Regression Discontinuity and the Price Effects of Stock Market Indexing

Internet Appendix

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In this Appendix we show results which were left out of the paper for brevity. In Section 1 we show the robustness of our main results. We report our estimates of the addition and deletion effects using different bandwidths and specifications and we also show that our assumption of random assignment is valid. In Section 2 we elaborate on the methodology used to construct firm rankings on either side of the Russell 2000 cut-off and explain why this is the correct approach. In Section 3 we describe the relative performance of funds that we identified as indexers vs. liquidity providers by their responses to index additions and deletions. Finally in Section 4 we show our estimates of the index addition and deletion effects across the lower threshold of the Russell 2000 by using firms with market capitalization rankings around 3000.

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1. Russell 1000 Cut-off

In this section we show that the RD estimates of the addition and deletion effect are not sensitive to specifications. Our preferred specification in the paper used a local linear regression and a bandwidth of 100 on either side of the cut-off. In Table A.1 we show those results alongside results using local quadratic regressions and a bandwidth of 200. In all cases June returns are positive and usually statistically significant. The magnitudes vary from 2.2% to 11.0% for additions and from 4.4% to 5.4% for deletions. There is no evidence of July reversals in any specification. The consistency of these results demonstrates that our conclusions are robust to changes in the details of our regression discontinuity design.

In the paper we addressed the validity of our RD design, which requires that attributes determined before the end-of-May ranking are smooth across the 1000 cut-off. This is necessary for the assumption of local randomization inherent in any regression discontinuity design. The smoothness of firm fundamentals around the cut-off is displayed graphically in Figure A.1. Subfigures (a) and (b) show that there are no differences in returns between firms that just made it into Russell 2000 and those that just missed in the month of May, leading up to the June reconstitution. Likewise, there are no discontinuities in assets. There appears to be slight break in assets for additions but it is not pronounced and insignificant in the regressions reported in the paper. Therefore the RD is not driven by differences in firm fundamentals that could be correlated with future returns.

2. Use of Appropriate Rankings

In this section we demonstrate the importance of using rankings based on May 31st market capitalization rather than those based on June index weights. Rankings based on the June index weights are inappropriate for two reasons. The first is that they incorporate June price changes and the second is that they do not identify the firms that were almost included in

the Russell 2000 index.

Membership in the Russell 2000 index is determined according to a ranking of firms by total market capitalization on May 31st. Once membership has been established, a different measure of market capitalization is used to determine each firm's weight within the index. The number of a security's shares is adjusted to reflect only those shares available to the public. Shares held by another listed company, a government, or a large private individual, and other types of restricted shares, are excluded.

Due to this share adjustment, a firm with high total market capitalization and a large number of restricted shares could end up with a low weight in the Russell 1000. It is not necessarily true that this firm was close to the cutoff for membership in the Russell 2000. The RD design relies on comparing firms that were barely included in the index to those that were barely excluded. If the firms with a low June ranking were not on the verge of index inclusion, they are not an appropriate control group for included firms. This problem is illustrated in Figure A.2, which shows the discontinuity in total May market capitalization around the cutoff when using June rankings. Clearly the firms at the bottom of the Russell 1000 have much higher total market capitalization than the firms in the Russell 2000.

The other issue introduced by using June weights is that they are calculated using adjusted shares and end of June share prices. Therefore any excess returns in June are mechanically incorporated into the rankings. The Russell 1000 firms with lowest returns in June will migrate toward the bottom of their index whereas the Russell 2000 firms with the highest June returns will move toward the top of their index. This creates a bias toward finding a positive inclusion effect in June returns. This is evident in the large excess returns in June shown in Table A.2. The estimates of the addition effect are around 15% and those of the deletion effect are around 22%, both significantly higher than the estimates using end of May rankings. Several specifications also show significant negative returns in May, demonstrating that firms on either side of the cutoff were different even before index reconstitution.

Tables A.3 and A.4 further highlight the differences between included and excluded firms when using June rankings. Firms with the highest weights in the Russell 2000 index have more institutional ownership, experience less turnover, and have more short interest than the firms with the lowest weights in the Russell 1000 index. These differences are present even before reconstitution. Consistent with the methodology of the share adjustment, the Russell 2000 firms have much smaller market capitalization but more float shares.

3. Performance of Indexers and Liquidity Providers

In this section we study the outcomes of indexation by comparing the fund performance of indexers and liquidity providers identified in Section 7.1 of the paper. We focus our analysis on fund performance in June since we expect that indexer demand for market making is concentrated right after Russell announces its annual constituents on May 31st.

