Index Changes and Unexpected Losses to Investors in S&P 500 and Russell 2000 Index Funds

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Abstract

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These losses are an unexpected consequence of index fund investors evaluating index fund managers based on tracking error in an effort to control agency costs. Minimization of tracking error coupled with the predictability and/or pre-announcement of index changes creates the opportunity for a wealth transfer from index fund investors to arbitrageurs, particularly for Russell 2000-linked funds where the index changes are predictable. We propose solutions aimed at resolving the problem that can be implemented by indexing companies, index fund managers, or fund investors.

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JEL Classification: G23; G32

Key Words: Index funds; Index changes; Agency costs;

I. Introduction

"When it comes to choosing your index, don't be too passive."[1]

Modern portfolio theory suggests that holding a well-diversified portfolio of stocks dominates holding a few individual stocks. However, since there are literally thousands of financial securities in the marketplace, transactions costs and the burden of monitoring these securities constrain investors from holding a well-diversified portfolio. The advent of the index mutual fund as an investment vehicle afforded investors the opportunity to both diversify at a

[1] Ryan (2004) in Fortune magazine.

reasonable cost as well as to transfer the monitoring function to professional fund managers. The first indexed mutual fund was introduced by Wells Fargo in the early 1970s followed by the much publicized Vanguard Index Trust S&P 500 portfolio in 1976. In addition to Standard and Poor's indexes, indexing companies such as Frank Russell, Dow Jones, Nasdaq, Morgan Stanley, Morningstar, and Barclays also construct indexes that mimic the U.S. stock market, industrial sectors, international and other regional markets. Indexed mutual funds have grown substantially over the last three decades with practically all large mutual fund companies offering one or more index funds. The popularity of index funds is, in part, due to the evidence that actively managed mutual funds do not necessarily and consistently outperform index funds. For example, Jones and Shanken (2005) report that while managers may be skilful in stock picking, their excess returns are not sufficient to offset the typical actively managed fund's expenses. Similarly, Pastor and Stambaugh (2002) find that most actively managed mutual funds have negative alphas.[2]

Investors use index mutual funds as a convenient vehicle for achieving the diversification and returns afforded by the underlying index. Thus, in the eyes of index fund investors, the function of index fund managers is to merely construct a portfolio that mirrors the return and risk of the index at the lowest possible cost. No stock picking or timing ability is expected. With that objective in mind, a simple way to constrain the fund manager's propensity to take risk as well as to evaluate the performance of the fund is to measure the fund's tracking error (the absolute difference between each day's index return and fund return).[3] Normally, for large pension fund sponsors a tracking error in excess of 0.10% per year is unacceptable.[4]

[2] See Baks, Metrick, and Wachter (2001) and Gruber (1996) for further discussion of actively managed mutual funds.
[3] There is no universally accepted definition of tracking error. Tracking error calculations may be based on daily returns, monthly returns, volatility, correlations, etc. Our definition is simple and is used for illustrative purposes only.
[4] Research by Del Guercio and Tkac (2002) suggests that pension fund sponsors punish fund managers with high tracking error, even if they outperform their benchmarks, by restricting the flow of funds to such managers.

While index funds are an effective way of passively holding a diversified portfolio, the compositions of the underlying indexes themselves are frequently changed by indexing companies. Index changes become necessary when a firm's publicly traded profile changes because of major corporate events such as bankruptcy, liquidation, delisting, or merger. Index changes may also occur whenever a firm ceases to meet the indexing company's criteria for inclusion in the index. Since indexed portfolios are passive, a major source of expense and tracking error is due to trading necessitated by index changes.[5] Index fund investors expect that the rebalancing of portfolios in response to index changes will be done at nominal cost and with a view to minimizing tracking error. In an attempt to assist managers to alter indexed portfolios concurrent with changes in the index, Standard and Poor's began pre-announcing index changes in October 1989. Similarly, changes to the Russell indexes are usually known in advance of the actual change. The prevailing custom is one where managers effect changes to indexed portfolios on the effective date of the change, rather than the announcement date, in order to minimize tracking error. We show that, in the presence of predictable or pre-announced changes, fund managers acting to minimize tracking error do not serve the best interests of their investors.

While the pre-announcement and/or predictability of changes may prepare fund managers for impending index changes, it also allows arbitrageurs to play a timing game. Realizing the constraints placed on indexers *vis a vis* tracking error, arbitrageurs buy the stocks added to the index upon announcement expecting to sell them to indexers at a higher price on the effective date. Similarly, they short sell stocks deleted from the index upon announcement and expect to repurchase them from indexers at a lower price or to buy the deleted stocks on the effective date and hold them for several weeks until prices recover. Several researchers have found evidence of arbitrage activity around changes to the S&P 500 index (see Beneish and Whaley, 1996; Chen,

[5] Other important reasons for tracking error and expenses are reinvestment of dividends, and cash management to meet investor purchases and redemptions. Fund managers are adept at minimizing the impact of dividends and cash flows through index futures.

Noronha, and Singal, 2004; Blume and Edelen, 2004). Similar evidence exists for the Russell 2000 (Madhavan, 2003; and Biktimirov, Cowan, and Jordan, 2004).

Not surprisingly, arbitrage returns are realized at the expense of index fund investors. Our estimates indicate that the loss is as high as 1.84% annually for investors in the Russell 2000 index and as high as 0.12% for investors in the S&P 500 index. With about $1,100 billion in assets benchmarked to the S&P 500 index and $264 billion benchmarked to the Russell 2000, passive investors in the S&P 500 index incur a loss of as much as $1.32 billion every year while Russell 2000 investors lose as much as $4.85 billion.

Under conditions currently prevailing, index fund investors are typically unaware of the loss,[6] arbitrageurs have little to cavil at, and index fund managers still meet the objective of minimizing tracking error. Thus, no one seems to have an incentive to change the status quo. Arguably, this calm is not dissimilar from conditions prevailing when the late trading, commission-discount, and market timing scandals erupted in the mutual fund industry.[7] While those scandals evinced aspects of illegality or impropriety, or both, the problem we discuss in this paper appears to have neither. Further, the actions underlying the scandals were concealed from public view precisely because of potential or evident illegality or impropriety. Predictability of index changes, pre-announcement of index changes, and tracking-error minimization, in contrast, are facts known to all professionals in the indexing business, and easily accessible to interested investors. Nonetheless, the economic significance of their combined effect cannot be understated since it results in very real losses to index fund investors.

Also, in this regard, the occurrence of unexpected losses consequent upon implementation of an agency solution is not without precedent and not limited to indexed mutual funds. Corporate performance-based compensation and stock option grants, long considered an

[6] Elton, Gruber, and Busse (2004) find that index fund investors do not always choose index funds in a rational manner.
[7] Chalmers, Edelen, and Kadlec (2001) and Goetzmann, Ivkovic, and Rouwenhorst (2001) are studies of market timing.

effective way to better align manager and stockholder objectives, have recently resulted in substantial unexpected losses to stockholders due to aggressive and unethical accounting practices. Much remains to be explored with regard to resolution of agency costs.

In the context of indexed mutual funds, we propose three solutions aimed at limiting losses incurred around index changes. Any one of the major participants - indexing companies like Standard and Poor's and Frank Russell, index fund managers, or index fund investors themselves, have the capacity to change the current system to mitigate losses. For example, Vanguard has been proactive in protecting its investors from indexes that are amenable to arbitrage. In Spring 2003, Vanguard changed its benchmark for small cap index funds from Russell 2000 to MSCI 1750. Gus Sauter, manager of Vanguard's index fund group, confirmed to Hulbert (2004) in the New York Times that "one of the primary motivations [for the change] was to reduce the ability of traders to exploit those index changes at the expense of index funds."

The rest of the paper is organized as follows. In the next section, we describe the process of indexing and index changes with special reference to the S&P 500 and Russell 2000. In section III, we describe the pattern of returns around index changes for the S&P 500 and Russell 2000 indexes. In section IV, we estimate the potential gains that would accrue to current index fund investors if index changes were not actually made on the effective date, and in section V, we discuss the motives of index fund managers. Section VI contains a discussion of appropriate actions by indexing companies that can reasonably solve the problem of index fund arbitrage. In Section VII, we discuss a variety of limitations, extensions, and implications of the analysis. Section VIII contains concluding remarks.

II. The Practice of Indexing

Though numerous indexes created by many indexing companies exist, we focus primarily on the S&P 500 and Russell 2000 indexes for two main reasons. First, S&P indexes and Russell

indexes are constructed in significantly different ways, a fact that allows us to contrast the impact of changes on index fund investors. Their constructions are different in terms of transparency, pre-announcement, and the number of changes that occur each year. Changes in indexes constructed by most other indexing companies like MSCI and Dow Jones (other than the Dow Jones Industrial Average) are, in principle, similar to the Russell indexes.

Second, the S&P 500 and the Russell 2000 are the most popular among all available indexes. The popularity implies that these indexes have the highest ratio of the value of assets benchmarked to the index relative to the value of the index. For comparison, Table 1 shows the number of products benchmarked to various indexes, the value of assets benchmarked, the market cap of each index as a proportion of the entire U.S. market's capitalization, and the ratio of assets benchmarked to index size. Table 1 shows that more than $1.1 trillion in assets or about 11% of the index's value was indexed to the S&P 500 in June 2003. In the case of the Russell 2000, the amount indexed is about 26% of index value. Thus, investors in these two indexes will be most affected by index changes.[8] While we don't consider the relatively new MSCI indexes for U.S. markets in detail, their strengths and weaknesses are discussed in sections VI.1 and VI.4.

II.1. Need for Index Changes

In order to keep the indexes current and to keep them representative of the economy, index constituents are frequently changed by indexing companies. Index changes may be voluntary or involuntary. Involuntary index changes occur when firms cease to exist publicly because of bankruptcies, liquidations, delistings, leveraged buyouts, or mergers. Voluntary changes occur when constituent firms do not meet the indexing company's criteria for inclusion. For example, Standard and Poor's deletes firms when a firm ceases to represent its industry or the industry itself ceases to represent the economy. Frank Russell Company deletes companies from

[8] Though comparisons between two large cap indexes or between two small cap indexes are possible, the low level of assets indexed to the Russell 1000 and the S&P 600 implies that index changes will only have a limited impact. Also see the discussion in sections VI.4 and VII.6.

its indexes based on the market cap, stock price, and float. Each deleted company is immediately or eventually replaced with another company in order to keep the number of firms in the index constant.

II.2. Process of Index Changes

The criteria for constructing an index, the frequency of reconstruction, and the means of communicating changes when they are decided vary considerably across indexing companies. We demonstrate in subsequent sections that the process of index changes is partly responsible for the loss to index fund investors.

