitution had cost investors an average of 1.84 percent per year in return over the study period. Their estimate was not controlled for factor effects.

Cariño and Pritamani (2007) improved on both of these studies by use of a characteristics-based procedure that adjusts the performance of additions and deletions for size, sector and momentum effects.⁵ Cariño and Pritamani observed that adjusting for factor effects is important because factor movements happening concurrent with reconstitution could have a significant effect on estimated index impacts. Index changes in the S&P indexes, for example, do not occur all at the same time, and so factor effects on different stocks are more likely to cancel out.

Petajisto (2011) studies the index impacts in an analysis covering the period 1990 to 2005 by use of a procedure that includes standard four-factor regression-based correction. For the period 1990 to 2000, Petajisto finds that the Russell 2000 Index impacts average 0.53% to 1.06% per year. For 2001 to 2005, he finds that the impacts average between 0.14% and 0.29% per year. Statistical tests on the significance of these differences are not reported.

Petajisto notes the downward trend in index impacts “despite the growing popularity of indexing during the entire period,” stating that the finding is “consistent with anecdotal evidence about more investors predicting the index changes and trading on them before June.” This greater reconstitution trading implies greater liquidity provision for passive investors and thus lower impacts on index performance.

Chang, Hong, and Liskovich (2015) use a technique from empirical microeconomics to estimate reconstitution effects on stock prices, based on comparing the performance of stocks that cross a reconstitution capitalization threshold with stocks of similar size that do not cross the threshold. Chang et al. do not estimate the impact of reconstitution effects on index performance, but they do conclude that reconstitution

“price effects have fallen over time even as more money has been indexed to the Russell 2000. This is due in large part to mutual funds with large stocks and growth stocks providing liquidity to the funds that track the Russell 2000 and to a lesser degree to more shorting by hedge funds over time.”

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⁵ The characteristics-based approach to controlling for factor exposure, developed by Daniel, Grinblatt, Titman, and Wermers (1997), constructs a portfolio with factor characteristics similar to those of the security under study. The difference in returns between the security and the benchmark portfolio are assumed to be due to the specific characteristics of the security. The principal other approach to controlling for factor effects models the excess returns of the security as the linear combination of the returns of a set of factor indexes. The weights on each factor index are determined by regression, and the difference between the returns of the security and the weighted combination of indexes is assumed to be due to the specific characteristics of the security. Chan, Dimmock and Lakonishok (2009) compare the effectiveness of these methods in benchmarking asset managers and find that the characteristics-based method consistently produces lower tracking errors of manager performance. These findings are consistent with the results presented here and support the use of the characteristics-based approach. A further consideration recommending the use of the characteristics-based approach is the biases found by Cremers, Petajisto and Zitzewitz (2013) in the standard academic market and factor benchmarks.

Data and control portfolio construction

Following Cariño and Pritamani (2007), the current study is based on the performance of two portfolios of stocks for every year: one for stocks added to and one for stocks deleted from the Russell 2000 Index. To save time and to simplify this study, we do not investigate performance impacts on the Russell 1000® Index.⁶

Excess returns for the portfolios of adds and deletes are measured as the float-adjusted cap-weighted return of the portfolio in excess of a benchmark portfolio return. The starting benchmark for the computation of excess returns is the Russell 2000 Index return. Additional benchmarks, or control portfolios, are constructed from stocks in a universe including all stocks in the Russell 3000® Index before or after reconstitution in a given year. The Russell 3000 is comprised of all constituents in both the Russell 1000 (U.S. large capitalization stocks) and the Russell 2000 (small capitalization stocks) indexes. Before computing the returns of any control portfolio, stocks to be added to or deleted from the Russell 2000 Index are excluded, thereby leaving a universe of stocks unaffected by index reconstitution. The returns of the control portfolios are then computed as the float-adjusted cap-weighted returns of the remaining stocks. The principal methodological difference between this current study and Cariño and Pritamani (2007) is that we do not exclude from control portfolios stocks that have been added to or deleted from the Russell 1000 Index but not added to or deleted from the Russell 2000 Index. Whatever the theoretical considerations that might be applied, the number of such stocks is very small, consisting primarily of large, recently launched companies that enter directly into the Russell 1000 Index.

After the universe of unaffected stocks is constructed, control portfolios are selected, based on the characteristics of size, sector and momentum. Size-based control portfolios are constructed by sorting stocks by their market capitalization and then assigning stocks from 1 to 500 in rank to a large company portfolio; those from 501 to 1,000, to a mid-size company portfolio; and those from 1,001 on to a small company portfolio. Size and sector control portfolios are constructed by sorting size-assigned companies into size- and sector-matched portfolios. Sector classification is based on the Russell U.S. sector classification system. Portfolios of companies matched by size, sector and momentum are constructed as follows. First, stocks are sorted into momentum deciles, where momentum is based on trailing total return for the 12 months ending in May, if returns are available, or for the longest of the nine-, six- or three-month period for which returns are available. The stocks are then matched by capitalization size and market sector.

The Russell 3000 is comprised of all constituents in both the Russell 1000 (U.S. large capitalization stocks) and the Russell 2000 (small capitalization stocks) indexes.