Univariate comparisons (not reported for brevity) of June raw returns show that indexers underperform liquidity providers by an average of 61 bps from 1996 to 2011. Consistent with our prior, liquidity providers enjoy a premium in market making while indexers are forced to purchase addition stocks and sell deletion stocks. To alleviate the concern that this difference in performance is due to fund styles, we repeat the analysis using style-adjusted returns. Every year we assign all funds in our database into one of 3-by-3 buckets using their median MV and MtB in holdings. We use NYSE size breakpoints for size cutoffs, and MtBs of all stocks in CRSP for value cutoffs. Style-adjusted returns are then June fund return minus the average return of all funds in the same bucket. Using style-adjusted returns, liquidity providers outperform indexers in June by 52 bps.

In Table A.5 we compare the performance of these two groups of funds using a regression similar to Chen, Hong, Huang, and Kubik (2004). We restrict our sample to funds that are either flagged as an indexer or a liquidity provider. The dependent variables are either raw

or style-adjusted June returns (in percentages). The independent variable is an indicator that equals one if a fund is an indexer and zero if a fund is a liquidity provider. Control variables are various lagged fund characteristics similar to Chen, Hong, Huang, and Kubik (2004). In addition to the full sample (1996-2011), we also divide the sample into an earlier (1996-2003) and a later sample period (2004-2011).

The full sample result reveals that indexers underperform liquidity providers in June by 37.8 bps in raw returns and 43.9 bps in style-adjusted returns, all else equal. These coefficients are both economically and statistically significant. The subsample results show that the underperformance of indexers is larger in earlier periods. In the first half of the sample, indexers underperform by 50 bps (62.4 bps) in raw (style-adjusted) returns. In the second sample period, indexers underperform by 22.9 bps (23.4 bps) in raw (style-adjusted) returns, roughly one-half to one-third of the difference in the earlier period. This pattern is consistent with the results in Section 6 that show addition and deletion effects have been declining.

4. Russell 3000 Cut-off

We repeat our main analysis for stocks around the lower cut-off of the Russell 2000; i.e., stocks ranked near the 3000 cut-off. Now our sample period is restricted to 2005 onwards because the Russell 3000E, which includes roughly 4,000 stocks in the U.S. market and allows us to identify the firm rankings around the lower cut-off, is not available until 2005. There is also no banding around the lower cutoff, making it more straightforward to calculate the cut-off point in every year. Figure A.3 plots the market capitalizations around the bottom 3000 cut-off. Notice that market capitalizations are smoothly declining across the cut-off, supporting the assumption of random assignment.

4.1. Discontinuities in Index Weights

In Figure A.4 we show the weight changes that occur for additions and deletions across the bottom 3000 cut-off. We find a modest change in index weights across the 3000 cut-off, in contrast to the sizable changes across the 1000 cut-off. On average index weights change from 0.02 percentage points to 0 when a firm cross the 3000 cut-off and leaves the Russell 2000. However even this smaller weight change is probably an over-estimate because the smallest stocks in the Russell 2000 have so little weight in the index that they may be skipped over by indexers. On the other hand, modest indexing changes for these small stocks may still translate into meaningful price effects.

4.2. Regressions

As shown in Table A.6, we are able to closely match actual index addition and deletion across the lower cut-off using our end of May rankings. The coefficient of actual addition on estimated addition is 0.862 with a t-statistic of 48.86 and the R^2 is 0.93. For deletion the coefficient is 0.865 with a t-statistic of 39.79 and the R^2 is 0.91. Table A.7 reports the results of a fuzzy RD design for the addition and deletion effects using bandwidths of 100 and 200 and both linear and quadratic specification on either side of the cut-off. The addition effect estimates are around 3%, which is not economically small. Yet the estimate is only significant in one specification. Our interpretation is that we do not have enough observations in the bottom cut-off to achieve a tight estimate.

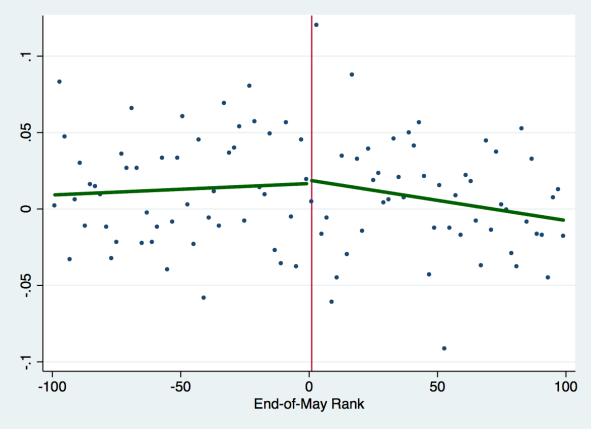
We see a similar coefficients of around 3% for the deletion effect in June, although none of these are statistically significant. What is interesting here is that we start getting significant effects for July and September, with excess returns of around 0.055 and t-statistics of around 2 in our preferred specification. We also see a large reversal in August of -0.054, though this coefficient is not significant. We attribute this bouncing around of estimates to a lack of

data. It might also be due to illiquidity in the bottom end of the index and the rebalancing delay of indexers. The data limitations make any causative attribution difficult.