Changes to the S&P 500 index are generally initiated by deletions. About three-quarters of all deletions from the index are involuntary, due to mergers, bankruptcies, or other forms of major restructurings. In addition to involuntary deletions, firms may be deleted voluntarily by Standard and Poor's when they cease to represent the economy, either because the industry is no longer representative of the economy (railroads) or because the firm is no longer representative of its industry (for example, Rite Aid for retail drug stores). Since the number of firms in the index is maintained at 500, additions to the index are almost always announced along with deletions. To pick a candidate firm for inclusion, Standard and Poor's uses four criteria that are not always strictly enforced: The firm must have sufficient liquidity; firm ownership must not be concentrated in a single or few entities; the firm must be profitable; and the firm must be a leader in an important U.S. industry. Thus, additions to the S&P 500 occur throughout the year whenever a deletion occurs.

In contrast, changes to the Russell 2000 occur at fixed intervals. The index was rebalanced quarterly from 1979 to 1986 and semi-annually from 1987 to June 30, 1989. Since 1990, the index has been reconstituted once a year, on the last day of June. Beginning with 2004, additions/changes to the Russell indexes occur at the close on the last Friday of June. As with the S&P indexes, firms that cease to exist are deleted from the Russell indexes. However, unlike the

S&P indexes, firms are not contemporaneously added to the Russell indexes to replace deleted firms. Thus, the number of companies in the Russell 2000 continues to fall from July 1 until the next reconstitution in June the following year, except when initial public offerings are added during the year. Also, unlike the S&P indexes, no firms are deleted from the Russell indexes if they fail to continue to meet the inclusion criteria except at the time of reconstitution in June. Though the S&P 500 firms may *not* be the largest firms in the economy or the industry, they are chosen on the basis of their importance to the economy or the industry. On the other hand, additions to the Russell 2000 are based entirely on the market cap of the firm, subject to their fulfilling certain conditions relating to float and stock price.

Since changes to the S&P indexes are somewhat subjective and largely unpredictable, arbitrageurs can trade on changes only between the date of announcement of the change and the effective date. Before October 1989, changes were announced at the close of trading the day before the change became effective. However, in October 1989 Standard and Poor's started pre-announcing changes to the index to ease "order imbalances" in an environment of explosive index-fund growth.[9] The delay between the announcement date and the effective date of an index change permitted the entry of arbitrageurs and resultant losses to investors in funds indexed to the S&P 500.

In terms of losses to investors, the case of the Russell 2000 index is worse than that of the S&P 500 for three reasons. First, Russell 2000 index changes are almost fully predictable because they occur based primarily on the market cap. Many large investors and financial institutions (Merrill Lynch, Morgan Stanley, Goldman Sachs, to name a few) begin to predict changes as early as March though the changes do not become effective until the end of June. Frank Russell Company officially announces the changes several times during the month of June. Second, the success of the Russell 2000, as measured by the high level of assets benchmarked to

[9] According to estimates by Standard and Poor, mutual funds indexed to the S&P 500 Index grew from around 3.5% of total market capitalization at the end of 1983 to around 8.15% by December 1989.

it (26% of index value), provides a more compelling case for arbitrage. Thus, the demand from indexers is greater than in the case of S&P 500, giving rise to greater price pressure. Finally, the larger number of index changes in small cap indexes (like the Russell 2000 where 25% of the firms change each year) compared to large cap indexes (like the S&P 500 where less than 5% of the firms are turned over each year) gives arbitrageurs more opportunities for timing.[10]

III. Return Patterns Around Index Changes: Evidence

III.1. Changes to the S&P 500 Index

Our sample of S&P 500 index changes begins in September 1976, when Standard and Poor's began to formally announce changes to interested investors and the media through its S&P Notification Service and ends in December 2002. The 1976-2002 period is divided into two sub-periods, the first one until September 1989, and the second one after September 1989. A significant change took place beginning October 1989. Until the end of September 1989, changes were announced after the close of market on Wednesdays, typically around 4:30 p.m. EST, and the change in the index became effective the next day upon the market's opening. Thus, there is no difference between the announcement day and the effective day during the first sub-period. Standard and Poor's began to pre-announce changes beginning in October 1989 with the result that the effective day of the change generally occurs several days after the announcement day.

The initial sample consists of 297 additions for the September 1976 – September 1989 period, and 303 additions for the October 1989 – December 2002 period. As there is one deletion for every addition, the initial sample consists of 600 additions and 600 deletions during the September 1976 – December 2002 period. We impose certain criteria for inclusion in the final sample. First, we require that any firm added to or deleted from the S&P 500 index have at least 60 trading days of pre-event and 90 trading days of post-event data on CRSP. We impose this

[10] Russell 1000, the large cap index, also has more changes (15.4%) than the S&P 500. See Table 8.

screen to enable computation of abnormal returns. Second, we exclude firms whose addition to the index was caused by a significant contemporaneous event or a likely major corporate event (restructuring, bankruptcy, merger, etc.) was anticipated based on an inspection of news reports over three months prior to the announcement. Third, we exclude the involuntary deletion of foreign firms in July 2002 as a result of a change in Standard and Poor's policy. Thus, the final additions sample consists of 526 firms and the final deletions sample consists of 100 firms.

Excess returns are reported in Table 2 based on abnormal and cumulative abnormal returns measured relative to the S&P 500 index.[11] We first focus on additions as reported in Panel A of Table 2 and, in particular, on the return between announcement date and the effective date. [12]

Since there is no difference between the announcement day and the effective day in the first sub-period, the returns in the fourth and fifth columns of Table 2 are identical. During the October 1989 – December 2002 period, from the announcement day to the effective day we observe an increase in the price of stocks added: the mean abnormal return increases from 5.1% to 8.4%. The results show that there are two components of the abnormal returns due to additions: a permanent effect and a temporary effect. The permanent change in the price of added stocks, as reflected in the cumulative abnormal return from the announcement through 60 days after the effective date (CAR60) is 3.56% during 1976-89, and 6.35% during 1989-2002. The temporary effect occurs only during 1989-2002 when there is a delay in making the changes effective. The temporary effect, measured by the difference between the CAR from the announcement date up to the effective date and the CAR 60 days after the effective date, is 2.0%.

[11] Lynch and Mendenhall (1996) and Chen, Noronha, and Singal (2004) compute raw returns and abnormal returns relative to the CRSP value-weighted index and relative to control firms matched on the basis of industry and size. They find that these methods for computing abnormal returns yield conclusions similar to those reported using the S&P 500 index as the benchmark. Also see Shleifer (1986) and Harris and Gurel (1986).

[12] Announcement day return refers to the return for the trading day following announcement because all announcements are made after the close of markets.

Results for the deletions sample are reported in Panel B of Table 2. As with additions, we note an increasingly negative announcement reaction to deletions after September 1989 once changes began to be pre-announced: the loss upon announcement is a significant 8.5% in the 1989-2002 period with an additional loss of 6% between the announcement day and the effective day. There is also a lack of permanence in the excess return. The negative effect of deletions disappears completely 60 days after the effective date. Thus, for deletions, there is a statistically insignificant permanent effect but the temporary effect is a large negative 15.6%.[13]

In summary, the temporary return of 2.0% in the case of additions and 15.6% for deletions cannot be captured because index fund managers have a mandate to minimize tracking error.

III.2. Changes to the Russell 2000 index

Prior work has found an upward price trend in stocks likely to be added to the Russell indexes during the March-June period. For example, Madhavan (2003) finds that additions to the Russell 2000 experience a cumulative return of more than 20% in the March-June period compared with a loss of about 9% for deletions during the same period. The firms added to the index lose approximately 7.7% in July suggesting a temporary price pressure similar to that for S&P 500 index changes. His sample covers the 1996-2002 period.

The large temporary price pressure is not unexpected because the Russell 2000 index, as a benchmark for small cap stocks, is used extensively by institutions. Approximately $260 billion was indexed to the Russell 2000, as of June 2003, accounting for around 26% of the $1,000 billion market value of the index at the time. Thus, Russell 2000 reconstruction has an effect of 26% which is much larger than the 11% for the S&P 500 index.

[13] This result is similar to that in Chen, Noronha, and Singal (2004). The result is also similar to that in Dash (2002), a study conducted by Standard and Poor's.

In Table 3, we focus on Russell 2000 index changes around the time of reconstitution during the 1990-2002 period.[14] Our results are similar to those of Madhavan (2003), though we report excess returns relative to the return on the Russell 2000 index. Moreover, we consider only the month of June because relying on prior month returns introduces a look-forward bias, since changes are not known with certainty until the end of May.[15] It is clear that added firms gain in June, as price pressure builds in anticipation of buying by index funds upon reconstitution on the last day of June, and then lose in July and August as the added firms return to price levels based on their fundamentals. By a symmetric argument, deleted firms lose in June and gain in July and August. The sample of additions includes firms that are actually added to the Russell 2000 at the time of reconstitution at the end of June. The initial sample of deletions includes firms deleted from the Russell 2000 from July 1 to June 30 during the previous year. However, returns are computed only for firms that are active as at June 30 – which means that all firms that stop trading prior to the reconstitution date are deleted. Our deletions results are presented in Panel B of Table 3.

In summary, the excess returns in June (3.1%) earned by the firms added to the Russell 2000 index are surrendered in the two months following the actual addition. Deleted firms, in contrast, lose in June but appreciate by a total of 4.3% in July and August.

IV. Losses to Index Fund Investors

It is evident from the previous section that there are price pressure effects around the effective day of index additions and deletions. In this section, we estimate the losses to index

[14] For additions, the difference between initial and final samples is due to our inability to match 0.21% of the added firms with CRSP. There is a significant difference between the initial sample of additions and deletions for 2002, where within-year deletions are not included in the deletions sample for that year. Non-inclusion of those deletions doesn't affect our final sample because only firms deleted at the time of annual reconstitution are included in our analysis.

[15] We only report results for June and later because Frank Russell Company uses May 31st as the cutoff date for determining index changes. Even though the change list is known with a high degree of confidence as early as March in any year, the probability of addition for a firm on the list is not one and this induces an additional risk factor into a portfolio of additions or deletions formed earlier than June 1.

fund investors due to the inability of managers to trade on a day other than the effective day. In our calculations, we implicitly make two assumptions. First, we assume that fund managers trade in a manner which does not allow arbitrageurs to time them. Second, we assume that arbitrageurs are not facilitating the index change by providing liquidity. Even if arbitrageurs do provide liquidity, index fund investors would be better off not being benchmarked to an index that requires "payment" for index changes. We discuss this issue in more detail in section VII.5.

We first estimate the loss based on the temporary price pressure effect. A more precise estimate is computed by implementing trading strategies based on price patterns observed in this paper and other papers around index changes.

IV.1 Losses to Index Investors: An Approximation

As a first approximation, the cost to index fund investors as a consequence of the focus on tracking error is the temporary component of the index change effect. We estimate this cost below for the S&P 500 and the Russell 2000.

We assume that fund managers buy additions on the day after announcement for the S&P 500 index and at the end of May for Russell 2000, and that they sell deleted stocks 60 days after the effective date for the S&P 500 and at the end of August for the Russell 2000. Our logic for using different addition and deletion dates for S&P 500 index changes and Russell 2000 index changes is based on Greenwood (2004). He finds that arbitrageurs realize abnormal returns by waiting for several weeks after the event. In our scenario, fund managers could step into the shoes of the arbitrageurs to capture the abnormal returns by waiting for a few weeks after the effective date. The effect of mismatched purchases and sales is discussed further in section VII.3.