⁶ Cariño and Pritamani (2007) found that the temporary price pressure impacts on the Russell 1000 Index were very small, because additions to and deletions from the large cap Russell 1000 are most likely to be at the small end of the index, among stocks that have the smallest weight.

Table 1 reports key statistics for annual adds and deletes portfolios from 2000 to 2015. The total float-adjusted capitalization of stocks in each portfolio as a percentage of index capitalization at reconstitution is reported, along with the number of stocks and the proportion of float-adjusted capitalization that is successfully matched to size, sector and momentum control portfolios. As in Cariño and Pritamani (2007), a control portfolio must have at least three companies with valid return and capitalization data available for use. Matching to size and combined size and sector portfolios is essentially 100%, as it was in Cariño and Pritamani (2007).⁷

Table 1: Russell 2000 Index additions and deletions at reconstitution.

Recon date	Russell 2000 Adds			Russell 2000 Deletes		
	Weight in index at recon	Number of stocks	Control size, sector & momentum	Weight in index at recon	Number of stocks	Control size, sector & momentum
June 30, 2000	32.4%	682	96.2%	31.9%	448	98.0%
June 29, 2001	20.0%	607	99.3%	28.0%	426	100.0%
June 28, 2002	17.0%	484	97.1%	26.6%	366	100.0%
June 30, 2003	16.1%	363	98.5%	17.0%	281	100.0%
June 25, 2004	15.2%	374	97.4%	13.3%	285	97.8%
June 24, 2005	13.2%	286	98.3%	16.7%	308	99.2%
June 30, 2006	11.7%	287	96.9%	18.3%	278	99.9%
June 25, 2007	6.9%	234	92.4%	6.2%	204	97.7%
June 30, 2008	7.4%	308	98.0%	17.8%	216	95.7%
June 29, 2009	6.9%	315	98.1%	11.7%	199	99.9%
June 28, 2010	5.9%	252	90.1%	8.9%	237	100.0%
June 27, 2011	5.3%	196	94.4%	9.6%	154	99.9%
June 25, 2012	4.8%	218	86.7%	10.7%	172	100.0%
July 1, 2013	4.9%	171	82.4%	7.5%	132	100.0%
June 30, 2014	5.4%	179	81.2%	9.4%	206	100.0%
June 29, 2015	5.9%	179	94.4%	8.1%	190	100.0%

Source: FTSE Russell Indexes, data as of June 2015.

The most salient difference observable in Table 1 is the considerable decline in the number and weights of stocks added to the Russell 2000 Index starting in 2007. This change is certainly the result of Russell’s introduction of a banding methodology before the 2007 reconstitution. The average share of index cap for the adds averages 17.9% in the early period and 5.9% in the later period. The number and weights of deletes started declining in 2007 as well, but not strongly or as consistently. The average share of index cap for the deletes averages 21.7% in the early period and 10.0% in the later period.

⁷ It is notable that our match rates for size, sector and momentum control portfolios reported in Table 1 differ fairly considerably from Cariño and Pritamani (2007), particularly with respect to coverage of deletes. For the period 2000 to 2006, the Cariño and Pritamani (2007) average coverage for size, sector and momentum matching is 97% for adds and 88% for deletes. These are float-adjusted cap-weighted portfolio shares. We obtain 98% for adds and 99% for deletes. This difference in matching rates is a possible explanation for some of the differences in our size, sector and momentum corrected returns, compared to those estimated by Cariño and Pritamani (2007).

Update of Cariño and Pritamani results for Russell 2000 Index

As in Cariño and Pritamani (2007), we compute returns over five time horizons for each year: from May 31 to the market close on reconstitution day, from market close on reconstitution day to day 5 and to day 10 after reconstitution, and from market close on reconstitution day to July 31 and to August 31.

We first consider the performance of the capitalization-weighted adds and deletes portfolios reported in Table 2. Results for the period 2000 to 2006 are easily compared to those obtained by Cariño and Pritamani (2007) in their Table 2, and these averages can be seen to correspond closely. Returns for each year and time horizon also correspond well, although not exactly.

Table 2: Returns of adds and deletes portfolios in excess of the Russell 2000 Index for the period 2000 to 2015.