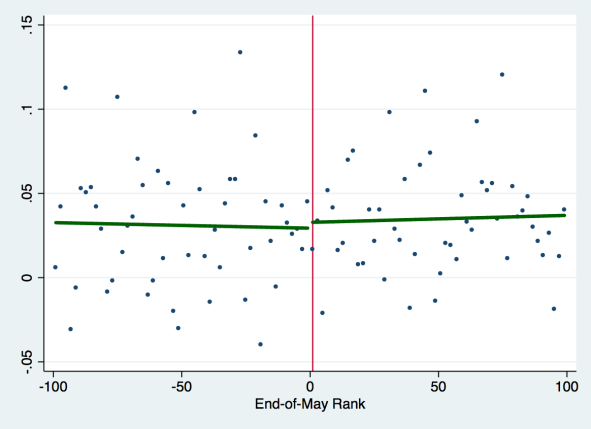
In Table A.8 we find no change in institutional ownership but do see a large response in trading volume for firms that switched indices. Interestingly, there is a pronounced increase in the short ratio following both addition and deletion. Perhaps this strong response in short interest ratio around the bottom cut-off dampens some of the price effects of addition and deletion. Manipulation by hedge funds is more of a concern for this experiment. We test for differences in pre-reconstitution attributes in Table A.9 but find no evidence of discontinuities in any measures.

Figure A.1: Validity Tests Around Upper Cut-off

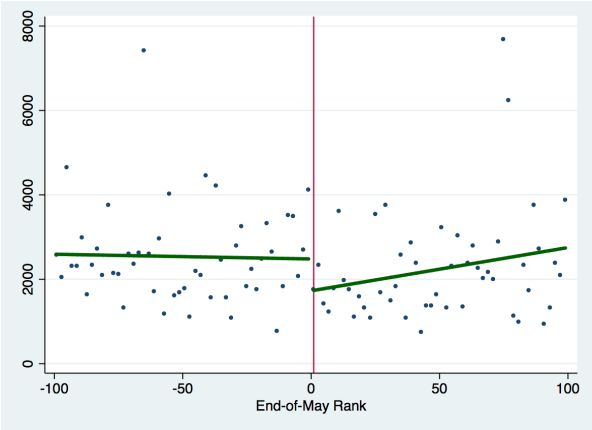
Outcome variables are plotted against market capitalization ranking. The firms that end up in the Russell 1000 are on the left hand side of the cut-off. The firms that end up in the Russell 2000 are on the right hand side. The sample period is from 1996 through 2012. The lines drawn fit linear functions of rank on either side of the cut-off. Every point represents averages over all years and over 2 ranks.



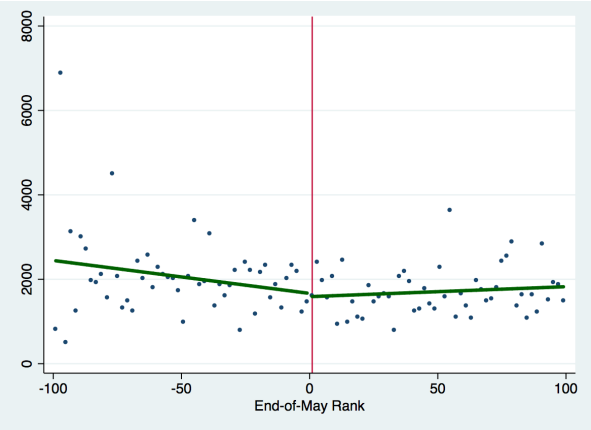
(a) May Returns; Addition



(b) May Returns; Deletion



(c) Assets; Addition



(d) Assets; Deletion

Figure A.2: End-of-May Market Capitalization for end-of-June Rankings

End-of-May market capitalization is measured in billions of dollars and plotted against end-of-June rankings. Firms that will end up in the Russell 1000 are on the left hand side of the cut-off and firms that will end up in the Russell 2000 are on the right hand side. The sample period is from 1996 through 2006.