IV.1.1 S&P 500 index: Based on the 1990-2002 period in Table 2, there are an average of 20 additions and 6 deletions every year. Though changes have been more frequent in recent years, we use these lower numbers to be conservative. The temporary price effect is 2.0% for additions

and -15.6% for deletions. Since the size of an average company entering the index is $8.3 billion according to Table 2 and the size of an average company dropped from the index is $0.5 billion, the estimated loss to the investors is calculated below.

-- $8.3 billion x 20 additions per year @2.0% temporary
= $166 billion @2.0% temporary = $3.32 billion

-- $0.5 billion x 6 deletions per year @15.6% temporary
= $3 billion @15.6% temporary = $0.46 billion

-- A combined $3.78 billion (loss) divided by $10,000 billion (S&P 500 market cap) = 0.04% per year.

According to our preliminary calculations, the loss to index fund investors is about 4 basis points per year. In dollar terms, based on the $1.1 trillion indexed to the S&P 500 (see Table 1), the loss to index fund investors is $0.44 billion.

IV.1.2 Russell 2000 index: For the Russell 2000 index, there are on average 550 additions and 375 deletions per year at the time of reconstitution. The difference in returns is 3.1% for additions and 4.3% for deletions (calculated as the sum of July and August returns). As per Table 3, the average size of the firm added to the index is $369 million and the average size of the firm deleted from the index is $415 million.[16]

-- $369 million x 550 additions per year @3.1% = $203 billion @3.1% = $6.29 billion

-- $415 million x 375 deletions per year@4.3% = $156 billion @4.3% = $6.71 billion

-- A combined $13.00 billion (loss) divided by $1,000 billion, Russell 2000's market cap = 1.30% per year.

[16] The mean size of deleted firms being larger than the mean size of added firms (Table 3) implies that several firms deleted from the Russell 2000 move up (are added) to the Russell 1000 and, similarly, several firms added to the Russell 2000 are those that move down (were deleted) from the Russell 1000.

Thus, 1.30% is lost by index funds indexed to the Russell 2000. In dollar terms, based on the $264 billion indexed to the Russell 2000, the annual loss to index fund investors is $3.43 billion.

IV.2 Losses to Index Investors: A More Precise Estimate

In order to calculate the impact of the pre-announcement or knowledge of index changes on an index fund constrained to trade only on the effective date of the change, we construct trading strategies that take advantage of the known patterns in price changes around the effective date. The effect of the trading strategy is separated from the normal operation of an index fund by overlaying the trading strategy on the index fund which would normally make all changes on the effective date. For example, in the case of S&P 500 additions, the normal strategy is to buy the added stock on the effective date. Based on the evidence, the fund manager should buy the stock on the announcement date. Thus, the overlay trading strategy or the incremental trading strategy entails buying the added stocks at the close on the day after announcement and selling on the effective day. The incremental trading strategy combined with the normal operation gives the desired result.

The abnormal return from the trading strategy is weighted by the size of the added firm relative to the size of the index to arrive at an estimate of the net effect on the total fund return. Mathematically, the impact of the trading strategy is given by equation (1).

$$\text{Net Impact} = \sum_{i=1}^{C} \frac{FirmSize_i}{IndexSize} \times \left(\left(\prod_t (1 + R_{it}) \right) - \left(\prod_t (1 + R_{mt}) \right) \right) \qquad (1)$$

Where "C" is the number of index changes, R_{it} and R_{mt} are the daily return for stock i and market on day t during the period of the trading strategy, respectively.

IV.2.1 S&P 500 Index

For additions to the S&P 500 index, we construct a trading strategy where an added stock is bought on the day after the announcement day and sold on the effective day.[17] Essentially, the strategies we propose are those that index funds would reasonably pursue absent the focus on tracking error minimization. We restrict our analysis to added stocks with at least one day between the announcement and effective dates. The mean impact for all added firms by year and for the entire 1989 – 2002 period are reported in panel A of Table 4.[18] Over the 1989 – 2002 period, the average net impact of added firms is 0.101%.[19] Blume and Edelen (2004) propose an early trading strategy for indexers. They find that if indexers bought on the announcement day rather than on the effective day, they would add 19.2 basis points per year with no added risk but with a substantial increase in tracking error. Our numbers are lower for at least two reasons. First, their sample period covers 1995 through 2002, a period over which the price impact is larger. Our estimate over the same period is 15.2 basis points. Second, their trading strategy involves trading at the open on the day after announcement, while we allow trading at the close on the day after announcement.

The results for deletions are reported in Panel B of Table 4. We follow a different strategy for deleted firms. Since we document a strong negative temporary effect for deleted stocks in Table 2 – an effect that completely reverses three months later, the strategy for an S&P 500 index fund to follow would be to buy at the close of the effective date and sell 60 trading days later when prices have recovered, which is equivalent to the index fund's selling the deleted stocks 60 days after deletion instead of on the effective date. Once again we report average risk-

[17] Since announcement takes place after exchanges have closed, we essentially buy at the closing price on the day after announcement. Thus we lose the announcement day return. This helps to explain why the numbers in Table 4 look considerably different from those in Table 2.

[18] The last column in Panels A and B of Table 4 can be obtained by multiplying the third column (number of stocks) with the second last and third last columns.

[19] In equation 1, we weight by firm market value on the effective date. It could be argued that the announcement date value should be used instead, particularly in the presence of outlier firms that had large temporary run-ups between the announcement and effective dates. If announcement date values are used, the average annual net impact for additions is 0.07% instead of 0.10%. There is no material change in the case of deletions.

adjusted compounded returns and the average relative size of deleted firms on the effective date, and use their product to obtain net impact. Over the 1989 – 2002 period, the average net impact of deleted firms is 0.022 percent.

This result implies that an index fund buying added stocks following announcement and selling deleted stocks 60 days after the effective date of deletion would earn an additional return of 0.123% per year, or 0.12%. In dollar terms, the average annual loss to investors is $1.32 billion. We note that, for additions, a large component of this impact comes from returns in the years 1998 through 2000, a period of considerable upheaval in the financial markets. If this period were excluded from the analysis, the average of the remaining years would be 0.03% per year, which is comparable to our rough estimate in section IV.1.1, and still translates to a substantial loss of around $335 million per year.

IV.2.2 Russell 2000 Index

We report results for the Russell 2000 in Table 5. For additions to Russell 2000, it is best to buy the added stocks at the end of May instead of at the end of June. Thus, the incremental strategy consists of buying all added stocks on the last trading day in May and selling them on the last day in June. The net impact is calculated in accordance with equation (1) and the results for additions are reported in Panel A of Table 5.[20] For deletions, the best course is to sell those stocks at the end of August instead of at the end of June. Thus, the incremental strategy consists of buying the deleted stocks at the end of June and selling them at the end of August. Abnormal returns and impact for this portfolio are computed in a manner similar to that for additions. Results are reported in Panel B of Table 5.[21]

[20] The last column in Table 5 can be obtained by multiplying the third and fourth columns and dividing by the fifth column.

[21] The sample size for deletions in Table 5 is sometimes marginally smaller because some firms cease to exist soon after June 30th.

The arithmetic mean abnormal return per year is 0.983% for additions and 0.854% for deletions.. The return from following both strategies simultaneously is 1.837% (≈ 1.84%) per year. Thus, if a fund indexed to the Russell 2000 bought additions on June 1 and sold deletions on August 31 of a given year, during the 1990 – 2002 period it could have earned an abnormal return of 1.84% per year. In dollar terms, the average annual loss to investors is about $4.86 billion. Again, if the 1998 – 2000 years are excluded, the average yearly impact falls to 1.30% for additions and deletions instead of 1.84%. This translates into a dollar impact of $3.43 billion, similar to the approximation in Section IV.1.2.

V. Investor-Manager Agency Conflicts

The evidence in the previous section unambiguously reveals that index fund investors lose due to the activities of arbitrageurs. For example, from Tables 2 and 3, we observe that the prices on the effective date are the most unfavorable for index fund managers: abnormally high for added firms and abnormally low for deleted firms. It clearly hurts index fund investors when fund managers alter their portfolios on the effective date. These results are consistent with those of Frino, Gallagher, and Oetomo (2005) who find that passive Australian funds would benefit from employing less rigid rebalancing and investment strategies. Our estimates in Tables 4 and 5 imply that investors in S&P 500 indexed funds would gain three to ten basis points every year, while investors in the Russell 2000 indexed funds would gain between 1.30% and 1.84% if changes were made when prices were more favorable. The limitations and extensions of these estimates are discussed in Section VII.

V.1 Tracking Error as a Low Cost Agency Solution

Given that arbitrageurs can time them, why do index fund managers focus on tracking error minimization and why do investors instruct fund managers to minimize tracking error? A

major justification has its roots in the principal-agent problem. When investors delegate investment decision-making to fund managers they accept that these managers' interests may diverge from their own. To the extent that fund managers are rewarded for performance, they have an incentive to strive for higher abnormal returns with little regard for assumed risk. If investors seeking broad diversification accept the S&P 500 index, for example, as a suitable representation of the market portfolio, they should reasonably expect their return from investing in an eponymous mutual fund, as well as the risk they bear, to mimic that of the S&P 500 index. One way to ensure this is to bind fund managers to an objective of minimizing tracking error.

Operationally, this translates to a full index replication strategy, where managers adjust fund holdings to closely follow changes to the index, since sampling, or enhanced indexing, the other common indexing strategy, is likely to result in larger tracking error. Thus, tracking error appears a simple yet effective way of reducing investor-manager conflicts and evaluating performance.

V.2 Tracking Error Is Inadequate

While tracking error has been effective in ensuring that index fund managers replicate the underlying index, the growth in indexing has made the focus on tracking error counterproductive as we discuss below. In addition, according to prior work (Roll, 1992; Jorion, 2003), tracking error is an inappropriate way of evaluating performance because it is not mean-variance efficient.

Though index fund managers are aware of the unattractiveness of prices on the effective date, Chen, Noronha, and Singal (2004) report that the trading volume on the effective date is several times the normal *daily* volume.[22] This suggests that index fund managers continue to change their portfolios on the effective date with a view to minimizing tracking error.

[22] Some observers have suggested that the actual trading volume on the effective day is much less than what would be expected if all index fund managers traded on that day. A quick check for all additions to the S&P 500 index in the latter half of 2002 reveals that the trading volume is sufficiently large to support all managers trading on that day. The trading volume on the effective date is 9% to 20% of the number of

Indeed, if index fund managers don't change their portfolios on the effective date, their tracking errors would be much higher. In Tables 6 and 7, we report tracking error and total standard deviation estimates for the index funds following the strategy we document in Tables 4 and 5 and compare these to the standard deviations of the S&P 500 and Russell 2000 indexes. Compounded strategy returns in excess of the S&P 500 index return are reported in the third column of Tables 6 and 7 and the sum of absolute tracking error for the year is listed in the fourth. Not surprisingly, the absolute tracking error with the implementation of these strategies is 0.26% for the S&P 500 and much higher at 7.24% for the Russell 2000. But the higher tracking error is accompanied by additional returns of 0.14% and 1.87% respectively.