Year	Russell 2000 Adds					Russell 2000 Deletes				
	May-end to recon	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end	May-end to recon	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
2000	12.00%	0.86%	1.40%	-3.05%	-2.67%	5.81%	-1.38%	0.30%	-6.28%	3.52%
2001	-0.98%	-2.26%	-1.96%	-3.15%	-7.57%	-6.45%	4.95%	5.50%	6.56%	5.87%
2002	-0.14%	-2.19%	-2.31%	-4.36%	-5.25%	-4.14%	3.50%	3.71%	9.10%	12.50%
2003	2.98%	-0.95%	0.27%	0.74%	0.50%	-2.59%	3.17%	1.94%	2.08%	2.97%
2004	-0.99%	-1.06%	-1.18%	-2.20%	-1.11%	-2.28%	0.97%	1.46%	0.18%	-1.25%
2005	1.16%	-0.99%	-1.38%	-1.43%	-1.21%	-1.07%	0.35%	-0.02%	0.30%	2.11%
2006	-4.84%	0.64%	0.45%	0.23%	0.74%	2.50%	-0.60%	-0.89%	-4.35%	-6.81%
2007	-1.38%	0.30%	0.83%	-2.36%	-3.45%	2.63%	-1.14%	0.77%	6.13%	3.22%
2008	-5.30%	-2.24%	-0.50%	2.22%	6.44%	9.44%	-1.35%	-1.06%	-9.19%	-15.27%
2009	4.24%	0.39%	-1.17%	1.78%	7.38%	-4.07%	0.21%	-0.13%	-0.91%	2.06%
2010	-0.29%	-3.15%	-3.81%	-6.60%	-11.59%	-2.24%	0.65%	2.44%	1.98%	7.14%
2011	0.13%	-0.84%	-2.15%	-3.06%	-9.96%	-0.27%	1.51%	1.96%	1.25%	0.66%
2012	-0.88%	-1.16%	-2.06%	-5.66%	-6.67%	-0.82%	-0.50%	0.29%	4.22%	1.93%
2013	-1.03%	-1.19%	-0.93%	-1.89%	-4.38%	-4.24%	-0.21%	1.17%	2.29%	4.74%
2014	0.31%	-0.85%	-0.69%	-1.51%	-1.17%	0.31%	-0.85%	-0.69%	-1.51%	-1.17%
2015	-4.47%	-1.95%	-3.40%	-7.22%	-5.83%	-4.71%	1.83%	0.81%	2.22%	0.76%
Avg 2000-2002	3.63%	-1.20%	-0.95%	-3.52%	-5.16%	-1.59%	2.35%	3.17%	3.13%	7.30%
Avg 2003-2015	-0.80%	-1.00%	-1.21%	-2.07%	-2.33%	-0.57%	0.31%	0.62%	0.36%	0.08%
Avg 2000-2015	0.03%	-1.04%	-1.16%	-2.35%	-2.86%	-0.76%	0.69%	1.10%	0.88%	1.44%
StDev 2000-2015	4.08%	1.15%	1.45%	2.76%	5.19%	4.17%	1.87%	1.74%	4.73%	6.10%

Source: FTSE Russell Indexes, data as of August 2015.

As noted in the prior study, the average returns over the entire 2000 to 2015 period display the pattern suggested by the stylized depiction in Figure 1. For the portfolios of adds, the average return in excess of the Russell 2000 Index was +0.03% from the end of May to the reconstitution date. From reconstitution to subsequent horizons, the average excess return was negative. Conversely, for the portfolios of deletes, the average return over the month prior to reconstitution was -0.76%, and over periods subsequent to reconstitution, the average excess return was positive. As described previously, this pattern is consistent with the existence of temporary price pressure around reconstitution.

Also as noted in Cariño and Pritamani (2007), the period 2000 to 2002 appears to be exceptional. Table 2 reports that 2000 to 2002 average returns for adds and deletes portfolios are considerably larger in magnitude than those for 2003 to 2015.

At first glance, one might consider this difference to be related to market conditions during the time of the technology bubble. Note, however, that excess return volatility appears high during the entire study period. For example, for the year 2008 for deletes, the average excess return from reconstitution to the end of August was -15.27%, greater in absolute magnitude than in any other year. Similarly, for the year 2010 for adds, the average excess return for that horizon was -11.59%, also greater in magnitude than in any other year. Adds and deletes returns for many other years after 2002 are also greater in absolute value than the largest returns during 2000 to 2002. These observations should make it clear that index impacts over the 2000 to 2002 period cannot simply be attributed to market conditions during the time of the technology bubble.

While the results in Table 2 are consistent with temporary price pressure, our main goal is to quantify the impact on the index returns of this price pressure. We compute the impact on the index return by the following formula:

Impact on index return = (weight of adds in post-recon index x post-recon excess return of the adds portfolio)
– (weight of deletes in pre-recon index x post-recon excess return of the deletes portfolio).

Negative excess returns of stocks added to the index are detrimental to the index return, while positive excess returns of deleted stocks also detract from the index return. Such positive excess return implies the reversal of a temporary price decrease that may have occurred before the stock was deleted. The extent to which the excess returns impact the index return depends on the weight of the added or deleted stocks in the index.

For example, from Table 1, for the 2015 reconstitution, the weight of the adds portfolio was 5.9% and the weight of the deletes portfolio was 8.1%. Combining those weights with the excess returns in Table 2, the index impact measured from the reconstitution date to the end of August is:

$$(0.0059 \times -5.83\%) - (0.0081 \times 0.76\%) = 0.40\%.$$

Using the Russell 2000 Index as the benchmark or control portfolio, Table 3 reports the results. The left-hand columns show the returns of a simple long/short portfolio, computed as the excess returns of the adds minus the deletes. These returns are an indication of the overall magnitude of the excess returns, but do not take account of the weights. The right-hand columns are the index impacts computed by use of the formula above. The returns are computed over four horizons for each year: from reconstitution to trading day 5, to trading day 10, to the end of July, and to the end of August.

These observations should make it clear that index impacts over the 2000 to 2002 period cannot simply be attributed to market conditions during the time of the technology bubble.

Table 3: Returns of adds minus deletes portfolios and impact on index returns, 2000-2015.