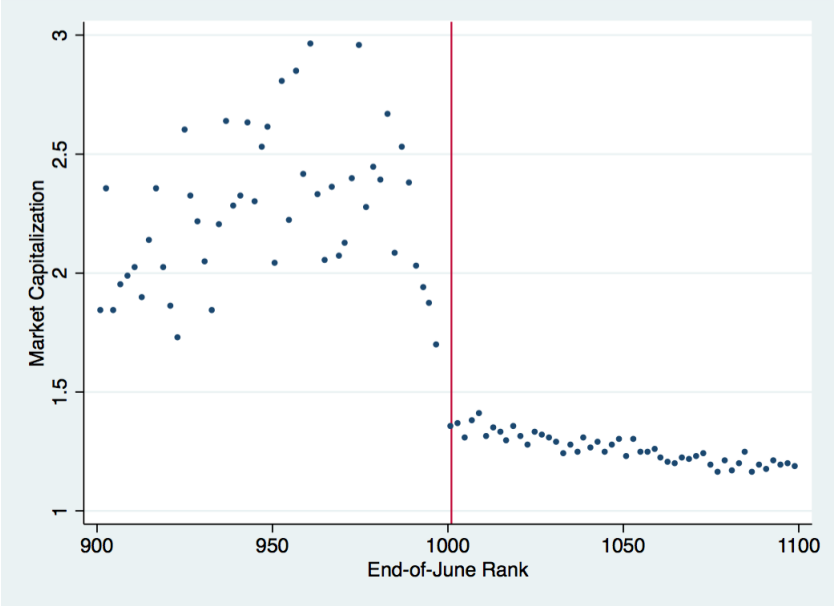


Figure A.3: End-of-May Market Capitalization Around Lower Cutoff

End-of-May market capitalization is measured in billions of dollars and plotted against end-of-May rankings. Firms that will end up in the Russell 2000 are on the left hand side of the cut-off and firms that will be deleted from the Russell 2000 are on the right hand side. The sample period is from 2005 through 2012.

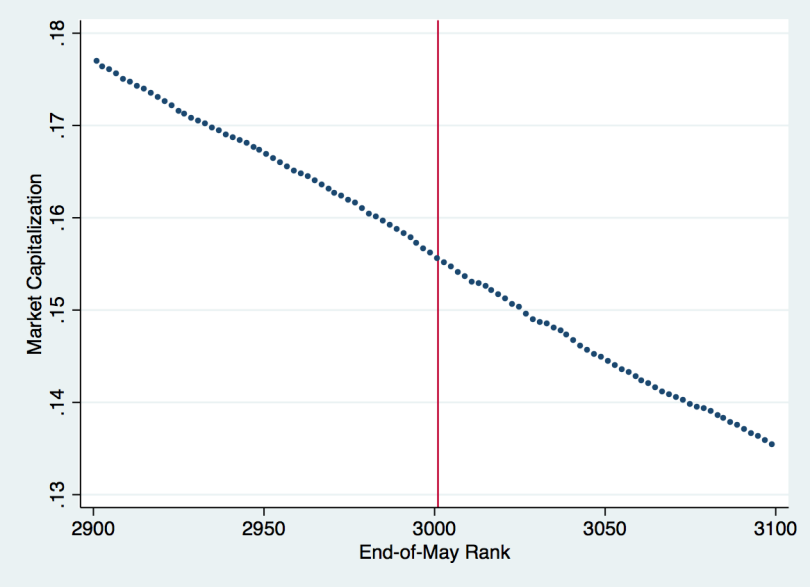
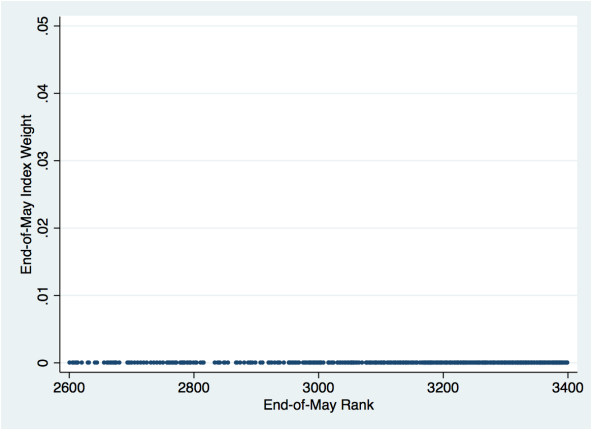
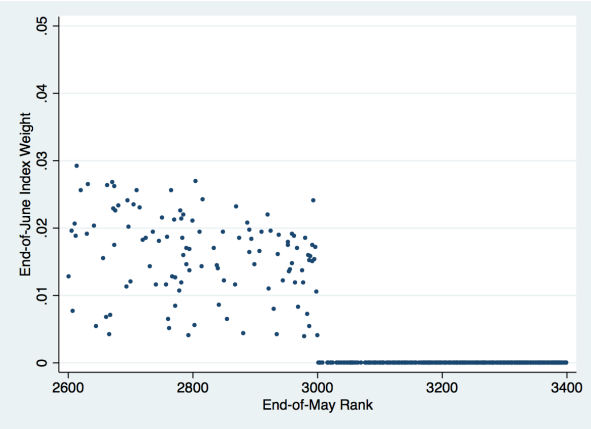


