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The index premium and its hidden cost for index funds☆

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ABSTRACT

This paper empirically investigates the index premium and its implications from 1990 to 2005. For additions to the S&P 500 and Russell 2000, we find that the price impact from announcement to effective day has averaged +8.8% and +4.7%, respectively, and −15.1% and −4.6% for deletions. The premia have been growing over time, peaking in 2000, and declining since then. The implied price elasticity of demand increases with firm size and decreases with idiosyncratic risk, supporting theoretical predictions. We also introduce a new concept that we label the index turnover cost, which represents a hidden cost borne by index funds (and the indexes themselves) due to the index premium. We illustrate this cost and estimate its lower bound as 21–28 bp annually for the S&P 500 and 38–77 bp annually for the Russell 2000.

1. Introduction

According to neoclassical finance, the price of a stock can be computed as its expected future cash flows discounted by their systematic risk. If the price deviates from this fundamental value, investors should aggressively step in and eliminate the mispricing. In a world with thousands of stocks and systematic market risk, the idiosyncratic risk of an individual stock will have only a negligible impact on a diversified investor's total portfolio risk, making investors relatively happy to buy or sell large quantities of an individual stock even for a very small abnormal return. Hence, if there is ever a clearly uninformed supply or demand shock for a stock, demand by other investors should be almost perfectly elastic—in other words, we expect demand curves for stocks to be almost perfectly horizontal.

This traditional view, held by many since the advent of the CAPM and widely publicized in textbooks and articles, has been challenged by mounting empirical evidence for steep demand curves.[1] In particular, the increasing popularity of indexing has provided researchers with a relatively clean experiment to test the slope of the demand curve. When index funds mechanically buy a fraction of all the stocks in an index, the demand by these funds represents an uninformed demand shock for a stock that is added to or deleted from an index. This demand shock induces a price effect which can then be used to infer the slope of the demand curve.

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[1] For example, Shleifer (1986), Holthausen et al. (1987, 1990), Loderer et al. (1991), Miller et al. (1994), Beneish and Whaley (1996), Lynch and Mendenhall (1997), Kaul et al. (2000), Wurgler and Zhuravskaya (2002), Chen et al. (2004), and many others. Amihud and Mendelson (1987, 1989) show how less liquid stocks tend to deviate further from their fundamental values.

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The early evidence for the S&P 500 index, including a 3% price impact documented by Shleifer (1986) and a 5–7% price impact documented by Lynch and Mendenhall (1997) in the days immediately around the effective day, has later been complemented by similar evidence from international markets, usually with somewhat different index selection rules.[2] Today the evidence for downward-sloping demand curves in general is overwhelming.[3] The main unsettled question is about how the slope depends on the horizon: if demand curves are much steeper in the short run than in the long run, then the price impact will reverse quickly, which is sometimes labeled “price pressure.” When we refer to downward-sloping demand curves, we generally mean both short-term and long-term effects, as both components seem to be important empirically.

In this paper, we first find out what the current state of the S&P 500 premium is. Indexing has surged in popularity since the comprehensive study by Lynch and Mendenhall (1997) whose data ended in 1995, so we ask whether the current higher fraction of indexing has materially affected the size of the index premium. We analyze both the short-term and long-term behavior of the premium as well as its evolution over the years.

In addition to the S&P 500, we run similar tests for the Russell 2000 which has received much less attention from academic researchers.[4] Nevertheless, the Russell 2000 generates hundreds of additions and deletions every year, making it very useful for research purposes. We estimate the slope of the demand curve for both the S&P 500 and Russell 2000 index changes, and we investigate how the slopes of demand curves vary across stocks.

Finally, we introduce a new concept that we label the “index turnover cost.” This reflects the recurring costs that a mechanical indexer will have to pay for always buying stocks with the index premium and selling them without the premium. The cost is measured against what we label an “index-neutral” strategy, which consists of holding a portfolio with essentially identical characteristics but not being mechanically tied to holding the index all the time. This is a cost that index investors should certainly care about (see also Petajisto (2006) for a theoretical treatment of the cost and its behavior). We pick simple examples to illustrate the cost for both the S&P 500 and Russell 2000, and we estimate the size of this cost from data.

We find that the index premia for both the S&P 500 and Russell 2000 have been growing over the 1990s with the popularity of indexing. The difference between additions and deletions reached 32.2% and 37.4%, respectively, for the two indexes in 2000. During the entire sample from 1990 to 2005, the additions have risen by 8.8% and 4.7%, respectively, while the deletions have fallen by −15.1% and −4.6%. Most of the price effect persists over the following two weeks. Over the following two months, about one half of the price effect is reversed; it is also possible that the entire effect is reversed over time. Lack of statistical power prevents us from making more accurate inferences about the long-term price impact. It is also surprising that there is a clear and economically significant drift for both indexes between the announcement and effective days. This drift was still very significant in 2000 but has slightly decreased since then.

The slopes of the demand curves for S&P 500 changes from 1990 to 2005 are slightly below unity, which is consistent with Shleifer's (1986) early results during a period when indexing was less popular. Demand curves are about twice as steep for the small-cap universe of Russell 2000 changes. Within each index, demand curve slopes are also negatively related to firm size and positively related to idiosyncratic risk.

The annual index turnover cost peaks at 65–82 bp for the S&P 500 and a dramatic 232–463 bp for the Russell 2000, both in the year 2000. We estimate the average cost from 1990 to 2005 as 21–28 bp for the S&P 500 and 38–77 bp for the Russell 2000. In dollar terms, using $1.2 trillion and $44 billion as the amount of mechanically indexed assets for the two indexes,[5] we get annual average costs of $2.5–3.4 billion for the S&P 500 indexers and $170–340 million for the Russell 2000 indexers. The range of our estimates reflects uncertainty about what fraction of the index premium is reversed over time—the more complete the reversal, the bigger the index turnover cost. Our estimates for the average cost are likely to represent a lower bound, particularly for the Russell 2000, because we do not fully take into account anticipation of index changes by market participants.

Because the cost is suffered by the benchmark index itself, it will remain hidden from index investors who simply focus on the explicit fees of index funds and their performance relative to the index. Yet it represents an unambiguous drag on returns, and it can be avoided with simple index-neutral strategies which have otherwise similar risk and return characteristics. Hence, this cost should receive similar attention as a fund's expense ratio which also has a first-order effect on returns.

Relative to the existing literature, we extend the S&P 500 and Russell 2000 samples to the 2001–2005 period and contrast it with the earlier time period. This is interesting because the enormous price effects following index changes in 1999 and 2000 generated so much attention that the market may well have become more efficient in this respect, and indeed we do document an apparent regime shift after 2000 at least for additions.[6] Furthermore, we provide a rather comprehensive analysis of the abnormal returns and their daily evolution, and we discuss the implied slopes of demand curves for stocks as well as their cross-sectional dependence on some key variables.

Concurrent work by Chen et al. (2006) as well as an earlier study by Gastineau (2002) also recognize that mechanical indexers may suffer from the price impact of index changes, yet they attribute it not to the price impact of the indexers themselves but to the price impact of arbitrageurs. Consequently, Chen et al. (2006) advocate making index changes as unpredictable as possible to the arbitrageurs, for example by having an opaque index selection rule, introducing randomness in index selection, and not

[2] Kaul et al. (2000), Deininger et al. (2001), Greenwood (2005), Chakrabarti et al. (2005), and others.

[3] Petajisto (2009) summarizes the leading alternative hypotheses (liquidity, information, and market segmentation) and points out why they cannot fully account for the variety of evidence for downward-sloping demand curves. For example, index stocks experience price effects if index weights are redefined even when index membership remains the same. Duffie (2010) also provides an overview of these issues and proposed explanations.

[4] The exceptions include Madhavan (2003), Biktimirov et al. (2004), and Chen (2006), which all focus on earlier sample periods.

[5] The S&P number is from its “Annual Survey of S&P Indexed Assets” as of 12/31/2007. The Russell 2000 number is directly from Russell.

[6] For example, the Russell effect was reversed for the first time in June 2003, presumably due to widespread anticipation of index changes.

preannouncing any of the changes. Their study has also been featured in the financial press, where the authors have argued for example that "Russell needs to make their [index selection] process less transparent."[7]

We come to exactly the opposite conclusion: predictability in index composition is actually desirable for passive indexers. The price impact of index changes on the effective day of the change is generated by the coordinated demand due to index funds. The arbitrage activity consists of anticipating these changes days or even months earlier, buying the additions and then selling the entire position to index funds on the effective day. In effect, the arbitrageurs are thus helping to meet the large spike in demand by indexers by spreading the trade over a longer period of time. This is precisely why S&P started to preannounce index changes in 1989. Thus "silent indexes" where index changes are announced only after the indexers have traded would be more likely to hurt than help indexers. Instead, our recommended index-neutral strategies, where investors deviate from the crowd but act with full transparency, seem the most attractive alternatives to index investors.

This paper proceeds as follows. Section 2 investigates the S&P 500 index premium. Section 3 does the same for the Russell 2000. The cross-sectional regressions for both indexes are presented in Section 4. Section 5 illustrates and estimates the index turnover cost for both indexes, and it also discusses the implications for both index providers and index investors as well as contrasts these implications with the existing literature. Section 6 concludes.

2. S&P 500 index premium

2.1. Background

The Standard and Poor's 500 Index consists of a sample of 500 firms intended to be representative of the U.S. economy. At the end of 2005, the aggregate market value of the firms in the index was roughly $11 trillion, accounting for about 76% of the total market capitalization of all U.S. stocks. If we compare the S&P 500 firms with all U.S. firms ranked by market capitalization, we find 81.4% of the index firms within the top 500, 97.5% within the top 1000, and 99.6% within the top 1500 firms, accounting for 97.6%, 99.9%, and 99.99%, respectively, of the market value of the index. Stocks within the index have historically been value-weighted based on total market capitalization; starting in 2005, the weights have been based on public float which excludes shares held by firm insiders or large blockholders.

The index is selected by the S&P index selection committee, which makes its decisions behind closed doors based on market capitalization, industry representation, liquidity, trading volume, and financial soundness. Market capitalization is a very important criterion, but from an investor's point of view significant residual uncertainty remains about index changes. Index changes are always prompted by deletions.

After October 1989, S&P has attempted to announce index changes usually about five trading days before they become effective. Prior to October 1989, index changes would become effective immediately after announcement. Both the actual changes and announcements are made after the close of trading. Announcements occur at apparently random times throughout the year, usually only one but almost always less than five stocks at a time.