The question arises as to whether these additional returns come at the price of increased risk. In Tables 6 and 7 we also report the risk of funds indexed to the S&P 500 and Russell 2000. In the last two columns of Table 6, we report that the standard deviation of the S&P 500 index is no different from the standard deviation for the index fund following the strategy we follow. Similar results for the Russell 2000 index are reported in Table 7. The standard deviation of the Russell 2000 Index return, and that of the index fund are virtually identical. It is clear that following the strategies we advocate would have resulted in generally positive alpha without altering risk.

Though principals (index fund investors) would probably welcome higher returns without significantly higher fund volatility, the additional return cannot be earned without increasing tracking error. Thus, the tracking error focus, while restricting the risk-taking propensities of fund managers, has also limited their ability to benefit their principals.

It is commonly believed that institutional index fund managers (as opposed to retail fund managers) have considerable flexibility in managing tracking error and that these fund managers trade around the effective date, enter into guaranteed price contracts with brokers for index

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shares outstanding for NYSE stocks and between 20% and 25% for Nasdaq stocks without adjusting the volume for the upward bias in Nasdaq's reported volume. This compares favorably with the ratio of 11.3% reported in the last column of Table 1 for S&P 500.

changes, and make extensive use of index futures to minimize the impact of index changes. This observation is consistent with the results in Table 9. However, Tables 4, 5, 8 and footnote 21 suggest that even after accounting for the superior money management skills of institutional managers there is significant residual impact of index changes on index returns that hurts investors.

V.3 Measuring Index Fund Performance

The focus on tracking error is thus an agency problem, and presumably, an unintended consequence, that arises from attempts to mitigate another agency problem, namely, the propensity of fund managers to enhance performance by assuming risk levels in excess of those contracted for by their investors. Unfortunately, in the case of index mutual funds, the tracking-error focus, in conjunction with another ostensibly good intention with unexpected consequences – that of pre-announcing changes to the index – results in the exacerbation of economic losses to index fund investors.

Given the limitations of tracking error, another measure of index fund performance is required. However, until a new measure becomes available, it appears prudent to eschew the use of tracking-error minimization as the only evaluative tool. Instead, positive deviations from the benchmark (positive alpha) should be permitted when not accompanied by greater risk for the fund portfolio or use of the Sharpe ratio should be extended to index funds. This recommendation is consistent with Roll (1992).

VI. Role of Indexing Companies in Protecting Index Fund Investors

Since the loss to index fund investors occurs due to the procedure by which changes are made by an indexing company to its index, we explore ways in which indexing companies can make their indexes less susceptible to arbitrage. Analysis in previous sections shows that there

are three factors under the control of indexing companies which affect the potential loss to index fund investors: the number of changes, the predictability of a change, and the length of the period between the announcement of a change and its effective date.

VI.1. Number of Index Changes

The number of index changes in a given period depends on both the frequency with which changes are made and the criteria driving those changes. All else constant, as the frequency of index changes increases, the number of changes in a given year will increase due to market volatility. A study by Russell staffers [Gardner, Kondra, and Pritamani (2001)] finds that changing from annual reconstitution to quarterly reconstitution would have increased the annual number of changes in the Russell 2000 from 546 (27% of all firms) to 899 (45% of all firms) over the 1983-2000 period, representing an increase of 65%. Since each index change may be associated with an opportunity for index arbitrage, a larger number of changes translates into a larger loss for index fund investors.

Though the frequency of changes appears directly proportional to the annual number of index changes, the effect of frequency on the number of changes can be diminished by the criteria for making index changes. For example, the Russell 2000 is reconstituted only once a year, less frequently than the MSCI indexes (semi-annually) and the S&P indexes (which can be as frequently as once a week). Yet, the percent of firms turned over every year is the largest for the Russell 2000 because the criteria for changes are largely mechanical and objective. In contrast, with subjective criteria, S&P does not need to make changes for several weeks or even several months. As a result, the average number of companies turned over in the S&P 500 is less than 5% over the 1977-2002 period compared to 15.4% for the Russell 1000 over the 1983-2000 period.[23]

[23] The Russell 1000, being a large-cap index, is a more appropriate index for comparison with the S&P 500. See Table 8.

On the other hand, the criteria for changes to the Morgan Stanley Capital International (MSCI) indexes are similar to that for the Russell indexes though MSCI reconstitutes the index every six months instead of once a year. However, like the Dow Jones indexes, it uses buffer zones to reduce the number of changes that occur when companies exit and enter an index due to transient changes in market value. For example, the MSCI Small Cap 1750 index consists of stocks whose market cap ranks from 751 to 2500. However, a stock is not dropped from the index until it rises above 551 in rank or falls below 3000. According to MSCI, the Small Cap 1750's turnover measured by market cap for 1999-2002 is 21.5% with buffer zones, much less than the 35.9% estimated turnover without buffer zones.

While a reduction in the frequency of index changes may reduce the total number of index changes, infrequent changes can cause the index to become less representative of the economy. Realizing the necessity of remaining current, Russell indexes has begun adding initial public offerings to the indexes once a quarter from October 1, 2004 instead of adding them only at the time of annual reconstitution in June.

In addition, the frequency of index changes could be increased without increasing the number of changes through a judicious choice of criteria. For example, the changes in the S&P 500 are more frequent than the changes in the Russell 2000 though the total number of changes as a fraction of the total number of stocks in the S&P 500 is not as large as for the Russell 2000 or for Russell 1000.

VI.2. Predictability of Index Changes

The second important factor in gaming by arbitrageurs relates to the predictability of index changes. Since subjective criteria are used for changes to S&P indexes, it is generally difficult to predict which firms will be added to or deleted from the index. The biggest source of predictability in the S&P 500 has to do with large initial public offerings like UPS and Goldman Sachs. For example, Goldman Sachs was considered closely held even after its initial public

offering on May 4, 1999 because about 87% of the shares were not available for trading. A significant portion of the restricted shares became available for trading on the third anniversary of the IPO (May 4, 2002). In line with the predictions of several brokerage firms, Goldman Sachs was added to S&P 500 soon thereafter, on July 19, 2002. Such predictable events, however, are relatively uncommon and, overall, it is difficult to predict changes to Standard and Poor's indexes.

As noted earlier, the Russell indexes, MSCI indexes, and many other indexes are constructed mechanically based primarily on the market cap of firms. Since the criteria for index changes are specified unambiguously, it is easy for arbitrageurs to predict changes with a great degree of accuracy resulting in the large temporary price effect around the effective date. It appears that it would be in the interest of investors if these indexing companies employed a random procedure to select some, but not all, of the firms eligible (based on current criteria) for additions or deletions. Introducing limited subjectivity into the selection process should ensure reduced predictability as well as a reduction in the number of changes every year.

VI.3. Pre-announcement of Index Changes

The third factor contributing to losses to index fund investors is the lag between announcement of a change and its effective date. The lag is of interest only for changes that are unpredictable, as with the S&P 500 index. Indexing companies claim that the pre-announcements are required to "ease order imbalances" that are likely to result from large transactions initiated by indexers. However, a comparison of volumes on the effective day shows that the volume for changes that are pre-announced is *not* less than the volume for changes that are not pre-announced possibly because index fund managers continue to trade on the effective date irrespective of whether a preannouncement is made or not.[24] This suggests that the problem of order imbalances cannot be resolved by pre-announcing changes. On the other hand, there is

[24] These results are not reported here, but are available from the authors. Also see footnote 21 above.

greater potential for arbitrageurs to take advantage of passive fund investors with the pre-announcement.

VI.4. Return and Risk of Indexes

The previous analysis is consistent with the notion that index construction and the level of indexing may cause returns for comparable indexes to be different. Are the index returns really different? To answer this question, we compare large cap and small cap indexes from three major indexing companies: Standard and Poor's, Frank Russell Co., and Morgan Stanley Capital International. Though the number of stocks, market capitalization, and other characteristics of these indexes are different, we believe that a comparison is reasonable because all large cap indexes (and small cap indexes) compete for the same customers.

In Table 8, we report the main characteristics of the indexes followed by the annual returns and associated risks of those indexes. Most of the data including the daily total returns are obtained from the indexing companies. The risk and return analysis begins in 1995, the earliest year for which total return data for all indexes are available. As mentioned earlier in the paper, the basis and frequency of changes is different for the three indexing companies. The median market caps of the firms in Russell indexes are smaller than for firms in the S&P indexes because the Russell indexes span a wider group of stocks than the S&P indexes. Not surprisingly and as we discuss in section VII.6, the number of changes is lower for large cap indexes than for small cap indexes. Among large cap indexes, the percent number of changes is much higher for the Russell 1000 firms than for the S&P 500 firms. Similarly, the percent number of changes is higher for Russell 2000 than for the S&P 600.

The annual returns and associated risks for the indexes are reported in Panel B.[25] The average returns for the 1995-2002 period show that the large cap indexes (S&P 500, Russell 1000, and MSCI 300) exhibit similar returns and risk. Even the returns for each year do not seem to be different. The small cap indexes tell a different story. The Russell 2000 index earns a lower return than S&P 600 in all years except 1999 while it underperforms MSCI 1750 in all years. Overall, the returns to the Russell 2000 are more than 3% less than the returns to the other two indexes. At the same time, the risk of the Russell 2000 index is not less than the risk of either the MSCI 1750 index or the S&P 600 index.

In Panel C of Table 8, we evaluate whether returns are statistically different by computing the fraction of months where the index return (S&P and MSCI) is higher than the corresponding Russell return. That is, S&P 500 and MSCI 300 returns are compared with the Russell 1000 return, and S&P 600 and MSCI 1750 returns are compared with the Russell 2000 return. For the large cap indexes, we find that the fraction of months for which the S&P 500 return is larger than the Russell 1000 return is not significantly different from 0.50.

The comparison of the small cap indexes is more interesting. S&P 600 index has a higher return than the Russell 2000 index for 62.5% of the months, which is significantly greater than 50%. To examine whether the excess return is related to the Russell reconstitution, we examine whether or not the returns are different around the reconstitution date. Excluding the months from May to August, the S&P 600 index outperforms the Russell 2000 index only 51.6% of the time. However, it has a higher return than the Russell 2000 index for 84.4% of the time from May to August and 93.8% of the time during June and July, both of which are significantly higher than 50%.

[25] The S&P 500 returns in Tables 6 and 8 are slightly different because the returns in Table 6 are from CRSP and the returns in Table 8 are from S&P. One of the reasons for the difference is that CRSP's S&P 500 portfolio does not always consist of 500 firms. In any case, the difference in the two computed returns is small and inconsequential for our analysis.