Year	Returns in excess of the Russell 2000								
	Abnormal Returns of Adds Minus Deletes					Impact on Index Returns			
	May-end to recon	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
2000	6.19%	2.25%	1.09%	3.23%	-6.19%	0.67%	0.37%	0.80%	-1.87%
2001	5.48%	-7.21%	-7.46%	-9.72%	-13.44%	-1.78%	-1.87%	-2.40%	-3.09%
2002	4.00%	-5.69%	-6.02%	-13.46%	-17.75%	-1.30%	-1.38%	-3.16%	-4.22%
2003	5.57%	-4.12%	-1.66%	-1.34%	-2.47%	-0.69%	-0.29%	-0.24%	-0.43%
2004	1.29%	-2.03%	-2.64%	-2.38%	0.14%	-0.30%	-0.38%	-0.36%	0.01%
2005	2.23%	-1.34%	-1.37%	-1.73%	-3.32%	-0.19%	-0.18%	-0.24%	-0.50%
2006	-7.34%	1.23%	1.34%	4.58%	7.55%	0.17%	0.20%	0.75%	1.22%
2007	-4.01%	1.44%	0.07%	-8.49%	-6.68%	0.09%	0.01%	-0.53%	-0.43%
2008	-14.75%	-0.89%	0.55%	11.41%	21.71%	0.04%	0.12%	1.56%	2.80%
2009	8.31%	0.19%	-1.04%	2.69%	5.33%	0.00%	-0.07%	0.22%	0.28%
2010	1.95%	-3.80%	-6.25%	-8.58%	-18.73%	-0.24%	-0.43%	-0.56%	-1.30%
2011	0.40%	-2.35%	-4.12%	-4.30%	-10.61%	-0.18%	-0.30%	-0.28%	-0.59%
2012	-0.06%	-0.66%	-2.35%	-9.88%	-8.60%	-0.01%	-0.13%	-0.69%	-0.51%
2013	3.21%	-0.98%	-2.10%	-4.18%	-9.12%	-0.04%	-0.13%	-0.26%	-0.57%
2014	0.51%	-0.74%	-1.37%	-2.66%	-2.89%	-0.04%	-0.09%	-0.17%	-0.20%
2015	0.25%	-3.78%	-4.21%	-9.44%	-6.59%	-0.25%	-0.26%	-0.59%	-0.40%
Avg 2000-2002	5.22%	-3.55%	-4.13%	-6.65%	-12.46%	-0.80%	-0.96%	-1.59%	-3.06%
Avg 2003-2015	-0.19%	-1.37%	-1.93%	-2.64%	-2.64%	-0.13%	-0.15%	-0.11%	-0.05%
Avg 2000-2015	0.83%	-1.78%	-2.34%	-3.39%	-4.48%	-0.25%	-0.30%	-0.38%	-0.61%
StDev 2000-2015	5.67%	2.61%	2.65%	6.56%	10.01%	0.58%	0.57%	1.12%	1.58%

Source: FTSE Russell Indexes, data as of August 2015.

Perhaps the most salient statistic in Table 3 is the -3.06% estimated average 2000 to 2002 index impact for the horizon window running to the end of August. This result is consistent with the Chen, Noronha and Singal (2006) estimate of -1.84% average annual impact over 1990 to 2002, a much longer time period. Both estimates are based on excess returns relative to the Russell 2000 Index. The present estimate is perhaps understandably larger than the earlier estimate, considering the time period it covers.

Casual observation of the combined excess returns reported in Table 3 should make it apparent that the absolute magnitude of the returns of the adds minus deletes portfolios in the post-2002 period does not decrease, and in fact appears to increase. As mentioned above in discussion of Table 2, 2008 and 2010 have notably large magnitudes in the reconstitution day to August 31 window.

The averages, however, show that the post-2002 adds minus deletes returns are dramatically less negative in spite of their volatility. In Table 3, the average spread for the August 31 window for the period 2003 to 2015 is -2.64%, much less negative than the -12.46% average spread for the period 2000 to 2002.

Looking at the average index impacts over the period 2003 to 2015, it can be seen that they peak ten days after reconstitution, at -0.15%, and decline thereafter, thus conforming to the model of temporary effects that reverse over time. Without factor correction, it appears that there is only -0.05% average impact on index performance once temporary effects reverse at the end of August over the period 2003 to 2015.

The results analyzed thus far use the Russell 2000 Index as the control portfolio against which to measure the excess returns. There could be systematic factors influencing the returns of groups of stocks around the time of the reconstitution event. If, by chance, the adds or deletes are particularly exposed to such systematic factors, then our measurements of excess returns and index impacts could be biased. To control for possible bias from systematic factors, we compute excess returns against alternate control portfolios. As described above, these portfolios consist of stocks that were neither added to nor deleted from the Russell 2000 Index at the given reconstitution, and are sorted based on the characteristics of size, sector and momentum.

We sequentially correct for size, then for size and sector, and finally for size, sector and momentum. Size and combined size and sector results show general reduction of the magnitude of 2000 to 2002 index impacts and little change in average 2003 to 2015 index impacts. These tables can be found in the appendix to this paper.

Reconstitution effects after controlling for size, sector and momentum are presented below in Table 4. Examining annual results and their standard deviations, it is apparent that the magnitude of estimated reconstitution impacts declines for all effects and horizon windows. Looking at Tables A1 and A2 in the appendix suggests that this reduction in impact increases with increasing factor control. This pattern is evidence that the characteristics-based approach to controlling for factor effects used here and by Cariño and Pritamani (2007) is removing systematic return components, rather than adding statistical noise.