There are a large number of mutual funds and pension funds that mechanically track the S&P 500 index. Indexing as an investment style began to grow dramatically since the 1980s, and the trend has continued all the way through the 1990s (Morck and Yang (2001), Cremers and Petajisto (2009)). According to S&P, at the end of 2005 about $1.26 trillion was directly indexed to the S&P 500, accounting for slightly over 10% of the market value of the stocks in the index. In the long run, according to a chief executive at the indexing giant Barclays, 50% of the stock market is "not an unreasonable target" for index funds.[8]

2.2. Index premium

Whenever a stock is added to the S&P 500 index, about 10% of its shares will be bought by mechanical indexers. Most significant indexers actually hold all 500 underlying stocks and try to update their portfolios as close as possible to the actual index change in order to minimize their tracking error relative to the index (Blume and Edelen (2001)).

According to neoclassical finance, investors can easily absorb such an uninformed demand shock for one stock with only negligible price impact, as explained in detail by Petajisto (2009). An investigation of the price impact of S&P 500 index addition thus provides a relatively clean test of the slope of the demand curve for a stock. Consequently, it will also serve as a test of our neoclassical asset pricing theories, namely the CAPM and in an informal sense also the APT.[9]

Could it be that there is some information content in S&P index changes about the firms' fundamentals? It seems unlikely, since the decision is driven mostly by market capitalization and industry representation, and S&P itself explicitly says that index membership is not intended to convey any message about the investment merits of those firms. We also observe similar price effects for other indices such as the Russell 2000 where membership is based on nothing but market capitalization. Even when all the same stocks are in the index before and after the event, but their index weights are redefined for an exogenous reason, we again see similar price effects (e.g., Kaul et al. (2000); same pattern was seen when the S&P 500 was redefined to be based on

[7] "Russell Redo May Be Costly," *The Wall Street Journal*, 6/3/2006. See also "Speculators Take Toll on Index Funds," *The Wall Street Journal*, 4/13/2006.

[8] *The Wall Street Journal*, 4/9/2001.

[9] Since the APT is not an equilibrium model, it does not formally imply any specific slope for the demand curve for a stock. However, to get an idea of the magnitude, Ross (1976) suggests a restriction that no portfolio have more than twice the Sharpe ratio of the market portfolio.

market value of public float and not all shares outstanding, in spite of the fact that it was public information that firms like Microsoft and Wal-Mart had large insider holdings).

2.2.1. Estimation procedure

We use data for S&P 500 changes in 1980–2005. For each event stock, we require valid CRSP return data 15 trading days before the announcement day and 15 trading days after the effective day. This eliminates firms that undergo M&A activity such as being spun off or acquired by another firm. It also eliminates firms that were delisted from their exchanges only a few days after their deletion from the index, which may occur for firms experiencing sudden financial distress. In the remaining sample there are more than twice as many additions as deletions, where the difference is accounted for by mergers between two index firms.

We define the effective day of the index change as trading day zero in event time, so the index is updated using the closing prices of trading day zero. The announcement usually occurs after close on trading day −5. We define the cumulative abnormal return (CAR) on a stock as the difference between the cumulative gross stock return and the cumulative gross return on the CRSP value-weighted market index, expressed as a percentage of the latter. Note that since index changes depend on past returns, this induces a selection bias to the alpha estimates of the market model, so the standard market model is not applicable here and that is why we use market-adjusted returns instead. We also use the four-factor model of Carhart (1997) as an alternative specification for abnormal returns. We normalize the CAR to zero at trading day −10. This allows us to identify a possible pre-announcement drift due to information leakage or other anticipation of the index announcement.

Note that with any model to adjust for risk, we are always testing the joint hypothesis of efficient pricing together with the model being correctly specified.[10] However, S&P index changes are unusually robust to this common challenge: First, the initial price impacts can be measured over such a short period of time, only a few days or weeks, that any risk premium has very little impact on the results. Second, since the events are scattered over random points in calendar time, this reduces the impact of other factors that might systematically influence returns.

Since the index premium is not likely to be constant across our sample period of 26 years, especially given the increasing relative size of index funds, we conduct our analysis separately for each year. Each year we form an equally weighted portfolio of additions at trading day −10 (with their effective days that year), and another portfolio of deletions at trading day −10. We then look at the cumulative buy-and-hold abnormal returns (CARs) on those portfolios.

To compute standard errors, we estimate for each stock the volatility of market-adjusted returns using a six-month period of daily data ending one week before the announcement day. Since index changes occur throughout the year, we assume the abnormal returns across stocks are uncorrelated when we estimate the volatility of the event stock portfolio. In reality there is of course some overlap in calendar time, especially since occasionally two or three stocks are replaced at the same time. As our market adjustment is unlikely to eliminate all systematic risk, our standard errors are likely to be somewhat understated.

As we are interested in the price effects around both the announcement day and the effective day, we want to align both days for all event stocks. While the most common difference between the announcement and effective days is five trading days, this difference may vary from zero to more than a month. Hence, we form two samples. The first one consists of stocks where the difference is at least two days. If the difference is two to four days, we linearly “stretch” the returns to cover five days in event time. If the difference is greater than five days, we shrink the interval to five days. This allows us to align the CAR at the close of trading following the announcement day and the CAR at the close of trading on effective day for all stocks in the sample. The second sample consists of the first sample (with the aligned event days) plus the stocks where the announcement was less than two days before the change, where the event time of the latter group is not altered.

2.2.2. Results

Table 1 shows the CARs in 1990–2005 at trading day zero, i.e. over a period of about one month, along with the associated standard errors. The table also shows the number of qualifying additions and deletions each year. The number of index changes peaks at 48 additions and 23 deletions in 2000. Over the entire sample period, the CAR for additions is 8.8% using market-adjusted returns and 8.1% using the four-factor model of Carhart (1997). The CAR for deletions is − 15.1% and − 14.7% with market-adjusted returns and four-factor alphas, respectively. The effects are statistically highly significant, with t-statistics ranging from about 15 to 18.

Fig. 1 describes the evolution of the CARs around the event, together with the 95% confidence intervals. In the last five trading days before announcement, the additions accumulate a 1% premium. As expected, the biggest jump occurs right after announcement. Nevertheless, the announcement return remains small enough to leave an economically significant 0.5−1% daily drift between the announcement and effective days. Given the publicity surrounding S&P index changes and the associated price premium, it is indeed surprising that such a drift can still persist and has not been arbitraged away.[11] The CAR peaks at the effective day and then experiences approximately a 2% reversal in the next three days. No further reversal occurs in the next two weeks.

The deletions behave somewhat similarly, except that there seems to be a greater anticipation of the announcement. Part of the negative pre-announcement return could also be due to S&P deleting stocks that just experienced sharp losses in market value and thus creating a selection bias. Since all index changes are prompted by deletions, and since extreme negative returns are more common than extreme positive returns, this selection bias is unlikely to affect the CAR for additions. Note that the deletions in the

[10] See e.g. Roll (1997), Roll and Ross (1994), and Kandel and Stambaugh (1995). Also the dynamic evolution of risk and return can affect estimates for abnormal returns (e.g., Detemple (1986), Dothan and Feldman (1986), Björk et al. (2010), and Feldman (2007)).

[11] In fact there is anecdotal evidence of hedge funds trading on this drift but apparently not enough to eliminate it.

Table 1
Abnormal returns for S&P 500 additions and deletions. The table shows the cumulative abnormal returns for all qualifying event stocks from 5 trading days before the announcement day to the effective day of the change. Stocks need to exist in CRSP 15 trading days before the announcement and 15 trading days after the index change.

	Additions					Deletions					Additions–deletions			
		Market-adjusted		Four-factor alpha			Market-adjusted		Four-factor alpha		Market-adjusted		Four-factor alpha	
Year	N	CAR	t	CAR	t	N	CAR	t	CAR	t	CAR	t	CAR	t
1990	11	3.6%	(1.97)	6.4%	(3.85)	7	−22.3%	(−2.78)	−21.3%	(−2.63)	25.9%	(3.15)	27.7%	(3.35)
1991	10	9.1%	(5.13)	8.1%	(4.94)	5	−43.1%	(−3.57)	−41.1%	(−3.50)	52.2%	(4.28)	49.2%	(4.15)
1992	6	3.3%	(1.13)	2.7%	(0.97)	5	−39.4%	(−5.76)	−36.6%	(−5.40)	42.7%	(5.74)	39.3%	(5.37)
1993	7	5.1%	(1.76)	4.8%	(1.76)	6	−6.0%	(−1.84)	−6.4%	(−2.04)	11.1%	(2.54)	11.2%	(2.69)
1994	13	6.4%	(3.96)	6.2%	(4.14)	13	−5.0%	(−1.72)	−4.2%	(−1.48)	11.3%	(3.43)	10.4%	(3.25)
1995	23	8.1%	(6.43)	7.6%	(6.69)	14	−7.8%	(−3.40)	−7.0%	(−3.10)	15.9%	(6.06)	14.6%	(5.79)
1996	20	7.4%	(4.40)	6.6%	(4.28)	14	−7.4%	(−4.21)	−6.7%	(−3.95)	14.8%	(6.08)	13.3%	(5.80)
1997	24	11.8%	(9.02)	10.2%	(8.25)	7	−5.3%	(−1.47)	−3.5%	(−1.01)	17.1%	(4.47)	13.6%	(3.71)
1998	37	12.7%	(9.91)	13.1%	(11.08)	10	−13.1%	(−3.98)	−11.5%	(−3.66)	25.8%	(7.31)	24.6%	(7.31)
1999	38	10.4%	(6.64)	8.7%	(6.15)	11	−10.9%	(−3.31)	−11.4%	(−3.68)	21.4%	(5.85)	20.1%	(5.91)
2000	48	14.4%	(6.90)	13.3%	(7.19)	23	−17.8%	(−6.13)	−17.4%	(−6.28)	32.2%	(9.01)	30.7%	(9.22)
2001	27	4.2%	(1.87)	2.6%	(1.33)	14	−20.2%	(−6.91)	−21.2%	(−8.63)	24.4%	(6.61)	23.7%	(7.59)
2002	21	7.6%	(4.72)	6.3%	(4.31)	16	−22.1%	(−6.93)	−23.9%	(−8.28)	29.7%	(8.32)	30.2%	(9.34)
2003	8	−1.1%	(−0.50)	−0.2%	(−0.11)	2	−32.1%	(−2.03)	−30.3%	(−2.15)	31.0%	(1.94)	30.1%	(2.11)
2004	14	4.3%	(3.19)	3.7%	(2.93)	7	−5.0%	(−2.01)	−4.9%	(−2.11)	9.2%	(3.28)	8.5%	(3.25)
2005	14	4.6%	(3.23)	3.6%	(2.78)	2	−22.2%	(−2.75)	−19.9%	(−2.74)	26.8%	(3.27)	23.5%	(3.18)
1990–2000	237	10.3%	(17.00)	9.6%	(17.63)	115	−13.7%	(−11.49)	−12.9%	(−11.13)	24.0%	(17.95)	22.6%	(17.58)
2001–2005	84	4.6%	(5.08)	3.6%	(4.47)	41	−19.0%	(−10.20)	−19.8%	(−12.01)	23.6%	(11.39)	23.4%	(12.76)
1990–2005	321	8.8%	(17.39)	8.1%	(17.69)	156	−15.1%	(−15.00)	−14.7%	(−15.36)	23.9%	(21.22)	22.8%	(21.46)

figure do not have quite as extreme alphas—this is because the figure only includes the narrower sample of stocks where the announcement day was at least two days before effective day.