The difference in returns for the Russell 2000 and S&P 600 indexes and the concentration of those differences in the months around reconstitution is consistent with the loss introduced by the arbitrage activity that occurs with predictable index changes in the Russell 2000 and the success of the Russell 2000 as evidenced by the high level of indexing (26%). On the other hand, the Russell 1000 does not severely underperform its competing large cap indexes even with predictable and numerous changes because the level of indexing is low. Moreover, the subjective nature of index changes in the S&P indexes limits the losses from arbitrage with the result that the popular S&P 500 index does not earn returns that are significantly different from other large cap indexes.

VI.5. Indexing Companies and Arbitrage

We can conclude from the discussions in this section that index fund investors are better served when indexing companies introduce uncertainty into the process of index changes. In addition, a reduction in the number of changes and possibly a reduction in the period of pre-announcement should further limit the ability of arbitrageurs to game index funds.

VII. Implications and Limitations

In our prior analysis, we did not fully consider several concerns and did not evaluate at least one other implication. We consider those issues in this section.

VII.1 Relative Performance of Index Funds and Enhanced Index Funds

In order to determine whether a policy of allowing fund managers more flexibility would have benefited investors, we compare the performance of closely-indexed and enhanced-index funds. In section IV, we report that investors in Russell 2000 indexed funds lose as much as 184 basis points a year compared with up to 10 basis points for the S&P 500. This implies that if the

fund manager inflexibility is one reason for losses to index fund investors, it should be easier for enhanced index funds to beat the Russell 2000 index than the S&P 500 index. To examine whether this is the case, we study the performance of indexed mutual funds over a 5-year period, 1998-2002.

Our starting point is Morningstar's Principia Pro because Morningstar identifies funds that claim to be indexed funds, both closely-matched index funds and enhanced index funds. While we realize that Morningstar's database has a survivorship bias, we don't believe that it is of significant concern to us because we are comparing the performance of similar kinds of index funds.

Based on Morningstar, we identify a total of 38 index funds indexed to the Russell 2000 index and 177 index funds indexed to the S&P 500. Of these, we are able to obtain daily price and return information for 32 Russell 2000 funds and 146 S&P 500 funds from QuotesPlus, our source for mutual fund prices.[26] We run a regression of daily returns adjusted for distributions on the appropriate index to estimate the alpha, beta, and the R^2 for each fund for each of the 5 years. We exclude six S&P 500 index funds with a beta of less than 0.90 or greater than 1.10. Upon closer examination, we find that these are special funds, for example, the Profunds Bear ProFund that is, by design, negatively correlated with the S&P 500.

For the purpose of this analysis, we assume that closely-matched index funds will have a beta very close to 1.0 (between 0.99 and 1.01) as they try to minimize the deviations from the index by adopting a pure replication strategy. On the other hand, enhanced index funds are not bound to mimic the index and may be more flexible about the beta. Accordingly, we require the

[26] Singal (2004) claims that Fasttrack.net provides the best mutual fund data in the industry, closely followed by QuotesPlus. Unfortunately, the price data on Fasttrack.net is available only for 22 Russell 2000 and 88 S&P 500 index funds.

enhanced index funds to have a beta between 0.90 and 1.10 but excluding closely-matched index funds.[27]

To evaluate the performance of these funds, we add back the expense ratio as reported by Morningstar to the alpha of the fund to obtain the gross alpha. The gross alpha is a better indicator of the fund's actual performance than the calculated alpha because the gross alpha is the true excess return earned by the fund. The expense ratio is part of the total return claimed by fund managers as compensation and administrative expenses. Since these expenses are not incurred by the benchmark index, they should be added back to the fund's return for comparison to the benchmark.

The results are tabulated in Table 9. Not surprisingly, the alpha for the closely-matched index funds is negative irrespective of whether the fund is indexed to the Russell 2000 or the S&P 500. Adding back the expense ratio results in similar performance – negative in both cases, but statistically insignificant for the Russell 2000.

The more interesting results relate to enhanced index funds where the criterion for performance evaluation is not necessarily solely minimization of tracking error. For these funds, managers probably have the flexibility to time their purchases and sales of index stocks. Given this flexibility and common knowledge about price pressure, we would expect fund managers to avoid trading changed stocks around the effective date. Based on the results presented earlier, enhanced funds indexed to the Russell 2000 have the potential to garner the greatest gains due to index changes.

Indeed, we find that the Russell 2000 enhanced index funds outperform the index by 204 basis points. This performance is in contrast to the closely-matched Russell indexed funds which do not outperform the index at all. At the same time for the S&P 500, enhanced index funds do not outperform the index probably because the benefit from capturing the return around index

[27] The results are virtually unaffected if we define enhanced index funds to have a beta between 0.95 and 1.05.

changes is quite small – only 0.12%. As a result, the mean performance of enhanced S&P 500 index funds is not significantly different from the performance of closely-matched S&P 500 index funds.

Is the excess return associated with higher risk? We find from Table 9 that the risk of an enhanced index fund is not higher than a closely-matched index fund. From Tables 6 and 7, we see that the risk of enhanced funds also compares favorably with that of the indexes themselves. The mean daily standard deviation for the 1998 – 2002 period for the S&P 500 is 1.37%, and for the Russell 2000 is 1.41%. The evidence presented above is consistent with our assertion that the loss to index fund investors is real and can be recouped by allowing index fund managers greater flexibility in tracking the index. Our results are consistent with those of Frino, Gallagher, and Oetomo (2005) who study Australian index funds and find that "during index revision periods, enhanced index funds commence portfolio rebalancing earlier than index funds" and that "this activity translates into higher returns and lower trading costs for enhanced index funds."

While a variety of methods are used for enhancement of returns in the mutual fund industry, the excess returns for the Russell 2000 enhanced funds documented in Table 9 are likely to arise from index changes for at least two reasons. First, we choose enhanced index funds with betas that are close to 1, within 10% on either side which implies that these funds are not very different from a typical index fund. Second, enhancement of returns by other means should affect S&P 500 enhanced index funds and Russell 2000 enhanced index funds in a similar manner. Yet, only the Russell 2000 enhanced funds outperform their benchmark.

The ability to outperform the Russell 2000 is also noted by Gastineau (2004). He states that "the embedded index change transactions costs in the Russell 2000 have averaged about 200-300 bp annually." (p. 97). Our own analysis in Table 8 illustrates that the Russell 2000 index return is lower than comparable small cap indexes by at least 300 bp and that the underperformance is concentrated around index changes.

VII.2 Losses to Investors – An Underestimate

In the following subsections, we consider reasons why our loss estimates may be on the high side. However, there are reasons we may have underestimated losses as well. One major factor that we have not considered in our calculations is the effect of involuntary deletions, such as bankruptcies, mergers, liquidations, and spinoffs. Approximately 75% of all deletions from the S&P 500 are involuntary, as are 25% of all deletions in the Russell 2000. Since such deletions are accompanied by important firm-specific news, we chose to exclude them from our sample in order to generate a clean sample where the index effect can be isolated.

It is difficult to estimate the impact of companies that cease to trade concurrent with the effective date of deletion. However, firms deleted from the index that are close to bankruptcy usually continue to trade even after the effective deletion date providing some noisy information about the effect of deletion.

One such example is Pan Am. The announcement of deletion was made on January 8, 1991 after the close of markets with January 9, 1991 as the effective date. Its closing price on January 8, 1991 was $0.75. It closed at $0.375 the next day (the effective day) and recovered to close at $0.75 on January 10, 1991. Over the next 60 trading days, its lowest closing price was $0.625, 67% above the effective day closing price. Another example is Carter Hawley Hale Stores. The deletion announcement was made on February 11, 1991 with February 12, 1991 as the effective day. The stock closed at $1.625 on February 11, 1991, fell to $1.125 on the effective day, recovered to close at $1.375 the following day. Over the next 60 trading days, its lowest closing price was $1.625, 44% above the effective day price. Both examples illustrate the potential underestimation of the loss to index fund investors because deletions with confounding events are not included in our sample.

VII.3 Losses to Investors – Times Series Variation

From tables 4 and 5, it can be seen that the largest impact from index additions occurs in three years: 1998, 1999, and 2000. Dash (2004) also documents a decline in price pressure following additions to the S&P 500 index between 1998 and 2004. One explanation that fits the evidence is that, because of the bull market, there was probably little competition among arbitrageurs resulting in larger profits from these strategies during 1998-2000. More capital seems to have found its way to index changes after 2000 reducing the gains to arbitrageurs and the losses to index fund investors.

Does it mean that index fund investors are unlikely to lose significantly in the future? Probably not. First, the impact of deletions on the Russell 2000 index returns has increased after the year 2000 though the impact of additions has declined. Thus, total losses to investors in funds indexed to the Russell 2000 remain significant. Second, while the losses during 1998-2000 period were abnormally large, index fund investors also experienced significant losses in the pre-1998 period. As mentioned in section IV.2, the annual loss to investors indexed to the S&P 500 is 0.03% and to those indexed to the Russell 2000 is 1.30% even if 1998, 1999, and 2000 are excluded from the analysis. In dollar terms, the estimated loss is about $3.75 billion a year.

VII.4 Mismatched Buys and Sells

Trading strategies in sections IV and V for both S&P 500 index changes and Russell 2000 index changes call for buying added firms before the effective date and for selling deleted firms after the effective date. Since added firms have to be bought before selling deleted firms, this would require an additional outlay of funds. Besides the non-availability of funds, there is also the concern of being over-invested during this period. One way to circumvent the funding constraint and the overinvestment limitation is to short-sell the appropriate index in the cash

market, perhaps, with exchange-traded funds, and to use short sale proceeds to buy added stocks.[28]

Another criticism of relying on mismatched buys and sells is that the design of the strategy is based on limited evidence especially in the case of Russell 2000. Greenwood (2004) provides corroborating evidence based on changes in the Nikkei 225 that suggests that waiting for a few weeks can generate excess returns. In any case, we recompute the returns assuming that S&P 500 index change trades (both buys and sells) occur on the day after announcement and the Russell 2000 index change trades (both buys and sells) occur at the end of May. The loss to index fund investors with matched buys and sells is 0.10% for the S&P 500 index instead of 0.12% and 1.19% for the Russell 2000 index instead of 1.84%. Thus, while the losses are smaller for Russell 2000 index fund investors, they are still large and important.

VII.5 Provision of Liquidity

Do arbitrageurs provide liquidity, thereby limiting the price impact on the effective day, for which they are compensated? Since most index fund managers make changes to the fund on the effective day, there must be a sufficient supply of added stock available for fund managers to buy. If an adequate supply of the stock added to the index is not available, the price impact can be quite large, at least temporarily.