Figure A.4: Index Weights Around Lower Cutoff for 2007 Index

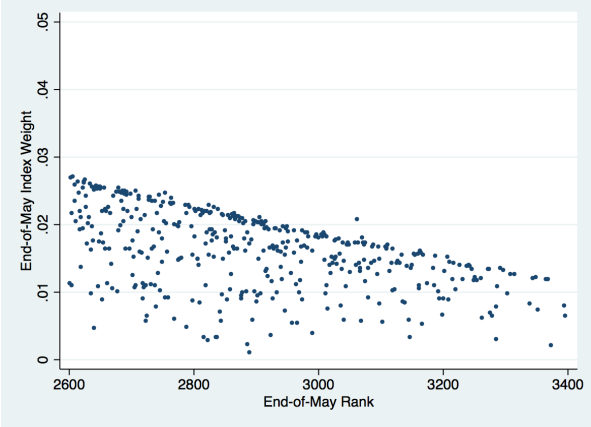
Index weights are measured in percent of index (in percentage points) and plotted against end-of-May market capitalization rankings. Figures (a) and (b) use firms that were outside of the Russell 3000 at the end of May while figures (c) and (d) use firms that were in the Russell 2000 at the end of May. The firms that end up in the Russell 2000 are on the left hand side of the cut-off. Those that end up outside of the Russell 2000 are on the right hand side.



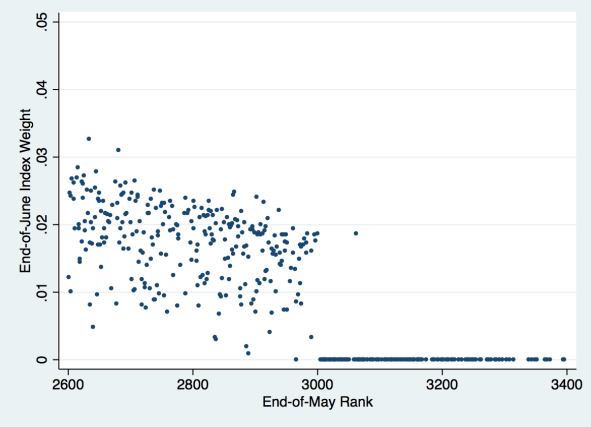
(a) End-of-May Weights for Firms Outside Russell 2000



(b) End-of-June Weights for Firms Starting Outside Russell 2000



(c) End-of-May Weights for Firms in Russell 2000



(d) End-of-June Weights for Firms Starting in Russell 2000

Table A.1: Returns Fuzzy RD

The table reports the results of a fuzzy RD design. For linear specification (p=1), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

For quadratic specification (p=2), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + \beta_{2l}(r_{it} - c)^2 + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c) + \beta_{2r}(r_{it} - c)^2\right] + \epsilon_{it}.$$

The outcome variable is monthly stock returns and the independent variable is an indicator for addition to (or staying in) the Russell 2000 index. Monthly returns are shown for the month immediately preceding the index rebalancing (June) and for four months after. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. Results are shown for two different bandwidths choices: 100, and 200. Only firms that were members of the Russell 1000 index at the end of May are used for addition. Only those that were members of the Russell 2000 at the end of May are used for deletion. The sample period is 1996-2012.
* p<0.05, ** p<0.01, *** p<0.001

Addition Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	-0.003	0.050**	-0.003	0.035	-0.021
	(-0.14)	(2.65)	(-0.11)	(1.59)	(-0.89)
p=2	-0.029	0.110**	0.085	-0.016	0.014
	(-0.68)	(2.73)	(1.78)	(-0.35)	(0.29)
N	1055	1057	1053	1052	1047

Addition Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	-0.012	0.022	-0.000	0.027	-0.015
	(-0.92)	(1.84)	(-0.02)	(1.88)	(-1.08)
p=2	-0.011	0.060**	0.001	0.013	-0.023
	(-0.47)	(2.86)	(0.05)	(0.55)	(-0.89)
N	2253	2255	2245	2231	2222

Deletion Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	0.005	0.054**	-0.019	-0.002	0.011
	(0.32)	(3.00)	(-0.96)	(-0.09)	(0.53)
p=2	-0.027	0.052	0.025	-0.000	0.019
	(-0.81)	(1.48)	(0.60)	(-0.00)	(0.44)
N	1546	1545	1533	1526	1519

Deletion Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	0.010	0.044***	-0.024	-0.004	0.010
	(0.94)	(3.97)	(-1.90)	(-0.33)	(0.77)
p=2	0.007	0.053**	-0.014	0.003	0.005
	(0.37)	(2.61)	(-0.60)	(0.14)	(0.20)
N	3027	3026	3003	2984	2974

Table A.2: Returns Sharp RD Using June Rankings

The table reports the results of a sharp RD design. For linear specification (p=1), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

For quadratic specification (p=2), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + \beta_{2l}(r_{it} - c)^2 + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c) + \beta_{2r}(r_{it} - c)^2\right] + \epsilon_{it}.$$