To control for possible bias from systematic factors, we compute excess returns against alternate control portfolios.

Table 4: Returns of adds minus deletes portfolios and impact on Russell 2000 Index returns, both controlling for company size, sector and momentum, 2000-2015.

Year	Returns Controlled for Size, Sector and Momentum								
	Abnormal Returns of Adds Minus Deletes					Impact on Index Returns			
	May-end to recon	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
2000	9.24%	0.67%	-0.21%	1.22%	-6.28%	0.25%	-0.03%	0.27%	-1.92%
2001	2.78%	-3.67%	-4.99%	-5.56%	-6.46%	-0.92%	-1.25%	-1.41%	-1.52%
2002	6.64%	-3.35%	-4.25%	-8.99%	-12.68%	-0.73%	-0.92%	-1.94%	-2.85%
2003	5.00%	-4.70%	-3.18%	-3.65%	-5.05%	-0.79%	-0.54%	-0.63%	-0.86%
2004	1.80%	-2.34%	-2.54%	-2.72%	0.55%	-0.34%	-0.37%	-0.42%	0.06%
2005	2.05%	-0.95%	-1.51%	-1.50%	-2.36%	-0.13%	-0.21%	-0.22%	-0.36%
2006	-7.54%	1.76%	2.34%	6.39%	8.55%	0.26%	0.35%	1.01%	1.31%
2007	-2.58%	1.14%	-0.17%	-8.25%	-6.26%	0.07%	-0.01%	-0.52%	-0.41%
2008	-9.52%	-1.14%	0.29%	5.33%	14.20%	-0.05%	0.01%	0.54%	1.42%
2009	7.75%	1.43%	0.51%	2.03%	2.91%	0.11%	0.07%	0.12%	0.03%
2010	1.56%	-3.13%	-5.13%	-8.02%	-17.91%	-0.20%	-0.33%	-0.50%	-1.20%
2011	1.21%	-1.63%	-3.54%	-6.27%	-13.02%	-0.11%	-0.24%	-0.43%	-0.82%
2012	-0.82%	-0.94%	-1.98%	-9.42%	-9.33%	-0.03%	-0.11%	-0.64%	-0.56%
2013	3.51%	-1.35%	-3.63%	-5.58%	-11.74%	-0.07%	-0.24%	-0.35%	-0.73%
2014	-0.53%	-0.22%	0.08%	-1.60%	-0.67%	0.00%	0.02%	-0.08%	-0.02%
2015	-0.57%	-1.87%	-1.69%	-4.82%	-4.34%	-0.12%	-0.09%	-0.29%	-0.26%
Avg 2000-2002	6.22%	-2.12%	-3.15%	-4.44%	-8.47%	-0.47%	-0.73%	-1.03%	-2.10%
Avg 2003-2015	0.10%	-1.07%	-1.55%	-2.93%	-3.42%	-0.11%	-0.13%	-0.19%	-0.18%
Avg 2000-2015	1.25%	-1.27%	-1.85%	-3.21%	-4.37%	-0.18%	-0.24%	-0.34%	-0.54%
StDev 2000-2015	5.01%	1.90%	2.19%	4.91%	8.27%	0.35%	0.39%	0.69%	1.07%

Source: FTSE Russell Indexes, data as of August 2015.

The key results reported in Table 4 are the estimated average index impacts for the period 2003 to 2015. Estimated index impact rises from -0.11% at five days after reconstitution to -0.19% at the end of July, and then declines slightly in magnitude to -0.18% at the end of August. After factor control, peak effect comes later. After factor control, short event window effects decrease, but long window effects increase.

This increase in factor-corrected average impacts at long horizons is almost certainly related to the low levels of index impacts obtained for the excess returns of the deletes portfolios over the same period, as reported in Table 3. It is likely that deletes from the Russell 2000 Index entering into the Russell 1000 Index perform reasonably, but not as well as they might be expected to, particularly given their trailing momentum characteristics. Reference to Tables A1 and A2 in the appendix confirms that it is momentum correction, particularly, that raises index impacts.

Our estimate of 0.18% for factor corrected reconstitution costs to Russell 2000 Index-based investors compares well with the Petajisto (2011) factor-corrected estimate for average cost over the period 2001 to 2005 as being between 0.14% and 0.29% per year. The average is 0.215%.

Statistical tests of the reduction in index impact effects

We are interested in assessing the statistical significance of the difference in average returns between the periods 2000 to 2002 and 2003 to 2015. Difference-in-mean tests based only on the 15 annual estimated index impacts for a given time horizon have little statistical power, and differences are not found to be statistically significant. Each annual index impact, however, is based on the returns of the hundreds of stocks added or deleted from the Russell 2000 Index. Utilizing the information in the security-level returns through the use of bootstrap testing procedures greatly increases the statistical power of the tests.

Table 5 reports the average index impact differences between the periods 2000 to 2002 and 2003 to 2015, and their statistical significance for all four horizon windows and for all control strategies. All differences are highly statistically significant. Differences decrease with the addition of additional control factors.⁸

Table 5: Bootstrap tests of the differences between excess returns averages from 2000 to 2002 and from 2003 to 2015, for impacts on the Russell 2000 Index.