Provision of liquidity by arbitrageurs is a plausible explanation. However, it may not be able explain a significant part of the price impact around the effective date. For example, for additions made during the 1976-89 period in Table 1, the entire price effect occurs on the announcement date with no reversal thereafter. However, in later years when changes are pre-

[28] We recognize that short sale proceeds are not usually available for reinvestment. Therefore, we acknowledge that the actual savings from this strategy may be marginally smaller than those assumed here.

announced, there is evidence of a price pop with a subsequent reversal. The reversal potentially reflects the additional price pressure due to arbitrageur activity.[29]

Even assuming that the loss to index fund investors is compensation to arbitrageurs for providing liquidity, there is no reason for index fund investors to choose only one particular index for small cap indexing. For example, Vanguard switched to the MSCI 1750 in Spring 2003 to attenuate losses due to timing by arbitrageurs. Moreover, index fund managers can avoid some of the losses associated with index changes by trading on days other than the effective day.

VII.6 Comparison of S&P 500 and Russell 2000 indexes

Though a comparison of the two popular indexes is valuable in highlighting the effect of index changes, it gives the impression that, from an investor standpoint, the S&P indexes are superior. However, such a conclusion is not necessarily valid since the S&P 500 is a large cap index while the Russell 2000 is small-cap. A natural bias arises from the fewer changes that are necessary for a large cap index and the smaller impact of each index change.

In the case of a small cap index, a company may be deleted because it becomes too big *or* too small. In contrast, most voluntary deletions from a large cap index occur only because a company becomes too small. The annual number of changes for the S&P 500 index is under 5% whereas the number of changes for the S&P 600 is approximately three times as frequent at 13%. Since each index change is a candidate for index arbitrage, fewer changes mean smaller losses for index investors.

The second source of bias is the impact of deletions on the index. Since deletions from the large cap index occur only from below, the size of the company being changed is small relative to the index. From Table 4, it can be seen that the relative size of deletions is approximately 0.01% of the S&P 500 index. On the other hand, deletions from a small cap index

[29] It can be argued that the level of indexing is significantly higher in the second period than in the first period. However, if only the years close to 1989 are considered when the level of indexing in different years was similar, the results are not materially different.

occur from above and below resulting in a relatively large firm size. For the Russell 2000, the average size of a deleted firm is about 0.05% of the index value. Not only is the size of deletions five times larger, the number of voluntary deletions for a small cap index as a percentage of total deletions is also larger (about 75%) compared with a large cap index (25%). Note that involuntary deletions are not included in the analysis because of confounding events. Finally, the price impact of large cap index changes may be smaller due to greater liquidity of the stocks that belong to a large cap index when compared with changes in a small cap index.

While a comparison between two small cap indexes or two large cap indexes may be preferred, neither the S&P 500 index nor the Russell 2000 index has a similar sized index with a comparable level of indexing. Thus, a comparison of the S&P 500 with the Russell 2000 is appropriate and highlights the effects of differences in index construction and index changes. A superficial comparison of indexes with similar capitalizations can be made by perusing Table 8.

VIII. Conclusion

The growth in popularity of index funds is a testament to portfolio theory and the virtues of diversification. According to Frank Russell Company, about $2,000 billion dollars in assets were benchmarked to major indexes as of June 2003 indicating that index funds are an important component of the financial landscape.

Investors, drawn by the broad diversification levels and low turnover rates that characterize index mutual funds and exchange traded funds, no doubt expect the fund to be invested in the firms constituting the index in the proper proportions at any given time. But fund managers rewarded for performance have an incentive to assume more risk than contracted for by the investors. To address this agency problem, fund managers implicitly or explicitly contract to minimize the size and volatility of tracking error. Accordingly, the performance of index fund

managers is usually measured both in terms of the cost of managing the fund and its tracking error.

In this paper, we show that index fund investors lose a significant amount due to the predictability and timing of index changes coupled with fund managers' objective of minimizing tracking error. The loss to an investor in the Russell 2000 index is about 130 basis points but can be as high as 184 basis points per year, while S&P 500 investors could lose as much as 12 basis points per year. Consistent with the above, we find that the Russell 2000 index underperformed other small cap indexes by more 3% per year over the 1995-2002 period though the comparable indexes did not entail greater risk. Moreover, the underperformance is concentrated in months surrounding the annual reconstitution of the index.

We suggest steps that can be taken by indexing companies, index fund companies, and by index fund investors to recoup a significant part of their losses. Since advance knowledge of changes allows arbitrageurs to time those changes, we recommend that indexing companies reduce the predictability of index changes as much as possible. In addition, the number of index changes should be reduced so that both the opportunity for arbitrage and transactions costs associated with index changes are limited. Changes effected by indexing companies are the most effective way of protecting fund investors from index arbitrage because it removes the cause of loss to investors.

Alternatively, managers of index funds can minimize losses by not trading on the effective date because the price pressure is the greatest at that time. To provide the necessary flexibility to fund managers, investors should rely on overall risk and return of the portfolio for performance evaluation instead of focusing on tracking error. Indeed, we find that the risk of funds using the strategies we outline is not greater than the risk of the benchmark index, though the return is higher by as much as 10 to 184 basis points. Finally, small, individual investors could protect themselves by choosing their index fund based not only on expenses and loads but also on the low likelihood of the fund being timed by arbitrageurs.

References

Baks, Klaas P., Andrew Metrick, and Jessica Wachter, 2001, "Should investors avoid all actively managed mutual funds? A study in Bayesian performance evaluation," *Journal of Finance* 56, 45-85.

Beneish, Messod D., and Robert E. Whaley, 1996, "An anatomy of the "S&P 500 Game": The effects of changing the rules, *Journal of Finance*, 51, 1909-1930.

Biktimirov, Ernest, Arnold Cowan, and Bradford Jordan, 2004, "Do Demand Curves for Small Stocks Slope Down." *Journal of Financial Research,* 27(2).

Blume, Marshall, and Roger Edelen, 2004, "S&P 500 Indexers, Tracking error, and Liquidity: A Complex Answer to Profiting." *Journal of Portfolio Management,* 30(3), Spring, 37-47.

Chalmers, John, Roger Edelen, and Greg Kadlec, 2001, "On the Perils of Financial Intermediaries Setting Prices: The Mutual Fund Wild Card Option." *Journal of Finance* 56(6), 2209-36.

Chen, Honghui, Gregory Noronha, and Vijay Singal, 2004, "The Price Response to S&P 500 Index Additions and Deletions: Evidence of Asymmetry and a New Explanation" *Journal of Finance,* 59(4), 1901-29.

Dash, Srikant, 2002, Price changes associated with S&P 500 deletions: Time variation and effect of size and share prices, Standard & Poor's, July 9.

Dash, Srikant, 2004, Index Effect Revisited: What Happened to the Post-Addition Price Pop?, Standard & Poor's, September 20.

Del Guercio, Diane, and Paula Tkac, "The Determinants of the Flow of Funds of Managed Portfolios: Mutual Funds vs pension Funds," *Journal of Financial and Quantitative Analysis,* 37 (4), 523-557.

Elton, Elton J, Martin J. Gruber, and Jeffrey A Busse, 2004, "Are Investors Rational? Choices among Index Funds," *Journal of Finance*, 59(1), 261-288.

Frino, Alex, David R. Gallagher, and Teddy N. Oetomo, 2005, "The Index Tracking Strategies of Passive and Enhanced Index Equity Funds," *Australian Journal of Management*, Forthcoming.

Gardner, Grant, Andra Kondra, and Mahesh Pritamani, 2001, "Examining the Frequency of U.S. constitution," Research Paper, Frank Russell Company.

Gastineau, Gary L., 2004, "The Benchmark Index ETF Performance Problem." *Journal of Portfolio Management*, Winter, 96-103.

Goetzman, William, Zoran Ivkovic, and K. Geert Rouwenhorst, 2001. "Day Trading International Mutual Funds: Evidence and Policy Solutions." *Journal of Financial and Quantitative Analysis* 36(3), 287-309.

Greenwood, Robin, 2004, "Short- and long-term demand curves for stocks: theory and evidence on the dynamics of arbitrage," forthcoming in the *Journal of Financial Economics*.

Gruber, Martin J., 1996, "Another Puzzle: The growth in actively managed mutual funds," *Journal of Finance* 51(3), 783-810.

Harris, Lawrence, and Eitan Gurel, 1986, Price and volume effects associated with changes in the S&P 500: New evidence for the existence of price pressures, *Journal of Finance*, 41, 815-830.

Hulbert, Mark, 2004, "A Quick Path to Profit, in Index Funds." New York Times, July 4, 2004.

Jones, Christopher and Jay Shanken, 2005, "Mutual Fund Performance with Learning Across Funds," forthcoming in the *Journal of Financial Economics.*

Jorion, Philippe, 2003, "Portfolio Optimization and Tracking Error Constraints," *Financial Analysts Journal*, September/October, 70-82.

Lynch, Anthony W. and Richard R. Mendenhall, 1997. "New Evidence On Stock Price Effects Associated With Changes In The S&P 500 Index," *Journal of Business*, 70, 351-383.

Madhavan, Ananth, 2003, "The Russell Reconstitution Effect," *Financial Analysts Journal*, July/August 2003, 51-64.

Pastor, Lubos and Robert F. Stambaugh, 2002, "Mutual Fund Performance and Seemingly Unrelated Assets," *Journal of Financial Economics* 63, 313-349.

Quinn, Jim, 2004, "US Stock Indexes: Is There a Best Choice?" April, www.djindexes.com.

Roll, Richard, 1992, "A Mean/Variance Analysis of Tracking Error," *Journal of Portfolio Management*, Summer, 12-22.

Ryan, Oliver, 2004, "Does Your Fund's Index Measure Up?" Fortune, August 9, 2004.

Shleifer, Andrei, 1986, Do demand curves for stocks slope down? *Journal of Finance*, 41, 579-590.

Singal, Vijay, 2004, Beyond the Random Walk: A Guide to Stock Market Anomalies and Low Risk Investing. New York: Oxford University Press.

Smith, Matthew and Eric Haughton, 2003, "US Equity Index Benchmark Usage." Frank Russell Company, September 30. Available at www.russell.com.

Table 1: Assets and Products Benchmarked to Major Indexes

The number of products and assets benchmarked to major indexes, as of June 2003, is given below. The last column is derived from columns 3 and 4. The estimate of the total market cap of all U.S. stocks, $12.5 trillion, is based on CRSP.

Index (1)	Number of products benchmarked (2)	Assets benchmarked ($ billions) (3)	Index size as a fraction of total US market cap (4)	Ratio of assets benchmarked to size of index times market value (5)=(3)/[(4)x12.5 trillion]
S&P 500 including growth/value	975	1127	80%	11.3%
Russell 1000 including Growth/Value	348	430	90%	3.8%
Russell 2000 including Growth/Value	532	264	8%	26.4%
Russell Mid-Cap incl. Growth/Value	166	81	24%	2.7%
S&P Mid-Cap 400	73	44	7%	5.0%
Wilshire 5000	15	13	100%	0.1%
Nasdaq Composite	11	3	23%	0.1%
Dow Jones	6	2	25%	0.1%
S&P Small-Cap 600	12	2	3%	0.5%

Source: Smith and Haughton (2003).