The long-horizon returns are described by Fig. 2. About half of the alphas from additions reverse within four months, leaving a price impact of about 5% after six months. In contrast, the alphas from deletions reverse fully within about two months. Since the standard errors of the estimates grow significantly with the horizon, it is hard to infer the exact long-term price impact of index membership. Nevertheless, it appears that index deletions have no long-term price impact, but additions appear to have at least a small long-term price impact.

To see the evolution of the effective-day premium over time, we compute it for each year from 1980 to 2005. Prior to 1989, the announcement was not made until after close on day zero, so the first closing price to reflect the index change is on day one. To keep the numbers comparable across years, we also calculate the day one CARs even for the years after 1989, which produces similar but slightly different numbers when compared to the day zero CARs in Table 1.[12]

In the 1980s the premium for additions seems fairly stable at 2–5%, averaging 3.5%. In the 1990s, the day one premium increases more or less steadily towards the end of the decade, reaching an average of 9.2% and peaking in 2000 at 12.3%. From 2001 to 2005, the index premium is again smaller, averaging 4.5%. These numbers are consistent with the earlier literature: Shleifer (1986) finds an addition premium of 3% for the 1976–1983 period, while Lynch and Mendenhall (1997) find an addition premium of about 5–7% for 1990–1995.

The increase in the premium in the 1990s coincides with an economically significant increase in the share of mechanical indexers over this period. Morck and Yang (2001) point out that the value (in 1982 dollars) of Vanguard 500 was $0.11 billion in 1982, $1.66 billion in 1990, and $32.3 billion in 1997, representing percentage shares of the S&P 500 index of 0.01%, 0.10%, and 0.69%, respectively. Since the Vanguard 500 is the oldest and largest S&P 500 index fund, its growth seems like a reasonable proxy for the growth rate of the index fund industry over this period. The current total share of mechanical indexers is estimated at around 10% of the index.

The price elasticity of demand for a stock can be estimated from the price impact and the size of the demand shock from indexers. Using the numbers from 1990–2005 and taking the average of the addition and deletion impacts in Table 1, we estimate the index premium at 11.9%. With a 10% demand shock, this gives us $\frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = -\frac{0.10}{0.119} = -0.84$. This is relatively close to the unit price elasticity of demand estimated by Shleifer (1986); using elasticity as a measure of market efficiency, we could infer that market efficiency has remained constant over time. However, the lower index premium and thus higher elasticity since 2000 suggests that the market may have become more efficient in the last five years of the sample, possibly helped by the growth of the hedge fund industry at the same time. One significant source of noise in the estimate, both on average and over time, comes from the share of indexers: while it is relatively easy to estimate the share of purely mechanical indexers, a very large number of funds

[12] Full table available upon request.

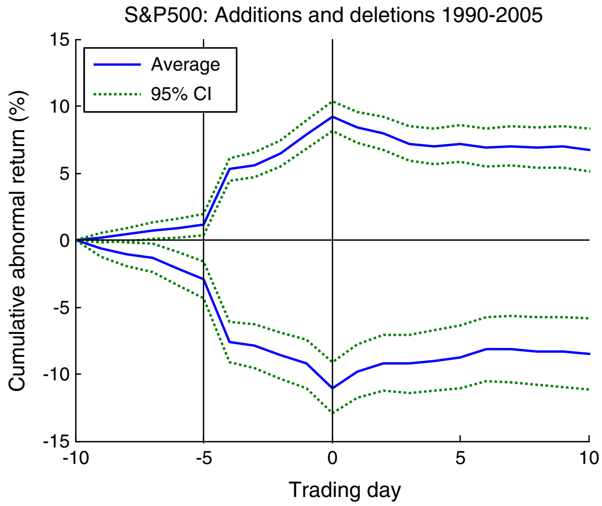

Fig. 1. S&P 500 index additions and deletions in 1990–2005. The figure represents cumulative average market-adjusted returns in event time for stocks added to the index (top graph) or deleted from it (bottom graph), as well as the 95% confidence intervals. Index changes are announced after close on day −5, and they become effective after close on day 0. Since the difference between the two days may be longer or shorter for some stocks, we have shrunk or stretched the actual intermediate time to fit the five-day interval.

are benchmarked against the index which creates additional long-run demand for index stocks. However, it seems unlikely that any such funds would regularly rush to trade on index changes within a few days of the effective day.

3. Russell 2000 index premium

3.1. Background

The most widely tracked small-cap index is the Russell 2000, selected mechanically based on market capitalization. The Russell 3000 index covers the largest 3000 U.S. stocks; it consists of the Russell 1000 index, which covers the largest 1000, and the Russell 2000, which covers the remaining 2000 stocks. In 2005, the lower cutoff of the Russell 2000 was $180 million and the upper cutoff $2.2 billion. The market capitalization of Russell 2000 was about $1.4 trillion, and at the same time an estimated $44 billion was indexed to it, implying that about 3% of the index is held by passive indexers. Furthermore, the Russell 2000 is the second most common index (after the S&P 500) for benchmarking purposes, which creates additional long-term demand for the index stocks.

The Russell indexes are updated once a year based on market capitalization on May 31. The changes become effective one month later at close on June 30. [13] Indexers typically update their portfolios at the end of June in order to minimize their tracking error. Russell has always determined index weights based on its definition of the public float of a firm and not the total number of shares outstanding. This is done in an effort to keep the index easily tradable, which is a concern especially for a small-stock index.

A clear index effect exists for the Russell 2000 in June, although it has not received as much attention as the S&P 500 effect. Furthermore, since index membership is based on market capitalization alone, the index changes are relatively easy to predict a few weeks before the new index stocks are determined. In 2001, Goldman Sachs estimated that during the 8 weeks preceding May 31, the stocks expected to be added to the index outperformed the index by 22%. Barclays says it started its own analysis of the 2001 index changes in February, more than three months before May 31.[14]

3.2. Index premium

3.2.1. Estimation procedure

We use data from 1990 to 2005, obtained from Frank Russell Co. The first clean annual reconstitution took place in 1990; prior to that, the indexes added new stocks also at other times of the year. Naturally, there is no reason to believe that the share of indexers and their behavior around index changes would stay constant throughout.

As the Russell 2000 has both a lower cutoff and an upper cutoff, we distinguish between four kinds of event stocks: additions from below and above, and deletions from below and above. When we aggregate event stocks into portfolios, this gives us four test portfolios. Stocks crossing the upper cutoff are bought and sold not only by Russell 2000 indexers, but the opposite side of the trades is taken by Russell 1000 indexers. These opposite effects are likely to confound the price effects, and hence the additions and deletions around the lower cutoff seem to be a cleaner sample for our test of demand curve slopes.

[13] Since 2004, the effective day has actually been the last Friday before June 28.
[14] *The Wall Street Journal*, 5/31/01.

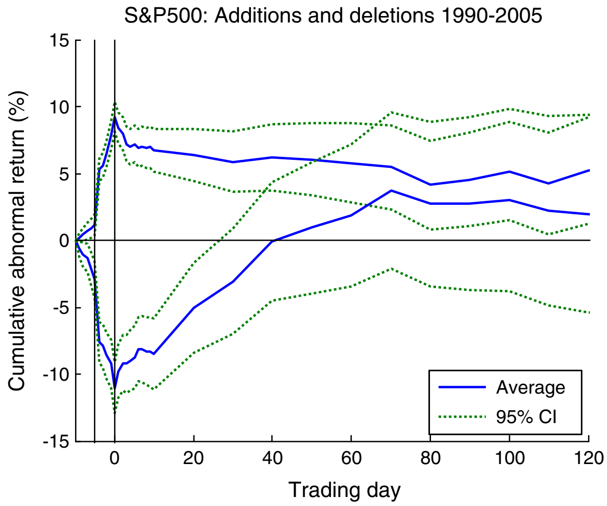

Fig. 2. S&P 500 index additions and deletions in 1990—2005. Everything is as in the previous figure, except for the different horizon.

Because all index changes in a year occur exactly at the same time, we can expect significant cross-correlation for stocks. Again we use two methods to control for systematic risk: market-adjusted returns and four-factor alphas. Any non-market sources of risk are likely to make the market-adjusted returns noisier than four-factor alphas. However, it is not obvious that the four-factor model is a better alternative: we are explaining the return on hundreds of additions and deletions (over 600 stocks in a typical year) with benchmark portfolios which place a significant weight on the exact same stocks, so the model may bias the results (especially for additions as they are larger) toward zero alphas.

When we aggregate event stocks into the four event portfolios, we equal-weight the portfolios on May 31 and start computing CARs from that date. This is effectively the announcement day of the event, since market participants can use the closing prices on

Table 2

Abnormal returns for Russell 2000 additions and deletions that cross the lower cutoff of the index. The table shows the buy-and-hold abnormal returns for all qualifying event stocks from May 31 (when the new index is determined) to June 30 (when the new index becomes effective). Stocks are given equal portfolio weights on May 31. Stocks need to have at least 2 months of CRSP return data prior to the event. The abnormal return on a stock is the difference between the stock return and the return on its control portfolio which has similar idiosyncratic risk and market equity.