		Average Returns 2000-2002 Against Average Returns 2003-2015			
		Impact on Index Returns			
		Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
Returns in Excess of the Index	Avg Difference	-0.68%	-0.83%	-1.45%	-3.07%
	p-value	0.000	0.000	0.000	0.000
Returns Controlled for Size	Avg Difference	-0.44%	-0.56%	-1.02%	-2.58%
	p-value	0.007	0.008	0.001	0.000
Returns Controlled for Size and Sector	Avg Difference	-0.36%	-0.55%	-0.95%	-2.32%
	p-value	0.027	0.020	0.001	0.008
Returns Controlled for Size, Sector and Momentum	Avg Difference	-0.36%	-0.60%	-0.86%	-1.92%
	p-value	0.019	0.015	0.002	0.004

Source: FTSE Russell Indexes, data as of August 2015.

Bootstrap tests are also conducted to assess the direct statistical significance of the averages over periods 2000 to 2002 and 2003 to 2015. These tests are conducted by dividing the observed average impacts by the standard deviation of the bootstrapped index impacts. Results for the period 2000 to 2002 are uniformly of very high statistical significance. These results can be found in Table A3 of the appendix.

Table 6 reports the statistical significance of average index impacts over the period 2003 to 2015. Results for the four horizon windows are shown across the columns of the table. Results for the four excess control strategies are shown down the rows. For each test, average returns, the *t*-statistic based on bootstrapped standard deviation, and the associated *p*-value are reported.

Considering first returns in excess of the Russell 2000 Index, it can be seen in Table 6 that, starting with the July-end window, index impact magnitude

⁸ The design of the bootstrap test for differences in average impact used here is that for each test reported, 10,000 bootstrap samples are drawn. In each draw, stocks in the adds and deletes portfolios for each year are separately sampled with replacement to construct simulated portfolios with the same number of observations as in the original portfolios. The average impacts are then calculated, and the classical difference-in-means *t*-statistic is calculated. The statistical significance of the observed difference is then calculated based on the fraction of resampled index impacts that achieve a higher difference-in-means test statistic.

and statistical significance decreases. These results suggest no statistically significant impact on Russell 2000 Index performance two months after reconstitution. It can be seen, however, that as the degree of factor control is increased, both the magnitude and the statistical significance of the July-end and August-end impacts increase as well. After size, sector and momentum are controlled for, August-end impacts become statistically significant.

Table 6: Bootstrap tests of the statistical significance of average impacts on Russell 2000 Index returns, 2003 to 2015.

Average Returns 2003-2015 in Excess of the Index					
		Impact on Index Returns			
		Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
Returns in Excess of the Index	Avg 2003-2015	-0.125%	-0.147%	-0.107%	-0.049%
	t-stat	-5.43	-4.46	-1.80	-0.65
	p-value	0.000	0.000	0.072	0.513
Returns Controlled for Size	Avg 2003-2015	-0.116%	-0.163%	-0.139%	-0.059%
	t-stat	-5.01	-4.98	-2.34	-0.79
	p-value	0.000	0.000	0.019	0.431
Returns Controlled for Size and Sector	Avg 2003-2015	-0.120%	-0.160%	-0.181%	-0.122%
	t-stat	-5.61	-5.07	-3.29	-1.73
	p-value	0.00	0.00	0.00	0.08
Returns Controlled for Size, Sector and Momentum	Avg 2003-2015	-0.109%	-0.130%	-0.185%	-0.185%
	t-stat	-4.94	-4.01	-3.27	-2.53
	p-value	0.000	0.000	0.001	0.011

Source: FTSE Russell Indexes, data as of August 2015.

Robustness tests

In addition to the results presented here, reconstitution impacts were estimated using equally weighted characteristics-based control portfolios. Size, sector and momentum control portfolios were constructed with momentum deciles conditional on size and sector assignment. The impacts calculated using these methods are qualitatively similar to those presented here.

Discussion and conclusion

We update the work of Cariño and Pritamani (2007) by extending the reconstitution history studied to include the years from 2000 to 2015 and by conducting tests of the statistical significance of index impacts and their changes over time.

We find that average estimated reconstitution impacts on Russell 2000 Index performance over the period 2003 to 2015 are similar to those estimated by Cariño and Pritamani over the period 2003 to 2006. We find that the average impacts over the period 2003 to 2015 are much lower than the average impacts over the period 2000 to 2002. We find that these differences are all highly statistically significant, regardless of the length of the horizon window or the method of determining excess returns. Our best estimate of the likely future average impact of reconstitution on Russell 2000 performance is a loss of 0.18% per year.

The statistical tests do not determine why the impact of index reconstitution has diminished. There are at least three possible explanations. An obvious

possible explanation is that reconstitution impacts over the period 2000 to 2002 were driven by the technology bubble and due to a singular market event. The second explanation, that put forward by Cariño and Pritamani (2007), focuses on improvements in the Russell index methodology, and, as well, to improvements in trading techniques, such as the introduction of the NASDAQ closing cross. A further possible explanation, offered by Chang, Hong and Liskovich (2015), focuses more on the increase in market liquidity and institutional trading counterparties for stocks moving from the Russell 2000 Index to the Russell 1000 Index.