The outcome variable is monthlystock returns and the independent variable D is an indicator for membership in the Russell 2000 index. Ranking r_{it} is imputed from June index weights and is above cut-off c when $D = 1$. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. Results are shown for two different bandwidths choices: 100, and 200. The regression identifying the addition effect only uses firms that were in the Russell 1000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. The sample period is 1996-2012.
* p<0.05, ** p<0.01, *** p<0.001

Addition Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	-0.008	0.137***	-0.024	0.022	0.016
	(-0.39)	(7.98)	(-1.16)	(1.05)	(0.80)
p=2	-0.012	0.188***	-0.060	0.047	0.003
	(-0.37)	(6.37)	(-1.83)	(1.24)	(0.10)
N	935	938	929	925	928

Addition Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	0.004	0.136***	-0.020	0.006	0.006
	(0.30)	(10.94)	(-1.41)	(0.45)	(0.44)
p=2	-0.007	0.154***	-0.037	0.023	0.005
	(-0.33)	(8.16)	(-1.69)	(1.00)	(0.24)
N	1814	1815	1802	1805	1800

Deletion Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	-0.040*	0.217***	0.000	0.018	0.002
	(-2.01)	(7.63)	(0.02)	(0.84)	(0.09)
p=2	-0.052	0.280***	-0.020	0.002	0.055
	(-1.84)	(5.96)	(-0.70)	(0.08)	(1.66)
N	1062	1060	1056	1059	1058

Deletion Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	-0.020	0.193***	-0.008	0.025	0.000
	(-1.47)	(11.44)	(-0.61)	(1.78)	(0.02)
p=2	-0.045*	0.228***	0.012	0.019	0.017
	(-2.18)	(7.61)	(0.60)	(0.87)	(0.72)
N	2303	2303	2288	2292	2295

Table A.3: Other Outcome Variables Using June Rankings

The table reports the results of a fuzzy RD design. The following equation is estimated.

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

The independent variable D is an indicator for membership in the Russell 2000 index. Ranking r_{it} is imputed from June index weights and is above cut-off c when $D = 1$. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. The bandwidth is 100. The regression identifying the addition effect only uses firms that were in the Russell 1000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. VR is volume ratio. IO is institutional ownership and is measured quarterly. The sample period is 1996-2012.

* p<0.05, ** p<0.01, *** p<0.001

Addition Effect

	May	Jun	Jul	Aug	Sep
VR	-0.177*	0.108	0.031	-0.151	-0.084
	(-2.22)	(0.91)	(0.41)	(-1.69)	(-0.98)
IO		0.313***			0.283***
		(8.14)			(6.06)
N	878	879	871	864	866

Deletion Effect

	May	Jun	Jul	Aug	Sep
VR	-0.063	-0.230	-0.404	0.060	0.079
	(-0.32)	(-1.69)	(-1.77)	(0.71)	(0.96)
IO		0.375***			0.381***
		(9.68)			(10.44)
N	951	954	948	952	957

Table A.4: Validity Tests for June Rankings

The table reports the results of a fuzzy RD design. The following equation is estimated.

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

The independent variable D is an indicator for membership in the Russell 2000 index. Ranking r_{it} is imputed from June index weights and is above cut-off c when $D = 1$. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. The bandwidth is 100. The regression identifying the addition effect only uses firms that were in the Russell 1000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. The data on fundamental variables is annual so estimates cannot be reported separately for each month. Mktcap is in billions of dollars. Repurchase is an indicator for repurchase activity in that fiscal year. ROE and ROA are return on equity and return on assets. EPS is earnings per share, excluding extraordinary items. Assets is asset book value in millions of dollars. C/A is the cash to asset ratio. ICR is the interest coverage ratio. Float is the number of floating shares (in thousands). The sample period is 1996-2012.

* p<0.05, ** p<0.01, *** p<0.001

Addition Effect

	Mktcap	Repurchase	ROE	ROA	EPS	Assets	ICR	C/A	Float
	-1.42***	.342***	.821	-.00335	-1.05**	-3,257***	21.4	-.0217	49,233***
	(-10.71)	(3.86)	(0.96)	(-0.15)	(-2.85)	(-3.33)	(0.55)	(-1.25)	(5.72)
N	938	661	786	786	785	787	677	751	938

Deletion Effect

	Mktcap	Repurchase	ROE	ROA	EPS	Assets	ICR	C/A	Float
	-.336***	-.0725	.25	.000583	-.0725	-1,180	-21.7	.0468*	32,169***
	(-5.37)	(-0.58)	(0.55)	(0.03)	(-0.17)	(-1.78)	(-0.43)	(2.32)	(7.24)
N	1059	619	762	762	761	762	668	754	1059