	Additions					Deletions					Additions–deletions			
		Market-adjusted		Four-factor alpha			Market-adjusted		Four-factor alpha		Market-adjusted		Four-factor alpha	
Year	N	CAR	t	CAR	t	N	CAR	t	CAR	t	CAR	t	CAR	t
1990	283	3.5%	(1.27)	1.3%	(0.73)	155	−3.7%	(−0.69)	−3.6%	(−0.70)	7.1%	(1.37)	4.6%	(0.81)
1991	382	2.2%	(0.88)	2.0%	(1.48)	330	−6.0%	(−1.69)	−7.9%	(−2.87)	8.6%	(2.77)	10.4%	(3.41)
1992	424	−1.6%	(−0.70)	2.2%	(1.79)	381	−7.4%	(−2.35)	−5.5%	(−2.34)	6.0%	(1.84)	8.0%	(2.82)
1993	326	1.0%	(0.46)	1.2%	(1.06)	309	−3.4%	(−1.21)	−2.9%	(−1.53)	4.4%	(1.82)	4.2%	(1.87)
1994	424	−0.4%	(−0.19)	0.3%	(0.27)	402	−3.0%	(−1.35)	−2.7%	(−1.79)	2.6%	(1.22)	3.1%	(1.59)
1995	333	7.0%	(2.83)	3.8%	(2.79)	238	−3.7%	(−1.47)	−5.0%	(−2.45)	11.1%	(3.96)	9.2%	(3.48)
1996	384	−3.5%	(−0.90)	2.1%	(1.31)	304	−10.1%	(−3.71)	−6.9%	(−3.70)	7.2%	(1.91)	9.5%	(3.74)
1997	410	8.0%	(2.58)	5.0%	(3.49)	305	−7.1%	(−1.88)	−8.1%	(−3.27)	16.1%	(5.08)	14.0%	(4.50)
1998	391	−0.1%	(−0.02)	3.6%	(1.75)	223	−5.3%	(−1.17)	2.9%	(0.78)	5.2%	(1.28)	0.5%	(0.10)
1999	348	9.6%	(1.92)	5.7%	(1.79)	227	−7.9%	(−1.53)	−6.7%	(−1.95)	18.3%	(2.64)	12.7%	(2.40)
2000	471	31.0%	(3.27)	8.0%	(1.31)	318	−5.1%	(−0.93)	−5.7%	(−1.51)	37.4%	(3.68)	13.9%	(2.16)
2001	490	5.6%	(1.30)	0.5%	(0.16)	257	−5.6%	(−0.73)	−16.1%	(−1.93)	10.8%	(1.22)	17.8%	(1.87)
2002	358	8.5%	(2.12)	3.6%	(1.04)	217	−10.0%	(−1.40)	−9.3%	(−1.20)	19.7%	(2.76)	13.3%	(1.30)
2003	275	1.1%	(0.28)	1.0%	(0.27)	179	5.6%	(1.36)	2.2%	(0.52)	−4.7%	(−0.93)	−1.5%	(−0.20)
2004	278	−2.0%	(−0.70)	−4.4%	(−1.19)	204	−1.6%	(−0.58)	−3.5%	(−1.02)	−0.6%	(−0.15)	−1.1%	(−0.17)
2005	183	6.0%	(2.23)	4.0%	(1.57)	207	1.4%	(0.43)	−1.9%	(−0.54)	4.4%	(1.07)	5.9%	(1.10)
1990–2000	380	5.1%	(4.11)	3.2%	(4.28)	290	−5.7%	(−4.81)	−4.7%	(−5.27)	11.3%	(7.72)	8.2%	(6.84)
2001–2005	317	3.8%	(2.39)	0.9%	(0.63)	213	−2.0%	(−0.85)	−5.7%	(−2.18)	5.9%	(2.16)	6.9%	(1.93)
1990–2005	360	4.7%	(4.75)	2.5%	(3.59)	266	−4.6%	(−4.11)	−5.0%	(−4.92)	9.6%	(7.27)	7.8%	(5.63)

Table 3
Abnormal returns for Russell 2000 additions and deletions that cross the upper cutoff of the index. The table shows the buy-and-hold abnormal returns for all qualifying event stocks from May 31 (when the new index is determined) to June 30 (when the new index becomes effective). Stocks are given equal portfolio weights on May 31. Stocks need to have at least 2 months of CRSP return data prior to the event. The abnormal return on a stock is the difference between the stock return and the return on its control portfolio which has similar idiosyncratic risk and market equity.

	Additions					Deletions					Additions–deletions			
		Market-adjusted		Four-factor alpha			Market-adjusted		Four-factor alpha		Market-adjusted		Four-factor alpha	
Year	N	CAR	t	CAR	t	N	CAR	t	CAR	t	CAR	t	CAR	t
1990	60	3.3%	(0.97)	4.0%	(1.33)	73	−1.9%	(−0.70)	−4.1%	(−2.11)	5.1%	(1.28)	8.3%	(2.08)
1991	78	2.2%	(0.69)	2.1%	(0.84)	67	−3.3%	(−1.32)	−1.4%	(−0.77)	5.6%	(1.48)	3.5%	(1.10)
1992	80	0.2%	(0.09)	2.5%	(1.45)	56	−4.2%	(−1.64)	−1.8%	(−0.96)	4.5%	(1.45)	4.4%	(1.57)
1993	92	−3.2%	(−1.52)	−1.6%	(−1.08)	60	1.0%	(0.40)	−0.3%	(−0.18)	−4.2%	(−1.48)	−1.4%	(−0.61)
1994	95	1.0%	(0.56)	0.9%	(0.60)	65	−3.9%	(−1.28)	−2.0%	(−0.90)	5.0%	(1.44)	2.8%	(1.05)
1995	67	2.6%	(1.15)	2.3%	(1.40)	78	4.1%	(1.32)	−1.2%	(−0.54)	−1.5%	(−0.40)	3.5%	(1.28)
1996	105	−1.3%	(−0.64)	1.4%	(0.92)	91	−6.6%	(−1.91)	−1.5%	(−0.68)	5.5%	(1.34)	2.9%	(1.06)
1997	93	2.0%	(0.59)	1.5%	(0.72)	100	−2.3%	(−1.00)	−3.9%	(−2.58)	4.4%	(1.44)	5.6%	(2.08)
1998	93	−7.0%	(−1.97)	−1.2%	(−0.54)	108	1.3%	(0.34)	2.0%	(0.75)	−8.3%	(−2.35)	−3.2%	(−0.87)
1999	95	3.3%	(0.70)	6.2%	(1.98)	123	−2.1%	(−0.51)	−8.4%	(−2.45)	5.1%	(0.76)	15.4%	(2.96)
2000	136	−4.9%	(−0.92)	1.3%	(0.31)	117	9.6%	(1.10)	−5.9%	(−1.25)	−14.2%	(−1.20)	7.3%	(1.16)
2001	105	2.2%	(0.20)	−5.4%	(−0.89)	152	−0.5%	(−0.17)	−3.4%	(−1.19)	2.3%	(0.19)	−2.4%	(−0.35)
2002	103	−5.1%	(−0.59)	3.9%	(0.85)	138	−2.0%	(−0.72)	−6.5%	(−3.27)	−3.5%	(−0.36)	11.1%	(2.07)
2003	82	4.3%	(1.31)	3.2%	(0.98)	94	−2.1%	(−0.85)	−3.4%	(−1.83)	6.5%	(1.99)	6.8%	(1.72)
2004	67	0.1%	(0.04)	−1.0%	(−0.42)	67	1.6%	(0.59)	−0.7%	(−0.34)	−1.7%	(−0.54)	−0.3%	(−0.10)
2005	80	2.0%	(0.83)	1.5%	(0.84)	89	1.4%	(0.66)	−1.7%	(−1.11)	0.6%	(0.20)	3.2%	(1.20)
1990–2000	90	−0.2%	(−0.18)	1.8%	(2.41)	85	−0.8%	(−0.65)	−2.6%	(−3.38)	0.6%	(0.41)	4.5%	(4.03)
2001–2005	87	0.7%	(0.24)	0.5%	(0.27)	108	−0.3%	(−0.26)	−3.2%	(−3.32)	0.9%	(0.26)	3.7%	(1.78)
1990–2005	89	0.1%	(0.08)	1.4%	(1.82)	92	−0.6%	(−0.70)	−2.8%	(−4.58)	0.7%	(0.48)	4.2%	(4.23)

May 31 to determine the future index composition with virtually no uncertainty.[15] Since some additions and deletions can be predicted earlier than May 31, part of the index-induced price effect is likely to occur earlier. Yet we focus on returns after May 31, primarily because we do not want to be subject to a forward-looking selection bias but also because over the years most of the abnormal returns seem to occur in June, in spite of the anecdotal evidence of some investors predicting index changes well ahead of time.

To apply the four-factor model, we use the period from December 1 to May 31 to estimate the factor betas of the event portfolios (the addition portfolios and the deletion portfolios), requiring at least two months of valid daily returns for each stock. We obtain standard errors by computing daily abnormal returns for the event portfolios from the same six-month estimation period and then using the volatility of these abnormal returns for the event portfolios in June and after. The event portfolios are buy-and-hold portfolios that do not require rebalancing.

3.2.2. Results

Table 2 shows the cumulative abnormal returns for Russell 2000 additions and deletions that cross the lower cutoff of the index. From 1990 to 2005, the CAR for additions is 4.7% ($t = 4.75$) with market-adjusted returns and 2.5% ($t = 3.59$) with four-factor alphas, and for deletions it is −4.6% ($t = -4.11$) and −5.0% ($t = -4.92$), respectively. The spread between returns on additions and deletions peaked in 2000–2001, reaching 37.4% in absolute terms and 17.8% in four-factor alphas.

The magnitude of the effect has decreased in the last few years of the sample, despite the growing popularity of indexing during the entire period. This finding is consistent with anecdotal evidence about more investors predicting the index changes and trading on them before June.

The qualifying sample has a large number of event stocks: 360 additions and 266 deletions per year on average. This is a far larger sample than for the S&P 500, which has about 20 additions and 10 deletions per year, so it is good news for the statistical power of our tests. The downside is the concentration of the event in calendar time and the subsequent cross-correlation between stocks which reduces the benefits of the large sample.

The sample of additions and deletions crossing the upper cutoff (Table 3) does not exhibit any clear pattern. The CARs of additions and deletions are small and statistically insignificant, except for the −2.8% ($t = -4.58$) four-factor alpha for deletions. Overall, we conclude that there is either no effect or a slightly negative effect when a stock becomes too big for the Russell 2000. This is also what we would expect if the share of indexers in the Russell 1000 is comparable to the share of indexers in Russell 2000.