Table 2: Abnormal Returns Around Changes in the S&P 500 Index

Abnormal returns are calculated relative to the S&P 500 index's total return. CAR Anndate is the abnormal return for the first trading day following the announcement. CAR Anndate to Effdate is the cumulative abnormal return from the day following announcement to the effective day, when the index change actually occurs. CAR20 and CAR60 represent cumulative abnormal returns from the first trading day following announcement to 20 days and 60 days after the effective day, respectively.

For the returns columns, the first line in each cell reports the mean (%) and the second line reports the proportion of returns that are positive, while for the firm size column, the first line reports the mean and the second the median. The significance of the mean is tested with a standard t-test, while the significance of the proportions is tested using the binomial distribution.

Panel A. Additions

Period	Sample Size	Size as of Effdate ($mil)	CAR Anndate	CAR Anndate to Effdate	Anndate to Effdate+20 (CAR20)	Anndate to Effdate+60 (CAR60)
197609-198909	263	1,164.93 990.34	3.171*** 0.932***	3.171*** 0.932***	3.122*** 0.681***	3.556*** 0.635***
198910-200212	263	8,315.41 6,086.10	5.124*** 0.943***	8.371*** 0.909***	5.947*** 0.688***	6.355*** 0.635***

Panel B. Deletions

Period	Sample Size	Size as of Effdate ($mil)	CAR Anndate	CAR Anndate to Effdate	Anndate to Effdate+20 (CAR20)	Anndate to Effdate+60 (CAR60)
197609-198909	28	351.98 106.12	-1.168 0.393	-1.168 0.393	-1.642 0.357	-1.715 0.429
198910-200212	72	497.90 309.58	-8.483*** 0.014***	-14.099*** 0.042***	-4.663 0.347**	1.521 0.458

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 3: Monthly Abnormal Returns for the Changes to Russell 2000 index

The returns given are for additions to and deletions from the Russell 2000. The additions sample contains firms actually added to the index on June 30. The deletions sample contains only those firms that were deleted concurrent with the additions on July 1 of the current year. The deletions sample excludes firms that were dropped from the index before reconstitution on June 30.

For each firm, daily returns are compounded to obtain monthly returns. These returns are used to obtain value-weighted and equally-weighted portfolio returns, and then adjusted for Russell 2000 index's total return each month to obtain the monthly abnormal returns. These results are reported below starting with the fifth column. The first number in each cell is the mean abnormal return for the value-weighted portfolio, whereas the second number is that for the equally-weighted portfolio, except in the firm size column, where the numbers represent the mean and median. The mean and standard deviation of time series averages of annual abnormal returns are used for assessing statistical significance.

Panel A: All Additions to the Russell 2000 (returns relative to the Russell 2000)

Year	Initial Sample	Final Sample	Firm Size ($ mil)	June (%)	July (%)	August (%)
1990	410	410	90.11 39.75	2.717 2.287	-1.890 -1.173	-2.182 -0.909
1991	526	524	118.70 82.42	3.668 3.227	-0.642 0.035	-0.351 -0.670
1992	579	575	156.49 103.32	1.896 1.050	-0.893 -0.561	-1.159 -1.125
1993	497	496	222.50 155.44	-0.558 0.073	-1.112 0.405	0.479 0.857
1994	608	608	249.61 178.57	1.211 0.595	0.436 0.090	0.145 0.772
1995	464	464	282.62 194.93	3.202 4.250	1.187 1.938	-1.702 -0.599
1996	559	559	418.58 308.63	0.371 0.082	-3.764 -5.941	-0.439 0.780
1997	573	572	458.95 337.13	5.659 6.855	-0.946 -1.416	1.140 1.914
1998	588	586	535.85 371.08	1.932 1.550	-0.535 0.488	-4.703 -4.516
1999	569	567	550.05 375.17	7.386 8.313	-5.064 -3.021	-1.827 -1.899
2000	741	740	704.14 579.91	13.860 19.502	-3.370 -3.760	-1.493 -0.586
2001	659	659	416.54 278.74	-0.792 0.508	-2.454 -0.886	-4.949 -3.865
2002	486	484	354.97 224.53	0.002 3.221	-3.049 -0.857	0.128 0.746
All	7259	7,244	368.88 253.20	3.119** 3.963**	-1.700*** -1.128*	-1.301** -0.700

Panel B: All Deletions from the Russell 2000 (returns relative to the Russell 2000)

Year	Initial Sample	Final Sample	Firm Size ($ mil)	June (%)	July (%)	August (%)
1990	410	268	146.22 24.40	-1.534 -3.364	2.933 2.010	1.371 -0.808
1991	526	419	92.98 15.55	-2.384 -3.039	5.338 0.554	1.376 -1.397
1992	579	475	93.88 27.38	-1.961 -4.011	2.999 0.369	-1.108 0.077
1993	497	407	175.65 48.54	0.318 -2.383	-0.170 0.993	3.168 -1.010
1994	608	483	167.09 67.64	-2.942 -2.117	1.012 0.027	3.041 0.682
1995	464	307	306.80 88.51	0.523 -4.477	6.222 3.632	-1.397 1.497
1996	559	387	382.20 121.59	-4.943 -6.036	-0.326 3.771	-0.121 -1.430
1997	573	387	419.76 130.67	-3.620 -6.130	4.821 5.158	-0.192 2.415
1998	588	320	718.74 180.83	5.579 -0.478	2.774 0.576	-2.825 -4.267
1999	569	335	824.73 149.33	-1.290 -5.015	1.527 6.396	3.842 0.932
2000	741	414	885.35 140.60	6.343 -4.837	-7.018 2.661	10.019 -0.419
2001	664	410	711.37 111.37	-5.512 -7.816	6.031 -0.465	-0.514 -1.895
2002	371	357	617.13 91.46	-4.056 -8.244	8.977 4.315	3.630 2.529
All	7149	4,969	415.43 89.78	-1.191 -4.457***	2.702** 2.308***	1.561 -0.238

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 4. Impact from S&P 500 Index Changes

Panel A. Additions

Abnormal returns are calculated relative to the S&P 500 index's total return. Anndate is the first trading day following the announcement, and Effdate is the effective date of the change. Only stocks with at least one trading day between Anndate and Effdate are considered. Change in value from Anndate through Effdate is calculated by buying the stock at the close of the day after announcement and selling it at the close on the effective day. Relative size is the ratio of the added stock's market capitalization on the effective date to the S&P 500 total market cap on the effective day. Net impact on S&P 500 returns is found by first multiplying the % change in value (adjusted for the S&P 500) by relative size, and then summing up all across all additions during the entire year. Reported changes in value from Anndate to Effdate (raw and adjusted) are weighted by relative size.

Period	Additions as per Table 2	Stocks used in the strategy	# Days Between Anndate and Effdate	Change in Value from Anndate to Effdate (%)	Change in Value from Anndate to Effdate (Adjusted for S&P 500) (%)	Size relative to the S&P 500 (%)	Net Impact on Index fund return (%)
198910-199012	14	12	2.50	4.545***	-2.027	0.051	-0.012
1991	9	4	2.50	4.607*	7.283	0.157	0.046
1992	6	5	3.80	7.178**	1.436	0.087	0.006
1993	6	4	3.25	5.602*	3.028	0.236	0.029
1994	10	9	4.78	6.231**	3.951	0.250	0.089
1995	21	19	4.58	4.411***	4.088**	0.128	0.099
1996	18	16	4.88	3.427**	0.768	0.104	0.013
1997	23	17	6.53	5.345***	0.250	0.082	0.003
1998	33	27	4.00	7.730***	4.318*	0.143	0.167
1999	35	30	7.53	17.905***	21.753***	0.091	0.591
2000	45	39	5.31	7.065***	6.015**	0.116	0.272
2001	23	18	3.50	-0.749	1.073	0.067	0.013
2002	20	13	5.08	3.152**	1.273	0.153	0.025
198910-200212	263	213	4.98				0.101%**

Panel B. Deletions

Abnormal returns are calculated relative to the S&P 500 index's total return. Anndate is the first trading day following the announcement, and Effdate is the effective date of the change. Change in value from Effdate through Effdate+60 is calculated by buying the stock at the close of the Effdate and selling it at the close on Effdate+60. Relative size is the ratio of the deleted stock's market capitalization at the effective date to the S&P 500 total market cap on the effective day. Net impact on S&P 500 returns is found by first multiplying the % change in value (adjusted for the S&P 500) by relative size, and then summing up across all deletions during the entire year. Reported changes in value from Anndate to Effdate (raw and adjusted) are weighted by relative size.

Period	Deletions as per Table 2	Stocks used in the Strategy	# Days Between Anndate and Effdate	Change in Value from Effdate to Effdate+60 (%)	Change in Value from Effdate to Effdate+60 (Adjusted for S&P 500) (%)	Size relative to the S&P 500 (%)	Net Impact on Index fund return (%)
198910-199012	1	1	1.00	62.500***	48.017***	0.000	0.000
1991	1	1	0.00	-25.000***	-25.633***	0.001	0.000
1992	4	4	4.75	23.075**	21.099**	0.001	0.001
1993	2	2	3.33	35.923	36.234	0.004	0.004
1994	6	6	3.60	-4.540**	-4.923**	0.048	-0.012
1995	9	9	6.22	11.700	4.934	0.005	0.002
1996	9	9	4.78	12.018	3.704	0.007	0.002
1997	3	3	3.33	27.348	21.038	0.007	0.005
1998	3	3	4.33	10.357**	5.749	0.007	0.001
1999	5	5	7.00	-4.439	-8.200	0.007	-0.003
2000	19	19	3.05	16.201	18.357	0.004	0.014
2001	6	6	2.67	10.453	15.086	0.008	0.007
2002	4	4	1.50	1.635	6.940	0.003	0.001
198910-200212	72	72	3.96				0.022

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 5. Impact from Russell 2000 Index Changes

Panel A. Additions

The table below pertains to a value-weighted portfolio constructed by buying all Russell 2000 index additions at the close on the last trading day in May and selling them at the close on the last trading day in June. The abnormal return is the difference in return from this portfolio and the return from the Russell 2000 index. The abnormal return times the ratio of the portfolio's market capitalization on the effective date divided by the Russell 2000 market capitalization on the effective day is the impact on the index fund's return, where effective day is the last trading day in June. The mean and standard deviation of time series averages of annual abnormal returns are used for assessing statistical significance.

Year	Sample Size	Abnormal Return during June (%)	Market Cap of additions on June 30 ($ Billion)	Market cap of Russell 2000 on June 30 ($ Billion)	Net Impact on Index fund return (%)
1990	410	2.717	36.95	199.16	0.504
1991	524	3.668	62.20	218.32	1.045
1992	575	1.896	89.98	293.02	0.582
1993	496	-0.558	110.36	408.32	-0.151
1994	608	1.211	151.76	490.74	0.375
1995	464	3.202	131.13	598.51	0.701
1996	559	0.371	233.99	807.37	0.108
1997	572	5.659	262.52	982.89	1.511
1998	586	1.932	314.01	1,154.80	0.525
1999	567	7.386	311.88	1,101.89	2.090
2000	740	13.860	521.07	1,269.61	5.688
2001	659	-0.792	274.50	1,083.29	-0.201
2002	484	0.002	171.80	921.30	0.000
1989-2002	(average)				0.983%**

Panel B. Deletions

The table below pertains to a value-weighted portfolio constructed by buying all Russell 2000 index deletions at the close on the last trading day in June and selling them at the close on the last trading day in August. The abnormal return is the difference in return from this portfolio and the return from the Russell 2000 index. The abnormal returns times the ratio of the portfolio's market capitalization on the effective date divided by the Russell 2000 market capitalization on the effective day is the impact on the index fund's return, where effective day is the last trading day in June.