Table A.5: Fund Performance of Indexers and Liquidity Providers

This table reports OLS regression results of fund returns on fund characteristics. We restrict the sample to funds that are either flagged as an indexer or a liquidity provider. The dependent variable is June raw or style-adjusted fund returns (in percentages). Monthly style benchmark returns are the average of all fund returns with the same size/value assignment. The Index Dummy equals one if a fund is an indexer and zero if it is a liquidity provider. Log(MV) and Log(MtB) are the log of median market capitalization and market-to-book of fund holdings, measured annually using the latest report date from April of year $t-1$ to March of year t. MtB is winsorized by dropping at 99.75% and assumes a five months lag in book value. Log(TNA), Log(1+ FAM TNA), Turn, Age, Exp Ratio, Flow, and Lagged Returns are a fund's lagged log total net assets (in millions), log fund family total net assets, turnover, age, expense ratio, total load, percentage of new fund flow over past 12 months, and cumulative fund return over past 12 months. T-stats are in reported in parentheses. The sample period is 1996-2011.
* p<0.05, ** p<0.01, *** p<0.001

	All		1996-2003		2004-2011	
	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
Index Dummy	-0.378*	-0.439**	-0.500	-0.624*	-0.229	-0.234
	(-2.58)	(-2.98)	(-1.94)	(-2.39)	(-1.72)	(-1.82)
Log(TNA)	0.00936	-0.0285	0.0617	0.00151	-0.0481	-0.0675
	(0.18)	(-0.54)	(0.61)	(0.01)	(-1.14)	(-1.64)
Log(1 + FAM TNA)	-0.0298	0.000315	-0.0544	-0.00921	-0.00926	0.00794
	(-0.99)	(0.01)	(-0.94)	(-0.15)	(-0.35)	(0.30)
Turn	0.0141	0.0343	0.0600	0.0792	-0.0418	-0.0151
	(0.27)	(0.63)	(0.56)	(0.73)	(-0.82)	(-0.28)
Age	-0.000104	0.00136	-0.00402	-0.00325	0.00672	0.00817
	(-0.01)	(0.12)	(-0.21)	(-0.14)	(0.85)	(0.95)
Exp Ratio	20.65	21.85	40.91	38.84	-5.381	-1.952
	(1.16)	(1.21)	(1.42)	(1.32)	(-0.33)	(-0.12)
Load	-2.659	-3.049	-4.138	-4.620	-0.967	-1.335
	(-1.41)	(-1.63)	(-1.28)	(-1.44)	(-0.59)	(-0.81)
Flow	-0.0300***	-0.0132*	-0.0369***	-0.0193**	0.121	0.107
	(-4.10)	(-1.97)	(-4.12)	(-2.79)	(1.75)	(1.43)
Lagged Returns	0.0886***	0.0757***	0.0959***	0.0815***	0.0492***	0.0439***
	(10.54)	(8.37)	(9.76)	(7.71)	(4.48)	(4.00)
N	1157	1157	573	573	584	584
adj. R^2	0.757	0.185	0.708	0.202	0.847	0.122

Table A.6: First Stage of Fuzzy RD

The table reports the first stage regression from a fuzzy RD design. The following equation is estimated.

$$D_{it} = \alpha_{0l} + \alpha_{1l}(r_{it} - c) + \tau_{it}\left[\alpha_{0r} + \alpha_{1r}(r_{it} - c)\right] + \varepsilon_{it}$$

The outcome variable D is an indicator for addition to the Russell 2000 index. The variable τ is an indicator for whether the firm's end-of-May market capitalization ranking r_{it} predicted addition to the Russell 2000 index. We show coefficient estimates of α_{0r} and t-statistics are reported in parentheses. All regressions use firms with end-of-May ranking within 100 spots of the predicted cut-off c. The regression identifying the addition effect only uses firms that were in the Russell 1000 at the end of May. The regression identifying the deletion effect only uses firms that were members of the Russell 2000 at the end of May. The sample period is 2005-2012.

* p<0.05, ** p<0.01, *** p<0.001

	Addition Effect	Deletion Effect
τ	0.862***	0.865***
	(48.86)	(39.79)
N	837	771
adj. R^2	0.933	0.910
F	3,896	2,601

Table A.7: Lower Cut-off Returns

The table reports the results of a fuzzy RD design. For linear specification (p=1), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

For quadratic specification (p=2), the following equation is estimated:

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + \beta_{2l}(r_{it} - c)^2 + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c) + \beta_{2r}(r_{it} - c)^2\right] + \epsilon_{it}.$$

The outcome variable is monthly stock returns and the independent variable D is an indicator for membership in the Russell 2000 index. An indicator for whether ranking r_{it} is above the cut-off c is used as an instrument for D. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. The results show two different bandwidth choices: 100 and 200. The regression identifying the addition effect only uses firms that outside of the Russell 2000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. The sample period is 2005-2012.