Fig. 3 shows the evolution of the CARs for additions and deletions from below using market-adjusted returns. The premium seems to accrue gradually between May 31 and June 30, with a peak on the effective day. There is an immediate 1% reversal from the peak, but the rest of the premium stays for at least two weeks after the event.

[15] Russell usually makes the official announcement 1–2 weeks later.

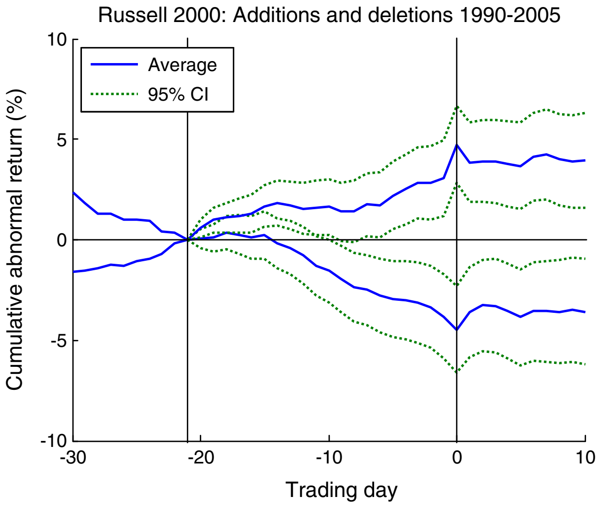

Fig. 3. Russell 2000 index additions and deletions in 1990–2005 for stocks that cross the lower cutoff of the index. The figure represents cumulative average market-adjusted returns in event time for stocks added to the index (top graph) or deleted from it (bottom graph), as well as the 95% confidence intervals. Trading day −21 represents May 31 when the new index composition is determined, and trading day 0 represents June 30 when the changes become effective. Since the difference in trading days between May 31 and June 30 may be longer for some years, we have shrunk the interval for those years to fit the shortest interval length.

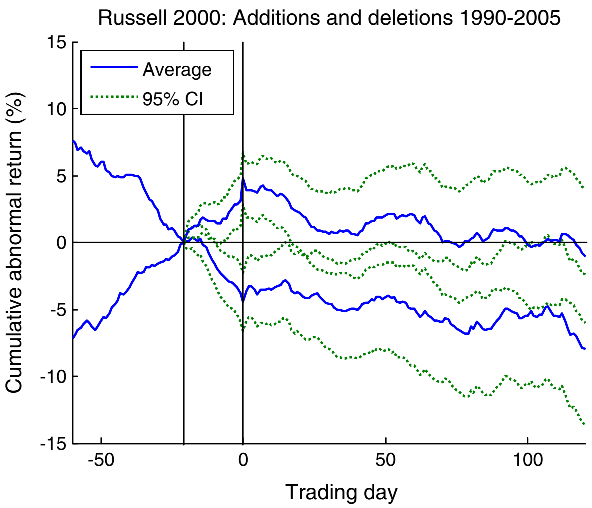

Fig. 4. Russell 2000 index additions and deletions in 1990–2005 for stocks that cross the lower cutoff of the index. Everything is as in the previous figure, except for the different horizon.

Fig. 4 illustrate the long-run price effects for additions and deletions. For additions, the premium reverses fully within two months. For deletions, the premium stays relatively constant for the next six months. Yet long-term inference is again difficult due to large standard errors. Overall, it seems that some part of the index premium stays for at least six months, but we cannot definitively rule out a full reversal.

To estimate the price elasticity of demand for index changes, we need a value for the fraction of indexed assets. While this number has reached 3% at the end of the sample, it was around 2% in 2001,[16] so we use the earlier estimate as it is likely to be closer to the time-series average from 1990 to 2005. When we plug in 2% for $\frac{\Delta Q}{Q}$ and 4.7% for $\frac{\Delta P}{P}$, we obtain an elasticity of −0.43. The elasticity of demand therefore seems to be about twice for the S&P 500 index changes as for the Russell 2000. Again, the same caveats apply for the percentage share of indexers. Just like with the S&P 500, the elasticity estimated from the Russell changes has declined in the last five years of the sample, suggesting either that the market has become generally more efficient or that the index events in particular have attracted more arbitrage capital.

[16] Russell web site, http://www.russell.com/, visited on 6/3/01.

Table 4
The results of a Fama–MacBeth regression for 16 annual cross-sections from 1990 to 2005. For each cross-section, we regress the cumulative abnormal returns on individual stocks in June on the stocks' market capitalizations and idiosyncratic volatilities estimated from November 1 to April 30. We then compute the time-series means of the regression coefficients (t-statistics in parentheses).

Fama–MacBeth regression: $R_{it} = \gamma_{0t} + \gamma_{1t}\sigma_{it} + \gamma_{2t}log_{10}(ME_{it})$

	(1)	(2)	(3)
γ_0	0.0119	0.0743	0.0337
	(4.76)	(9.45)	(3.69)
$\overline{\gamma}_1$	0.0313		0.0283
	(10.42)		(8.37)
$\overline{\gamma}_2$		−0.0206	−0.0117
		(−5.93)	(−3.35)

4. Cross-sectional dependence of the premium

Can we identify any characteristics that would be associated with a higher elasticity of demand for a stock? Here we investigate two candidate variables: the market value of equity, and the idiosyncratic risk of a stock. Market equity could be associated with the elasticity of demand e.g. if investors are segmented into different subsets of the market depending on the market value of the firms they trade; qualitatively this would follow from Merton's (1987) market segmentation story. The idiosyncratic risk of a stock could also matter, as a greater idiosyncratic volatility makes it riskier to take positions even against clearly uninformed traders; the limits-to-arbitrage literature exogenously assumes this, while Petajisto (2009) derives it as a quantitatively significant equilibrium implication. In contrast, the impact of idiosyncratic risk in a CAPM world should be essentially zero.[17]

4.1. Russell 2000

4.1.1. Methodology

We choose our event window again as June 1 to June 30. Hence, we test if the abnormal return in June on a stock crossing the lower cutoff of the index is positively related to the idiosyncratic risk or market equity of the stock. To estimate idiosyncratic risk, we regress the stock's daily excess return from November 1 to April 30 on the three factors of Fama and French, and we define idiosyncratic risk as the root mean squared error of this regression. We also take the market equity of every firm on April 30 in order to obtain a value that is not affected by the anticipation of the index event.

Since we know that market equity is related to systematic comovement between stocks and idiosyncratic risk could also be associated with such comovement, we try to eliminate such effects from our CAR estimates by forming a 10×5 matrix of control portfolios based on market equity and idiosyncratic risk. We pick all U.S. firms on April 30, and we sort them into deciles based on Fama–French breakpoints for market equity. We then subdivide each market equity decile into quintiles based on idiosyncratic risk. We perform a sequential sort rather than an independent sort because idiosyncratic risk and market equity have a high negative correlation, following the general approach of Fama and French (1992).

On May 31, we set portfolio weights based on market capitalization on April 30. We then calculate the buy-and-hold return on this portfolio for each day in June. Given the breakpoints for market equity and idiosyncratic risk, we can assign each event stock to its corresponding cell in the 10×5 matrix. The cumulative abnormal return on a stock is then the difference between the cumulative stock return and the corresponding cumulative control portfolio return. Since all index changes each year occur at the same time, the abnormal returns are likely to exhibit significant cross-correlation. To get around this issue, we run a Fama–MacBeth regression for the 16 annual cross-sections of data covering the years 1990–2005. We use both additions and deletions for the analysis, where the CAR of the latter is multiplied by −1.

4.1.2. Results

The univariate Fama–MacBeth regression produces a highly significant t-statistic of 10.42 for the coefficient of idiosyncratic risk (Table 4). The t-statistic drops slightly to 8.37 when we add log market equity into the regression. Market equity also comes in as statistically significant, although with a negative sign. Its t-statistics are −5.93 and −3.35.

Economically the coefficient of idiosyncratic risk implies that an increase of 10% in annual idiosyncratic volatility would increase the price impact of Russell 2000 changes by 0.3%, or about 6% of the average price impact over this period. This is not a trivial magnitude, especially as our coefficient estimate is likely to be biased down due to the noisy measurement of idiosyncratic risk.

[17] See Petajisto (2009) for a theoretical treatment of these hypotheses.

Table 5
The results of cumulative abnormal returns for index additions and deletions in 1990–2005 regressed on the log of market equity and idiosyncratic volatility of a stock as well as year dummies. The cumulative abnormal returns are defined as the market-adjusted cumulative returns from 15 trading days before the announcement up to the effective day of the change. We compute White's heteroskedasticity-consistent standard errors and report the corresponding t-statistics in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
σ_{it}	0.4583		0.4595	0.3444		0.3065
	(3.62)		(3.51)	(2.88)		(2.44)
$log_{10}(ME_{it})$		−0.0328	0.0028		−0.1002	−0.0656
		(−0.98)	(0.08)		(−2.58)	(−1.63)
Year dummies	No	No	No	Yes	Yes	Yes
Degrees of freedom	399	399	398	384	384	383
R^2	6.3%	0.2%	6.3%	13.7%	12.1%	14.2%

4.2. S&P 500

We then proceed to run a similar test with S&P 500 data. In fact another similar test, albeit with a very different implementation, has already been carried out with S&P 500 data for the 1976–1989 period by Wurgler and Zhuravskaya (2002). The authors find evidence of a link between idiosyncratic risk and the price impact around index addition. However, their tests do not touch the more recent data since the index rule change in October 1989, so we want to confirm the result with data from the 1990s, especially as the fraction of mechanical indexers has grown so much since the 1976–1989 period. Furthermore, this allows us to link the S&P 500 results to the Russell 2000 results.

4.2.1. Methodology

We try to keep our procedure comparable to the one we followed for the Russell 2000. We take the last end-of-month market value of equity three weeks before the announcement day (i.e. about a month before the effective day) of the index change. We choose the six-month period ending with the measurement day for market equity, and we estimate idiosyncratic risk in this period as the standard deviation of the Fama–French regression residual. The cumulative abnormal return on a stock in the event window is the difference between its own cumulative return and the cumulative return on its estimated four-factor benchmark portfolio.

For the S&P 500 the event windows are more or less randomly distributed throughout the year, so we regress all the observations on the explanatory variables in one cross-section, using White's heteroskedasticity-consistent standard errors for inference. We also plug in a dummy variable for each year to account for the time trends in the index premium.