Year	Sample Size	Abnormal Return during July and August (%)	Market Cap of deletions at the End of June ($ Billion)	Market cap of Russell 2000 at the End of June ($ Billion)	Net Impact on Index fund return (%)
1990	267	3.944	39.19	199.16	0.776
1991	419	7.025	38.96	218.32	1.254
1992	475	1.756	44.59	293.02	0.267
1993	406	3.595	71.49	408.32	0.629
1994	483	4.126	80.71	490.74	0.679
1995	306	4.798	94.19	598.51	0.755
1996	385	-0.484	147.91	807.37	-0.089
1997	387	4.639	162.45	982.89	0.767
1998	318	-0.369	230.00	1,154.80	-0.073
1999	335	5.329	276.28	1,101.89	1.336
2000	414	1.372	366.53	1,269.61	0.396
2001	410	5.396	291.66	1,083.29	1.453
2002	356	12.354	220.32	921.30	2.954
1989-2002					0.854%***

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 6: Volatility estimates for an S&P 500 index fund

This table reports the volatility of an S&P 500 index fund with trading strategies around index changes described in the text. For each day, the index fund return is enhanced by the abnormal returns earned by qualified additions and deletions in Table 4. These daily returns are then compounded to the end of the year to obtain the total return on the index fund. The difference between the index fund return and the S&P total return is "Total Additional Return". The tracking error is the sum of the absolute difference between the daily S&P 500 return and the daily index fund's return. The last three columns report the daily standard deviations of the tracking error, the S&P 500, and the index fund. All the returns and tracking errors and standard deviations are in %.

Year	Total S&P 500 Return	Total Additional Return	Absolute Tracking Error	Std. Dev. of Tracking Error (X100)	Std. Dev. of S&P 500	Std. Dev. of Index Fund
198910-199012	-1.394	0.027	0.039	0.054	1.019	1.019
1991	30.687	0.037	0.033	0.107	0.896	0.896
1992	7.683	0.027	0.043	0.074	0.605	0.606
1993	9.777	0.051	0.063	0.126	0.538	0.538
1994	1.394	0.096	0.398	0.458	0.615	0.615
1995	37.588	0.129	0.194	0.214	0.489	0.489
1996	23.186	0.075	0.149	0.169	0.741	0.741
1997	33.453	0.074	0.211	0.155	1.129	1.129
1998	29.030	0.380	0.463	0.859	1.277	1.276
1999	21.121	0.512	0.692	1.427	1.136	1.135
2000	-8.894	0.268	0.766	0.702	1.416	1.416
2001	-11.798	0.036	0.186	0.192	1.362	1.362
2002	-22.158	0.156	0.241	0.660	1.644	1.642
Average of 13.25 yrs	11.296	0.141***	0.263	0.392	0.971	0.971

Note: The average is the sum of all the years divided by 13.25. The 0.25 yr reflects 1989.
*, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 7: Volatility estimates for a Russell 2000 index fund

This table reports the volatility of a Russell 2000 index fund with trading strategies around index changes described in the text. For each day, the index fund return is enhanced by the abnormal returns earned by qualified additions and deletions in Table 5. These daily returns are then compounded to the end of the year to obtain the total return on the index fund. The difference between the index fund return and the Russell 2000 return is the "Total Additional Return". The tracking error is the sum of the absolute difference between the daily S&P 500 return and the daily index fund's return. The last three columns report the daily standard deviations of the tracking error, the Russell 2000, and the index fund. All the returns and tracking errors and standard deviations are in %.

Year	Russell 2000 Return	Total Additional Return	Absolute Tracking Error	Std. Dev. of Tracking Error (X100)	Std. Dev. of Russell 2000	Std. Dev. of Index Fund
1990	-19.475	1.123	4.523	0.048	0.822	0.838
1991	46.039	3.393	4.268	0.060	0.780	0.782
1992	18.413	1.073	3.691	0.053	0.613	0.625
1993	18.867	0.370	2.903	0.028	0.548	0.550
1994	-1.816	1.049	4.141	0.044	0.628	0.631
1995	28.453	1.615	3.835	0.043	0.517	0.528
1996	16.483	0.045	7.878	0.084	0.669	0.711
1997	22.359	2.464	3.478	0.046	0.815	0.817
1998	-2.548	0.385	4.976	0.053	1.269	1.281
1999	21.256	3.916	14.330	0.154	0.887	0.928
2000	-3.022	4.402	17.576	0.192	1.872	1.889
2001	2.486	1.528	11.688	0.141	1.460	1.451
2002	-20.483	2.930	10.797	0.111	1.584	1.557
Average	9.770	1.869***	7.237	0.081	0.959	0.968

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

Table 8: Risk and Return of Indexes

The table presents a comparison of large cap and small cap indexes offered by Standard and Poors, Frank Russell and Co., and MSCI. Market caps are in millions of dollars and are as at the end of December 2003. Information about market caps for the Russell indexes is obtained from Quinn (2004) and for the S&P indexes from Standard and Poor's. Information regarding the number of changes is from section III.1 (S&P 500), Gardner, et al. (Russell 1000), Table 3 (Russell 2000), Standard and Poors (S&P 600), and MSCI (MSCI 1750). Daily total return data has been obtained from the indexing companies. Annual returns are reported only for the 1995-2002 period, a period for which total returns including distributions are available. Standard deviation is calculated for each calendar year based on daily returns. The first number in each cell of Panel B is the annual return while the second number is the annualized standard deviation of that return. Panel C contains the difference in returns as measured by the fraction of months where the index return is greater than the corresponding Russell return. That is, large cap indexes are compared with Russell 1000 whereas small cap indexes are compared with Russell 2000.

Panel A. Index Characteristics

	S&P 500	**Russell 1000**	**MSCI 300**	**S&P 600**	**Russell 2000**	**MSCI 1750**
Basis for changes	Index committee, not predictable	Objective and predictable	Objective and predictable	Index committee, not predictable	Objective and predictable	Objective and predictable
Frequency of changes	any time, frequent	Once a year	two times a year	any time, frequent	once a year	two times a year
Median Market cap	9,108	3,789	N.A.	629	469	N.A.
Highest Market cap	311,066	311,066	N.A.	4,865	2,064	N.A.
Lowest Market cap	902	489	N.A.	64	42	N.A.
Number of changes	4.6% (1977-2002)	15.4% (1983-2000)	N.A.	12.9% (1995-2002)	27.9% (1990-2002)	21.5% (1999-2002)

Panel B. Returns and Risk

	S&P 500	Russell 1000	MSCI 300	S&P 600	Russell 2000	MSCI 1750
1995	37.58 7.83	37.77 7.84	38.56 7.87	29.93 9.48	28.45 8.20	31.48 8.43
1996	22.95 11.82	22.45 11.62	23.18 12.05	21.32 10.99	16.48 10.67	19.02 10.95
1997	33.36 18.16	32.85 17.16	34.60 18.16	25.58 13.84	22.36 12.99	24.34 13.26
1998	28.58 20.29	27.02 19.96	33.40 20.42	-1.30 21.12	-2.55 20.15	0.58 20.58
1999	21.04 18.08	20.91 17.67	22.95 18.67	12.41 13.33	21.26 14.23	21.94 13.88
2000	-9.12 22.22	-7.79 23.16	-13.86 24.45	11.80 26.48	-3.02 29.89	8.67 25.29
2001	-11.92 21.38	-12.45 21.85	-13.94 22.59	6.53 22.65	2.49 23.17	3.21 22.66
2002	-22.06 26.04	-21.65 25.75	-22.86 26.28	-13.50 24.67	-20.48 25.15	-18.37 23.85
Average 1995-2002	**12.55** **18.23**	**12.39** **18.13**	**12.75** **18.81**	**11.60** **17.82**	**8.12** **18.06**	**11.36** **17.36**

Panel C. Difference in Returns: Fraction of months where the index return is higher than the Russell return

	S&P 500	MSCI 300	S&P 600	MSCI 1750
All months (1995-2002)	0.542	0.542	0.625**	0.604*
For May to August (1995-2002)	0.531	0.563	0.844***	0.656
Months other than May to August (1995-2002)	0.547	0.531	0.516	0.578
For June and July (1995-2002)	0.563	0.688	0.938***	0.750*
Months other than June and July (1995-2002)	0.538	0.513	0.563	0.575

Note: *, **, and *** indicate the fractions are significantly different from 0.5 at the 10%, 5%, and 1% levels respectively.

Table 9: Relative Performance of Index Funds

Beginning with index funds as identified by Morningstar's Principia Pro, we obtain price and return information for 32 Russell 2000 funds and 146 S&P 500 funds from QuotesPlus. Regressions of daily returns adjusted for distributions on the appropriate index are estimated to obtain the alpha and beta for each fund for each of the 5 years, 1998-2002. The funds are divided into two groups: closely-matched index funds with a beta between 0.99 and 1.01 and enhanced index funds with a beta between 0.90 and 1.10. Gross alpha is the sum of alpha and the expense ratio reported by Morningstar. The mean and median of standard deviations of daily returns computed for each fund year are also reported.

Panel A: Russell 2000 Index funds

Index (1)	Closely-Matched Index funds (2)	Enhanced Index funds (3)	Difference (column 3 minus 2)
Sample size (fund-years)	44	43	
Beta (mean)	0.997	0.975	-0.022***
Alpha (mean)	-0.89%***	1.35%*	2.24%***
Gross Alpha (mean)	-0.27%	2.04%***	2.31%***
Gross Alpha (median)	0.00%	3.57%***	3.57%***
Std. Dev. of Daily Returns (mean)	1.47%	1.42%	0.05%
Std. Dev. of Daily Returns (median)	1.58%	1.38%	0.20%

Panel B: S&P 500 Index funds

Index (1)	Closely-Matched Index funds (2)	Enhanced Index funds (3)	Difference (column 3 minus 2)
Sample size (fund-years)	318	191	
Beta (mean)	0.997	0.980	-0.017***
Alpha (mean)	-0.78%***	-0.89%***	-0.11%
Gross Alpha (mean)	-0.17%***	-0.25%*	-0.08%
Gross Alpha (median)	-0.08%***	-0.26%***	-0.18%***
Std. Dev. of Daily Returns (mean)	1.43%	1.37%	0.06%***
Std. Dev. of Daily Returns (median)	1.36%	1.40%	-0.04%***

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.