* p<0.05, ** p<0.01, *** p<0.001

Addition Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	-0.034	0.036	0.022	-0.031	0.029
	(-1.09)	(1.45)	(1.02)	(-1.29)	(1.25)
p=2	-0.024	0.042	0.001	-0.025	0.021
	(-0.45)	(0.94)	(0.03)	(-0.58)	(0.56)
N	822	835	829	823	813

Addition Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	-0.011	0.037*	0.009	-0.020	0.031
	(-0.54)	(2.15)	(0.59)	(-1.27)	(1.90)
p=2	-0.060	0.025	0.020	-0.048	0.026
	(-1.78)	(0.94)	(0.88)	(-1.85)	(1.02)
N	1657	1676	1669	1658	1645

Deletion Effect: Bandwidth = 100

	May	Jun	Jul	Aug	Sep
p=1	0.015	0.033	0.058*	-0.054	0.055*
	(0.52)	(1.25)	(1.97)	(-1.82)	(2.00)
p=2	0.012	0.034	0.055	-0.033	0.062
	(0.29)	(0.74)	(1.03)	(-0.72)	(1.32)
N	770	771	766	765	764

Deletion Effect: Bandwidth = 200

	May	Jun	Jul	Aug	Sep
p=1	0.022	0.027	0.006	-0.036	0.037*
	(1.09)	(1.50)	(0.29)	(-1.87)	(1.99)
p=2	0.027	0.001	0.055	-0.030	0.034
	(0.86)	(0.02)	(1.73)	(-0.95)	(1.11)
N	1527	1528	1518	1516	1513

Table A.8: Lower Cut-off Outcome Variables

The table reports the results of a fuzzy RD design. The following equation is estimated.

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

The independent variable D is an indicator for membership in the Russell 2000 index. An indicator for whether ranking r_{it} is above the cut-off c is used as an instrument for D. We show coefficient estimates of β_{0r} and t-statistics are reported in parentheses. The bandwidth is 100. The regression identifying the addition effect only uses firms that were outside of the Russell 2000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. VR is volume ratio. IO is institutional ownership and is measured quarterly. The sample period is 2005-2012.
* p<0.05, ** p<0.01, *** p<0.001

Addition Effect

	May	Jun	Jul	Aug	Sep
VR	-0.750	3.332***	0.332**	0.091	-0.231
	(-1.86)	(7.02)	(2.91)	(0.62)	(-1.01)
IO		0.012			0.009
		(0.30)			(0.22)
N	496	502	499	495	489

Deletion Effect

	May	Jun	Jul	Aug	Sep
VR	-0.093	-1.530***	0.196	0.046	0.406***
	(-0.78)	(-6.00)	(1.96)	(0.36)	(3.72)
IO		0.031			0.041
		(0.78)			(1.04)
N	581	580	577	575	574

Table A.9: Lower Cut-off Validity Tests

The table reports the results of a fuzzy RD design. The following equation is estimated.

$$Y_{it} = \beta_{0l} + \beta_{1l}(r_{it} - c) + D_{it}\left[\beta_{0r} + \beta_{1r}(r_{it} - c)\right] + \epsilon_{it}.$$

The independent variable D is an indicator for membership in the Russell 2000 index. An indicator for whether ranking r_{it} is above the cut-off c is used as an instrument for D. We report coefficient estimates of β_{0r} and t-statistics are reported in parentheses. The bandwidth is 100. The regression identifying the addition effect only uses firms that were outside of the Russell 2000 at the end of May. The regression identifying the deletion effect only uses those that were members of the Russell 2000 at the end of May. The data on fundamental variables is annual so estimates cannot be reported separately for each month. Mktcap is in billions of dollars. Repurchase is an indicator for repurchase activity in that fiscal year. ROE and ROA are return on equity and return on assets. EPS is earnings per share, excluding extraordinary items. Assets is asset book value in millions of dollars. C/A is the cash to asset ratio. ICR is the interest coverage ratio. The sample period is 2005-2012.

* p<0.05, ** p<0.01, *** p<0.001

Addition Effect

	Mktcap	Repurchase	ROE	ROA	EPS	Assets	ICR	C/A
	0.013	0.090	0.196	0.001	0.033	-43.161	-159.180	0.061
	(1.44)	(0.78)	(0.84)	(0.02)	(0.11)	(-0.37)	(-1.57)	(1.57)
N	837	357	396	396	395	396	315	393

Deletion Effect

	Mktcap	Repurchase	ROE	ROA	EPS	Assets	ICR	C/A
	-0.011	0.094	0.126	-0.012	-0.400	-49.995	24.090	0.030
	(-1.06)	(0.90)	(0.83)	(-0.27)	(-1.14)	(-0.34)	(0.03)	(0.87)
N	771	458	501	501	500	502	394	494