4.2.2. Results

Table 5 shows the regression results. Idiosyncratic risk turns out to be statistically significant both in the univariate regression in column (4) ($t = 2.88$) and in the bivariate regression in column (6) ($t = 2.44$). Market equity also turns out to be weakly statistically significant ($t = -2.58$ and -1.63). When the year dummies are not present, the coefficient of market equity is somewhat greater (i.e., less negative) as the increasing size of event stocks picks up some of the increasing time trend in the CARs over the years.

The coefficient of idiosyncratic risk is about 0.3, meaning that an increase in annualized idiosyncratic volatility of 10% would increase the abnormal return around index changes by 3 percentage points. This certainly has economic significance, especially as the estimates are still likely to be biased down due to measurement error. The coefficients on market equity are negative, which is consistent with our general finding that demand curves are steeper for small stocks.

5. Index turnover cost

For an index fund that mechanically tracks an index, the index premium represents a recurring cost. Whenever a stock is added to the index, the index fund has to buy it at a price which includes the premium. Whenever a stock is deleted from the index, the index fund has to sell it at a price which does not include the premium. In contrast, an unconstrained investor can buy non-index stocks without the premium, and if such a stock is later added to the index, the investor will actually earn the index premium for himself. The extra cost due to mechanical indexing relative to an index-neutral strategy is what we label the index turnover cost.[18]

Index funds themselves probably do not care about the index turnover cost per se, even if they are aware of it, because the fund managers are not penalized when the index itself suffers from the same cost. However, the people who invest in index funds certainly should care about this cost, as they could potentially invest in similar index-neutral portfolios and avoid the cost. In this section we illustrate the index turnover cost and estimate its size for the two most commonly tracked indexes, the S&P 500 and Russell 2000.

The index turnover cost can be estimated in two ways. Given the size of the index premium and index turnover, we can estimate the cost ex ante, relative to a similar but not identical portfolio. Alternatively, we can compute the actual ex post returns

[18] The first time we noticed some of these concerns raised publicly was in the May 2002 issue of *Institutional Investor* ("Is Time Running Out for the S&P 500?"), which was later followed by Siegel (2007). The only academic reference and still the only other serious attempt to quantify these costs that we are aware of is the concurrently started work by Chen et al. (2006).

on an index-neutral portfolio and compare them to the index returns. We prefer the former approach because it is less noisy, but we also compute estimates with the latter approach.

5.1. S&P 500

5.1.1. Source of the cost

To illustrate the index turnover cost for the S&P 500, let us think about a simplified example. Let the index consist of randomly selected stocks accounting for a fraction s of a commonly known pool of large stocks. These index stocks have a price premium p (relative to what the price would be without index funds). Additions to the index throughout the year account for a fraction a of its market value, while deletions account for a fraction d (both in percentage terms). The difference in the additions and deletions (a–d) is due to mergers between index firms. There is an index fund that mechanically tracks the index, holding all the index stocks at all times.

There is also an “index-neutral” fund that mechanically buys a fraction s of these large stocks, regardless of whether or not they are in the index. On the average, a fraction s of these stocks would be in the index. Some fraction of these stocks disappear due to mergers, some randomly selected stocks are sold for other reasons, and some randomly selected new stocks are added to the portfolio. The fund wants to keep the fraction of index stocks s constant in its portfolio.

The index fund starts by investing all of its wealth in the index. During the year, stocks worth a fraction d are deleted from the index and they have to be sold. As they are deleted from the index, they also lose the index premium p, so the index fund will only get a price $\frac{d}{1+p}$ for the stocks that it bought at a price d. To replace the deleted and merged stocks, new stocks worth a are added to the index, and they are bought by the index fund at a price a (which includes the index premium—before the addition these stocks were worth $\frac{a}{1+p}$). We assume a merger does not on average change the combined value of the merged firms. If stock prices on average do not move during the year and no dividends are paid, the net portfolio value will change from 1 to $1-d+\frac{d}{1+p}=1-\frac{pd}{1+p}$. This decrease in portfolio value is due to the premium p that the index fund lost when it had to sell a fraction d of its stocks without the index premium p although it had bought them at a price which did include that premium.

The other fund (the index-neutral fund) starts by having a fraction s of its wealth in index stocks and a fraction 1-s in non-index stocks. As the fund tries to keep its index share constant, it effectively has two portfolios: one purely consisting of index stocks and one purely consisting of non-index stocks. The index stock portfolio behaves just as the portfolio of the index fund: after a year, its value will change from 1 to $1-\frac{pd}{1+p}$. The value of the non-index portfolio is not affected by the fund buying or selling non-index stocks, but it is affected by additions of non-index stocks to the index. Index additions are worth a fraction a of the index, and since the index stocks are a fraction s and the non-index stocks are a fraction 1-s of the pool of large stocks, a fraction worth $\frac{s}{1-s}a$ of non-index stocks have to be selected. Before index addition, these stocks did not have the index premium, so they were worth $\frac{s}{1-s}\frac{a}{1+p}$ of the non-index stocks. Hence, this fraction of the non-index portfolio will suddenly earn the premium p, increasing the non-index portfolio value from 1 to $1+\frac{s}{1-s}\frac{pa}{1+p}$. The total value of the portfolio of the index-neutral fund is then

$$s\left(1-\frac{pd}{1+p}\right)+(1-s)\left(1+\frac{s}{1-s}\frac{pa}{1+p}\right)=1+\frac{ps(a-d)}{1+p}. \tag{1}$$

In other words, the fund gains the index premium on index additions but loses it on index deletions, so the net effect is that the fund gains the index premium on the difference between index additions and deletions (i.e. the merged stocks).

The difference in the performances of the index fund and the index-neutral fund is given by the difference in net portfolio value. Hence, the index turnover cost for the S&P 500 is given by

$$\left(1+\frac{ps(a-d)}{1+p}\right)-\left(1-\frac{pd}{1+p}\right)=\frac{p[s(a-d)+d]}{1+p}. \tag{2}$$

This expression gives us the cost of mechanically tracking the index as opposed to following a strategy where we buy similar stocks but do not make any effort to distinguish between index stocks and non-index stocks. The two portfolios will be essentially the same, except that the indexing strategy persistently loses the index premium on stocks deleted from the index while the index-neutral strategy also buys some non-index stocks and hence gains the index premium on the stocks later added to the index.

Note that the above example assumes a permanent index premium. If the index effects are fully reversed, the index fund would have to pay a separate cost for both additions and deletions, which would increase it to $p\left(\frac{a+d}{1+p}\right)$, i.e. the premium times the “non-index value” of the additions and deletions.

5.1.2. Magnitude

The leftmost columns of Table 7 show the market share of the index accounted for by additions and deletions. There are fewer deletions than additions due to mergers between index firms, but their much smaller turnover shows that individual deletions are also smaller than additions. Hence, while market value is a very important characteristic for additions, the S&P seems to be reluctant to delete firms from the index based on their market value unless it really falls to a low level.

The left panel of Table 7 shows the index turnover cost for the S&P 500. We compute it each year using the turnover and index premium estimate for that year. We provide two estimates: one based on a permanent index premium (Eq. (2)) and another based on full reversal of the premium. We choose 83% as the share s of index stocks in the index-neutral portfolio.[19] The index premium estimate is taken as the average price impact of additions and deletions.

From 1990 to 2005, the index turnover cost has been 21–28 bp per year, depending on whether one believes in full reversal of the price impact. The cost depends on both turnover and the size of the price premium, so it peaks in 2000, reaching an annual value of 65–82 bp. Economically the cost is certainly nontrivial, especially as prominent index funds charge explicit fees of only 9–10 bp per year even for retail investors, leaving investors with "hidden fees" (i.e., underperformance of index itself) that are much higher. The dollar loss of index funds, based on S&P's reported $1.2 trillion indexed to the S&P 500 at the end of 2007, therefore ranges from $2.5 to $3.4 billion per year on average.

If the share of stock market wealth indexed to the S&P 500 keeps growing, the index premium will most likely continue to grow as well, and this will further increase the index turnover cost in the future. Even if more arbitrageurs enter the market trying to predict S&P 500 index changes before announcement, this may reduce our simple estimates of the index premium (because we exclude any price impact more than a week before announcement), but it will not necessarily change the underlying index premium—that is primarily driven by the fraction of mechanical indexers.

5.2. Russell 2000

5.2.1. Source of the cost

Since the Russell 2000 index is selected differently from the S&P 500, we need to determine the cost somewhat differently as well.

An index fund will always hold the index. To maintain the index portfolio, once a year it has to buy additions and sell deletions. Denote the "index value" of deletions by d (from below) and d_t (from above), and additions by a (from below) and a_t (from above) This generates a cash flow of

$$d(1-p) + d_t - a - a_t, \tag{3}$$

when the deletions from below lose the index premium p and when the additions and deletions from above do not experience any price effects.

Now assume a "custom index fund" that follows the rule for Russell 2000 but instead updates its own portfolio on December 31, i.e. six months off the official cycle. These two portfolios will be essentially indistinguishable from one another, except for the phase shift in the updating of the portfolios. This would be an appropriate index-neutral benchmark for the Russell 2000.

Further assume for simplicity that there is a steady stream of would-be additions to and deletions from the index, so that in six months we accumulate about half of the index changes that we would accumulate over twelve months. Hence, the cash flow generated by holding the index-neutral portfolio would be

$$\frac{1}{2}[d(1-p) + d_t - a - a_t] + \frac{1}{2}[d + d_t - a(1-p) - a_t]. \tag{4}$$

In other words, the index-neutral portfolio would update half of the stocks after the last official change (and get the same cash flow as the index fund), and half of the stocks ahead of the next official change (selling deletions with the premium and buying additions without it). The difference between the two would be

$$\frac{p}{2}(a + d), \tag{5}$$

i.e. the index-neutral investor would only suffer the premium for half of the additions and deletions. If the price effects reversed fully over six months, the difference would increase to $p(a+d)$.

5.2.2. Magnitude

Turnover for the Russell 2000 is much higher than that for the S&P 500, with additions and deletions accounting for 12.5% and 3.4% from below, and 9.2% and 17.3% from above (Table 6). In light of our previous results about no clear price effect for stocks crossing the upper cutoff, we focus exclusively on stocks crossing the lower cutoff.