The main pieces of evidence developed here, which cast some light on the relative salience of these competing explanations, are the observed decline in the fraction of Russell 2000 Index market capitalization traded during reconstitution and the volatility of the returns of the annual adds and deletes portfolios.

The turnover statistics reported here in Table 1 show that the weight of constituents added to the index has declined by more than two thirds, and the weight of constituents deleted has declined by more than half, when averages over the periods 2000 to 2006 and 2007 to 2015 are compared. These declines are almost certainly the result of Russell's introduction of banding in its U.S. indexes with the 2007 reconstitution.

In contrast to the decline in index turnover, the volatility of returns of the adds and deletes portfolios reported in Table 2 show no uniform trend when the periods 2000 to 2002 and 2003 to 2015 are compared. Most salient for the purposes here are the returns to the end of August. In this case, both for the adds and deletes portfolios, the returns of the later period show higher volatility.

Both of these observations cast significant doubt on the idea that it was the unique characteristics of the market during the technology bubble that drove reconstitution impacts. More specifically, there seems good reason for believing that index turnover would have been substantially higher in 2008 and 2009 if not for the introduction of banding. There is little reason to believe that the boom-and-bust in the technology sector was fundamentally different from that which followed in the finance sector a few years later.

The volatility statistics for the adds and deletes portfolios also cast some doubt on the Chang, Hong and Liskovich (2015) focus on the growth of liquidity supply in the market. This general trend is certainly important in keeping the costs of reconstitution trading from increasing. Disruptions in the supply of capital for market making, however, are increasingly thought to be a source for market liquidity shocks such as those experienced following the financial crisis (see, e.g., CGFS [2014]) and are perhaps reflected here in post-crisis reconstitution portfolio volatility.

Advances in index methodology (such as banding) and in exchange technology (in the form of closing cross exchange double auctions) thus provide the most compelling explanation for the observed reduction in reconstitution impacts.

In summary, we have developed significant evidence showing that the expected costs of index reconstitution for Russell 2000 Index-based investors has declined greatly since the early years of the last decade, and that costs are likely to stay low. This is good news for passive investors and index providers alike. Liquidity provision to passive investors is an important service that should have a price, but a price that is not in itself a significant disincentive for passive investing. These results support the arguments for transparency made in Petajisto (2011) - and the use of transparent index reconstitution methods that lead to the competitive provision of liquidity to passive investors.

In summary, we have developed significant evidence showing that the expected costs of index reconstitution for Russell 2000 Index-based investors has declined greatly since the early years of the last decade, and that costs are likely to stay low.

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Appendix: Additional results

Table A1: Returns of adds minus deletes portfolios and impact on Russell 2000 Index returns, both controlling for company size, 2000 to 2015.

Year	Returns Controlled for Size								
	Abnormal Returns of Adds Minus Deletes					Impact on Index Returns			
	May-end to recon	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end	Recon to day 5	Recon to day 10	Recon to July-end	Recon to Aug-end
2000	4.44%	2.27%	1.36%	3.50%	-5.77%	0.69%	0.45%	0.80%	-1.81%
2001	1.39%	-6.14%	-6.83%	-8.97%	-13.34%	-1.46%	-1.66%	-2.15%	-3.01%
2002	0.63%	-4.35%	-4.72%	-9.86%	-13.98%	-0.89%	-0.97%	-2.10%	-3.09%
2003	5.54%	-4.59%	-2.72%	-2.73%	-3.62%	-0.77%	-0.47%	-0.48%	-0.63%
2004	0.66%	-2.23%	-2.35%	-1.74%	1.01%	-0.33%	-0.35%	-0.28%	0.12%
2005	1.70%	-1.59%	-2.16%	-2.48%	-3.73%	-0.23%	-0.32%	-0.36%	-0.57%
2006	-7.52%	1.79%	2.30%	5.24%	7.97%	0.28%	0.38%	0.87%	1.30%
2007	-4.12%	1.33%	-0.01%	-7.74%	-6.86%	0.08%	0.01%	-0.49%	-0.45%
2008	-13.28%	-0.08%	0.00%	8.74%	17.82%	0.16%	-0.03%	1.11%	2.16%
2009	7.29%	0.20%	-0.99%	1.52%	5.25%	0.00%	-0.07%	0.12%	0.32%
2010	2.18%	-3.38%	-4.79%	-8.07%	-16.86%	-0.20%	-0.31%	-0.51%	-1.12%
2011	-0.17%	-1.97%	-4.38%	-4.16%	-9.50%	-0.15%	-0.32%	-0.26%	-0.49%
2012	-2.26%	-0.98%	-2.82%	-9.27%	-7.52%	-0.04%	-0.18%	-0.62%	-0.39%
2013	2.06%	-1.35%	-2.95%	-4.46%	-9.54%	-0.07%	-0.20%	-0.29%	-0.60%
2014	-0.20%	-0.50%	-0.57%	-1.40%	-1.09%	-0.02%	-0.03%	-0.07%	-0.06%
2015	-1.59%	-3.46%	-4.04%	-8.48%	-5.75%	-0.23%	-0.25%	-0.52%	-0.34%
Avg 2000-2002	2.15%	-2.74%	-3.40%	-5.11%	-11.03%	-0.55%	-0.73%	-1.15%	-2.64%
Avg 2003-2015	-0.75%	-1.29%	-1.96%	-2.69%	-2.49%	-0.12%	-0.16%	-0.14%	-0.06%
Avg 2000-2015	-0.20%	-1.56%	-2.23%	-3.15%	-4.09%	-0.20%	-0.27%	-0.33%	-0.54%
StDev 2000-2015	5.00%	2.40%	2.46%	5.63%	8.86%	0.50%	0.49%	0.88%	1.33%

Source: FTSE Russell Indexes, data as of August 2015.