Table 7 (right panel) shows the index turnover cost for the Russell 2000. Over the entire sample period, the cost has been 38–77 bp per year, depending on whether the price impact reverses or not. The highest value is reached in 2000 due to a combination of a large price impact and high turnover, producing a substantial cost of 232–463 bp. With an estimated $43 billion in assets in Russell 2000 index funds, this represents a dollar loss of $160 to $330 million per year on average and a peak of $1 to $2 billion per

[19] The S&P 500 index covers about 76% of the total value of the U.S. stock market. Since the index is selected primarily from the largest 1,000 firms (97.5% of index firms and 99.9% of index cap), we restrict ourselves to this subset of the market. This changes the index share s from 76% to about 83%.

Table 6
Index turnover for Russell 2000 additions and deletions. The table shows the percentage share of additions to the index as they occur (June 30), and the share of deletions the month before they occur (May 31). In a typical year we miss about 5 stocks because we cannot find them in CRSP.

	Additions				Deletions			
	From below		From above		From below		From above	
Year	N	Weight	N	Weight	N	Weight	N	Weight
1990	284	7.3%	61	8.2%	174	2.3%	74	15.5%
1991	403	18.3%	78	8.8%	344	2.3%	67	16.8%
1992	439	17.4%	81	10.2%	388	3.8%	56	12.3%
1993	344	13.0%	93	10.6%	314	3.9%	60	13.0%
1994	462	18.1%	97	10.0%	415	6.4%	65	13.3%
1995	363	11.6%	67	6.9%	251	3.9%	79	13.5%
1996	413	14.1%	106	10.9%	312	4.8%	91	16.4%
1997	436	14.3%	94	7.3%	320	4.7%	101	15.8%
1998	427	14.0%	97	8.9%	243	4.2%	108	17.7%
1999	412	13.7%	101	10.2%	250	3.9%	124	23.8%
2000	546	20.0%	137	12.6%	334	4.8%	117	26.7%
2001	501	12.3%	108	8.3%	279	1.8%	152	26.1%
2002	382	9.0%	104	7.8%	233	1.9%	138	23.6%
2003	283	6.3%	82	9.7%	187	1.6%	94	15.7%
2004	310	6.8%	67	8.1%	214	2.5%	67	11.7%
2005	206	4.1%	80	8.7%	215	2.1%	89	14.3%
1990–2000	412	14.7%	92	9.5%	304	4.1%	86	16.8%
2001–2005	336	7.7%	88	8.5%	226	2.0%	108	18.3%
1990–2005	388	12.5%	91	9.2%	280	3.4%	93	17.3%

year. Again, these are economically large values especially for investors who think they are getting a great deal on a low-cost index fund.

The index turnover cost is low in the last three years of the sample, in part because of low turnover but also because of a small price impact. However, the price impact especially for the Russell 2000 may be misleading in the last years because the index changes are so easy to predict a little before May 31, and consequently we expect that part of the price impact now occurs before June and therefore does not show up in our estimates. Thus the full sample or even the earlier period 1990–2000 are more likely to give a full picture of the price pressure in the months leading up to the reconstitution of the index.

Table 7
Index turnover cost for S&P 500 and Russell 2000. The index turnover cost represents the performance drag for the index relative to an index-neutral strategy that follows a very similar but not identical index selection rule. The cost is computed from turnover and CAR as described in the text for two different cases, depending on whether the index premium is permanent or not. For the S&P we use 83% as the fraction of index stocks in the index-neutral universe. For the Russell 2000, we only consider stocks crossing the lower cutoff of the index. CAR represents the average of the CAR for additions and deletions that year.

	S&P 500					Russell 2000				
	Turnover		CAR	Index turnover cost		Turnover		CAR	Index turnover cost	
Year	Additions	Deletions		No reversal	Full reversal	Additions	Deletions		No reversal	Full reversal
1990	0.59%	0.59%	12.9%	0.07%	0.14%	7.28%	2.33%	3.6%	0.17%	0.34%
1991	1.81%	0.01%	26.1%	0.31%	0.38%	18.28%	2.32%	4.3%	0.44%	0.89%
1992	0.53%	0.01%	21.4%	0.08%	0.09%	17.43%	3.77%	3.0%	0.32%	0.63%
1993	1.46%	0.55%	5.6%	0.07%	0.11%	12.99%	3.88%	2.2%	0.18%	0.37%
1994	3.25%	1.13%	5.7%	0.15%	0.23%	18.07%	6.43%	1.3%	0.16%	0.32%
1995	2.81%	0.19%	8.0%	0.17%	0.22%	11.63%	3.90%	5.5%	0.43%	0.86%
1996	2.96%	0.26%	7.4%	0.17%	0.22%	14.14%	4.77%	3.6%	0.34%	0.68%
1997	2.11%	0.23%	8.6%	0.14%	0.18%	14.29%	4.70%	8.0%	0.76%	1.52%
1998	4.83%	0.14%	12.9%	0.46%	0.57%	14.03%	4.24%	2.6%	0.24%	0.47%
1999	3.22%	0.14%	10.7%	0.26%	0.32%	13.74%	3.86%	9.2%	0.81%	1.61%
2000	5.56%	0.39%	16.1%	0.65%	0.82%	19.99%	4.79%	18.7%	2.32%	4.63%
2001	1.82%	0.35%	12.2%	0.17%	0.24%	12.35%	1.78%	5.4%	0.38%	0.77%
2002	2.50%	1.34%	14.8%	0.30%	0.50%	8.98%	1.91%	9.8%	0.54%	1.07%
2003	0.41%	0.01%	15.5%	0.05%	0.06%	6.33%	1.62%	−2.4%	−0.09%	−0.19%
2004	1.41%	0.09%	4.6%	0.05%	0.07%	6.81%	2.55%	−0.3%	−0.01%	−0.03%
2005	1.23%	0.01%	13.4%	0.12%	0.15%	4.12%	2.12%	2.2%	0.07%	0.14%
1990-2000	2.65%	0.33%	12.0%	0.24%	0.32%	14.72%	4.09%	5.6%	0.53%	1.06%
2001-2005	1.48%	0.36%	11.8%	0.14%	0.19%	7.72%	2.00%	3.0%	0.14%	0.29%
1990-2005	2.28%	0.34%	12.0%	0.21%	0.28%	12.53%	3.43%	4.8%	0.38%	0.77%

Table 8
Realized index turnover cost in 1990–2005. Panel A shows the return on an index-neutral strategy described in Sections 5.1 and 5.2 when compared with the corresponding index return. Panel B shows the return on an enhanced index portfolio that holds all index stocks with a two-month time lag. Returns and volatilities are annualized and in percent.

Index	Period	Neutral	Index	Neutral minus index		
		Return	Return	Return	Volatility	t-stat
Panel A: Broader index-neutral universe						
S&P 500	2001–2005	1.82	1.65	0.17	0.91	0.41
S&P 500	1990–2005	11.19	11.10	0.09	2.06	0.18
Russell 2000	2001–2005	10.95	9.76	1.20	3.35	0.80
Russell 2000	1990–2005	13.12	11.92	1.20	3.08	1.55
Panel B: Closer tracking with a time lag						
S&P 500	2001–2005	1.70	1.65	0.04	0.23	0.41
S&P 500	1990–2005	11.19	11.10	0.09	0.29	1.23
Russell 2000	2001–2005	11.64	9.76	1.89	1.97	2.14
Russell 2000	1990–2005	13.52	11.92	1.59	1.75	3.64

Unfortunately for index providers, they cannot do much to mitigate the index turnover cost. The main culprit are the mechanical indexers that are tracking the index and thus creating price pressure around index changes. Russell 2000, just like any other small-cap index, will also unavoidably have a higher turnover than a large-cap index such as the S&P 500. The only way for an investor to avoid the cost is to follow a custom index that no one else tracks, such as the index-neutral strategy proposed here.

5.3. Realized cost for S&P 500 and Russell 2000

In the previous sections we estimated the index turnover cost using index turnover and our estimates of the index premium. In contrast, Panel A of Table 8 shows the actual performance of the proposed index-neutral strategies. We would expect the index-neutral strategies to perform better in 2001–2005 than 1990–2000 for two reasons: First, indexing was more popular after 2000, since indexing was still growing significantly in the 1990s. Second, the growth of indexing might have even generated one-time capital gains on index stocks in the 1990s, offsetting the cost during the earlier year. The remaining difference between the index-neutral returns and index returns arises from the other holdings, such as the non-index stocks that were not actually added to the index but were still part of the index-neutral portfolio.

The index-neutral portfolios in Panel A are constructed as suggested in Sections 5.1 and 5.2. We take the largest 1000 U.S. stocks in CRSP as the index-neutral strategy for the S&P 500, since that is the pool of stocks the index is selected from. We take the next 2000 stocks on December 31 each year as our index-neutral version of the Russell 2000 index, thus updating our portfolio six months off the official cycle. These are the simplest index-neutral strategies we could come up which is why our prior calculations were also based on them; more fine-tuned strategies can certainly be developed to better reflect the actual index selection criteria without exactly replicating the index.

We find that the index-neutral strategies have outperformed the indexes in 2001–2005 by 17 bp per year for S&P 500 and 120 bp per year for Russell 2000. These numbers are a little lower for S&P 500 and higher for Russell 2000 than our expected costs calculated earlier. Unfortunately statistical inference here is severely limited by the nontrivial tracking error volatility of the strategies, which is 91 bp and 335 bp per year, respectively, for the two indexes. In other words, the portfolios are too different from the index to obtain accurate estimates for their average difference in returns.

To address this issue, Panel B shows the results for alternative index-neutral portfolios that track the indexes more closely. We construct the portfolios using the actual index composition two months earlier. Hence, any short-term reversal in the price effects following additions and deletions will benefit the index-neutral strategy relative to the index. However, this strategy entirely misses any gains from anticipation of index changes.

The alternative S&P 500 index-neutral portfolio has only a 4 bp annual edge over the index in 2001–2005, indicating that short-term reversals alone are not a major source of costs for S&P 500 indexers. For Russell 2000 the difference is rather high at 189 bp per year ($t=2.14$), implying that reversal plays a large role there.

Overall, we prefer the ex ante estimates of the index turnover cost in the previous sections. They are more accurate measures of the expected cost since both index turnover and price impact can be predicted relatively well and other cross-sectional variation in stock returns can be kept constant. In contrast, the realized returns on index-neutral strategies either reflect other noisy return differences across the portfolios (as in Panel A) or do not capture the full effect (as in Panel B). However, in the long run the two estimates should converge, so the realized returns can be used even in small samples to confirm the range of reasonable ex ante estimates.

5.4. Comparison with Chen et al. (2006)

Concurrent work by Chen et al. (2006) has also discussed losses to index investors. However, there are important differences: First, their study understates the index turnover cost of the S&P 500 because they ignore the initial price response at

Table 9
S&P 500 reversal and the announcement lead time in 1990–2005. The table shows the results when the reversal return on stocks added to or deleted from the S&P 500 index is regressed on the number of days between the announcement and effective day of the change. Reversal return is measured as the four-factor CAR since the effective day of the change, where the sign is switched for deletions. We only use lead times up to 10 trading days. Standard errors are clustered by the effective date of the index change, and t-statistics are reported in parentheses.

Day	Included	Constant	log(diff)	N	R^2
1	All	0.0358	−0.0175	440	2.3%
		(2.88)	(−2.13)		
1	Deletions	0.1048	−0.0575	149	8.5%
		(2.49)	(−2.13)		
1	Additions	0.0098	−0.0026	291	0.3%
		(3.17)	(−1.12)		
5	All	0.0728	−0.0318	439	1.5%
		(3.42)	(−2.31)		
10	All	0.0716	−0.0272	439	1.0%
		(3.26)	(−1.91)		

announcement which constitutes most of the cost. Second, their interpretation of the underlying economic effect is fundamentally different. Third, as a result of their interpretation, their prescriptions for index providers are the opposite of what we would advocate.

5.4.1. Implementation and interpretation

In terms of implementation, the main difference is that Chen, Noronha, and Singal ignore any price impact that a trader cannot anticipate. Their alternative S&P 500 indexing strategy consists of buying additions on the first day after the announcement and selling deletions 60 trading days after the effective day. Hence, this strategy still suffers from the initial price impact at announcement, which matters especially for the additions and thus for the index turnover cost overall. In contrast, our index-neutral strategy is further removed from the official index and thus it will actually benefit from the announcement return. Ours is essentially a custom index, while theirs is more of an enhanced way to track the official S&P 500 index.

For the Russell 2000, Chen, Noronha, and Singal treat the additions and deletions identically regardless of whether these are stocks that cross the upper or lower cutoff of the index. Yet our analysis reveals that only the stocks crossing the lower cutoff have an unambiguous price impact in June. This is not surprising, since the stocks that become too large for the Russell 2000 will in turn be purchased by Russell 1000 indexers, which mitigates the price impact around the upper cutoff. We distinguish between these stocks, which we believe is important to keep the analysis clear.

In terms of interpretation, Chen, Noronha, and Singal argue that "arbitrage returns are realized at the expense of index fund investors" when active investors can anticipate index changes. Yet they provide no evidence to support this claim. Index investors are indeed hurt by the price impact of index additions and deletions, but this price impact would be there even without the arbitrageurs. In reality, the price impact is created by the index investors themselves because they all trade simultaneously, thereby effectively acting as one very large trader who moves prices against himself.

One way to see this is to consider a representative arbitrageur who buys Russell 2000 additions on May 31 and sells them to indexers at the end of June. The actions of the arbitrageur will push the price of the additions up already on May 31, but a month later, the arbitrageur will sell his entire inventory to the indexers, and thus having no effect on the demand for those stocks when the indexers actually trade. Hence, from the point of view of an index investor who plans to trade at the closing price when the index is officially updated, it is irrelevant whether the arbitrageur held the stock in the prior month. This behavior of market prices in a frictionless market with mechanical indexers is also illustrated in a theoretical paper by Petajisto (2006).

However, the real financial market has frictions which prevent many market participants from responding immediately to a supply or demand shock. If index funds suddenly and unexpectedly rushed out to buy 10% of all the shares of a firm, as in the case of an S&P 500 addition, who would sell those shares to them? This is a major supply shock, about $1 billion worth of stock for a typical $10 billion firm, which would cause a dramatic short-term price impact before other market participants have time to react. In fact, this sudden order imbalance is precisely the reason why S&P started to preannounce the index changes about five trading days before the effective day of the change, as they wanted to give active traders enough time to get ready to meet such large demand. So once we include these real-world considerations, the actions of arbitrageurs are no longer irrelevant to indexers—instead, arbitrage activity actually benefits indexers by offsetting the price impact of the indexers.

5.4.2. Should index providers preannounce index changes?

Chen, Noronha, and Singal argue that index providers should make index changes less predictable: they should "use an opaque process of index changes without necessarily using any pre-announcement period," and "if a pre-announcement period is unavoidable, it should be as short as possible." Furthermore, they believe that Russell should introduce a "random procedure" to select some of the index changes. These authors are not alone in their views: at least Gastineau (2002) echoes conceptually similar views.

Yet these conclusions arise entirely from the unsupported notion that it is the arbitrageurs and not the indexers who create the price impact. We argue that the opposite is true - the more predictable the index changes and the longer the pre-announcement period, the less the index funds will suffer. This gives arbitrageurs more time to get ready and build up their inventories of shares to sell to indexers on the effective day.

In fact, we can test this prediction with S&P 500 additions and deletions. The time between the announcement and effective day in 1990–2005 has varied from zero to as long as seventy trading days, with most announcements coming 1–8 trading days before the effective day. We would predict that the less time the arbitrageurs have to prepare, the greater the initial price impact and the greater the subsequent short-term reversal.

Table 9 shows the results of a panel regression where the reversal is regressed against the logarithm of the number of days between announcement and effective day.[20] Reversal is measured as the CAR based on four-factor residuals since the effective day. The evidence indeed shows that the longer lead times generate smaller reversals, with $t = -2.13$ for one-day reversals and similar significance for five and ten-day reversals. Most of the effect is coming from deletions, which also exhibit greater reversals in general.

Actually this is still not a clean test because the lead time is likely to be determined endogenously to reduce the impact of large additions and deletions. For example, when several large foreign firms were simultaneously removed from the index and replaced with large domestic firms in July 2002, the announcement took place 8 days earlier. When Microsoft was finally added to the index in June 1994, it was already the 13th-largest firm by market capitalization; combined with Microsoft's large and inelastic insider holdings, the predicted price impact was unusually high, and the lead time was chosen as 16 trading days. These offsetting efforts by S&P therefore make it harder to detect a relationship between the lead time and reversal, yet we still find empirical support for it.

Our argument is consistent with the "sunshine trading" equilibrium presented by Admati and Pfleiderer (1991). They discuss two reasons why some traders may prefer to preannounce their trades: First, this allows more time for other market participants to prepare and take the opposite side of the trade. The better matching of buyers and sellers leads to a lower price impact. Second, pre-announcement can identify the trade as informationless. If other market participants know that the purchases are coming from a passive index fund, they do not have to worry about the buyer having private information, which again leads to lower price impact. In contrast, a "silent index" as advocated by Gastineau (2002) and Chen et al. (2006), where index changes are made public only after the indexer has updated his portfolio, would be on the wrong side of both effects.

These economic arguments, more formally presented in Petajisto (2006) and Admati and Pfleiderer (1991), support the transparency and long lead times provided by the Russell indexes, while our test on reversals provides further empirical support. S&P's usual lead time of five trading days between announcement and effective days seems relatively short, but it may still be enough for active arbitrageurs.

5.4.3. Minimizing the index turnover cost

Besides index predictability and transparency, is there anything else an index investor can do to minimize the index turnover cost? There is no way around the fact that a large mass of mechanical indexers will move prices against themselves, no matter what index they track. A simple solution is to deviate from this crowd and buy a broadly similar portfolio such as the index-neutral strategies we discussed earlier. Of course, if everyone bought the same index-neutral portfolio, the same problem would reappear, so a long-run equilibrium would then consist of multiple coexisting indexes that are similar but not identical. This would spread out the indexed assets so that they do not all move as one massive block tracking the same popular index.[21]

Another solution is to track a "total market index" such as the DJ Wilshire 5000, the Russell 3000E, or the Russell 3000, which covers about 100%, 99%, and 98% of the U.S. equity market capitalization, respectively. Since these indexes have so much market capitalization and they include new stocks only months after their IPOs, the additions will represent such a small fraction of the index that the index-induced price effects do not matter much.

6. Conclusions

In this paper we provide updated evidence on the index premium for the S&P 500 and Russell 2000 indexes. The index premia seem have grown since the 1980s with the increasing popularity of indexing, peaking in 2000, and then decreasing again, perhaps due to increasing anticipation of index changes in the recent years. From 1990 to 2005, the market-adjusted price impact on additions to the two indexes has been +8.8% and +4.7%, with corresponding price impacts of −15.1% and −4.6% on deletions.

Our estimated price elasticity of demand for S&P 500 stocks, −0.84 using data from 1990 to 2000, is close to Shleifer's (1986) estimate of unit elasticity for the same index at a time when indexing was much less popular. The elasticity of demand for Russell 2000 stocks seems to be about one half of this, or −0.43, so the market seems to be more efficient for large-cap stocks. Surprisingly, the premia seem to come about only gradually between the announcement and effective days, as opposed to being fully incorporated into prices right after announcement. This is particularly unexpected as both researchers and practitioners have been aware of some of these index price effects for a long time.

The cross-sectional link between the index premium and idiosyncratic risk is significant both statistically and economically, translating to a 3% additional price premium for an S&P 500 addition with a 10% increase in annual idiosyncratic volatility. There is also a negative relationship between the index premium and market equity, reinforcing the conclusion that smaller stocks have steeper demand curves than large stocks.

[20] We only use lead times up to ten trading days because that would presumably be enough for active arbitrageurs to find out about the index change, but the results are similar when all observations are included.

[21] For example, Dimensional Fund Advisors define their own target universe by using CRSP size deciles. Their U.S. small-cap portfolio, based on size deciles 6-10, has beaten the Russell 2000 index by about 2% per year since its inception in 1992; their large-cap funds have essentially matched the benchmark returns.

The annual index turnover cost from 1990 to 2005 is about 21–28 bp for the S&P 500 and 38–77 bp for the Russell 2000. This is the cost of mechanically tracking the index rather than holding an essentially similar index-neutral portfolio. In fact, the true cost may well be higher, as our estimates for the price impact do not fully take into account investors' anticipation of the index changes. It seems like a relatively high cost for being religiously tied to an index and thus something investors should care about. It acts as a guaranteed drag on returns in a way similar to the annual management fee which in turn may be less than 10 bp for presumably cost-conscious index investors.

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