Table A2: Returns of adds minus deletes portfolios and impact on Russell 2000 Index returns, both controlling for company size and sector, 2000 to 2015.

Year	Returns Controlled for Size and Sector								
	Abnormal Returns of Adds Minus Deletes					Impact on Index Returns			
	May-end to Recon	Recon to Day 5	Recon to Day 10	Recon to July-end	Recon to Aug-end	Recon to Day 5	Recon to Day 10	Recon to July-end	Recon to Aug-end
2000	7.46%	0.94%	0.22%	1.39%	-7.21%	0.32%	0.11%	0.25%	-2.23%
2001	1.29%	-3.97%	-5.40%	-6.64%	-9.18%	-0.99%	-1.38%	-1.68%	-2.12%
2002	3.87%	-3.72%	-4.15%	-9.28%	-13.42%	-0.78%	-0.88%	-1.96%	-2.97%
2003	5.34%	-4.33%	-2.43%	-2.76%	-3.05%	-0.73%	-0.42%	-0.48%	-0.53%
2004	0.77%	-2.28%	-2.39%	-2.03%	0.33%	-0.33%	-0.36%	-0.32%	0.02%
2005	2.15%	-1.32%	-1.78%	-1.76%	-2.51%	-0.19%	-0.26%	-0.25%	-0.37%
2006	-7.76%	1.60%	2.04%	5.53%	8.00%	0.24%	0.33%	0.90%	1.27%
2007	-3.56%	1.28%	-0.15%	-7.67%	-7.17%	0.08%	0.00%	-0.49%	-0.47%
2008	-11.20%	-1.10%	-0.60%	5.39%	14.13%	-0.01%	-0.10%	0.56%	1.55%
2009	7.94%	0.73%	-0.43%	1.51%	4.77%	0.05%	-0.01%	0.10%	0.25%
2010	1.68%	-3.38%	-5.01%	-8.89%	-18.48%	-0.20%	-0.33%	-0.58%	-1.26%
2011	-0.78%	-2.14%	-4.63%	-5.40%	-11.24%	-0.15%	-0.34%	-0.36%	-0.64%
2012	-1.69%	-1.10%	-2.67%	-9.58%	-8.37%	-0.04%	-0.17%	-0.65%	-0.46%
2013	2.41%	-1.32%	-3.19%	-4.99%	-9.75%	-0.07%	-0.22%	-0.33%	-0.61%
2014	-0.50%	-0.30%	-0.29%	-1.08%	-0.52%	0.00%	-0.01%	-0.04%	-0.02%
2015	-0.72%	-3.13%	-3.44%	-6.96%	-5.36%	-0.21%	-0.21%	-0.42%	-0.32%
Avg 2000-2002	4.21%	-2.25%	-3.11%	-4.85%	-9.94%	-0.48%	-0.72%	-1.13%	-2.44%
Avg 2003-2015	-0.45%	-1.29%	-1.92%	-2.98%	-3.01%	-0.12%	-0.16%	-0.18%	-0.12%
Avg 2000-2015	0.42%	-1.47%	-2.14%	-3.33%	-4.31%	-0.19%	-0.26%	-0.36%	-0.56%
StDev 2000-2015	5.02%	1.94%	2.13%	4.93%	8.30%	0.36%	0.40%	0.71%	1.17%

Source: FTSE Russell Indexes, data as of August 2015.

Table A3: Bootstrap tests of statistical significance of average impacts on Russell 2000 Index returns, 2000 to 2002.

Average Returns 2000-2002 in Excess of the Index Impact on Index Returns					
		Recon to Day 5	Recon to Day 10	Recon to July-end	Recon to Aug-end
Returns in Excess of the Index	Avg 2000-2002	-0.81%	-0.97%	-1.59%	-3.06%
	<i>t</i> -stat	-5.36	-5.15	-6.68	-8.50
	<i>p</i> -value	0.000	0.000	0.000	0.000
Returns Controlled for Size	Avg 2000-2002	-0.55%	-0.73%	-1.15%	-2.63%
	<i>t</i> -stat	-3.32	-3.71	-4.24	-6.98
	<i>p</i> -value	0.001	0.000	0.000	0.000
Returns Controlled for Size and Sector	Avg 2000-2002	-0.48%	-0.72%	-1.13%	-2.44%
	<i>t</i> -stat	-3.29	-3.71	-4.98	-6.67
	<i>p</i> -value	0.001	0.000	0.000	0.000
Returns Controlled for Size, Sector and Momentum	Avg 2000-2002	-0.47%	-0.74%	-1.03%	-2.10%
	<i>t</i> -stat	-3.49	-3.88	-4.39	-5.62
	<i>p</i> -value	0.000	0.000	0.000	0.000

Source: FTSE Russell Indexes, data as of August 2015.

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