Hidden costs in index tracking

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Buying an index tracker is seen as a cheap and easy way to get exposure to stock markets. The last decade has seen a growth in the amount of money passively tracking market capitalisation weighted indexes.

This trend has been driven by evidence of traditional active fund managers underperforming passive benchmarks. This added validity to the argument of market efficiency; the Capital Asset Pricing Model dictates that a market capitalisation portfolio represents an "optimal" that you should not expect to beat. Furthermore such a portfolio requires almost no turnover.

In this study we look at the S&P 500 which is the most prominent market capitalisation weighted index in the world. It is very hard to know just how much money is passively tracking the S&P 500, but it has been estimated [6] at more than 10% of the total capitalisation.

Buying a tracker on the S&P 500 is therefore akin to buying a share of a huge managed equity portfolio. The size of which is at least $1.5 TN. Collectively the managers of such funds can be attempting to buy or sell 10% of an entire company within the space of 1 or 2 days. In addition, their intention is publicly known often a week in advance. This opens up the possibility of other market participants profiting at their expense. All this has a cost to index tracking investors which is not reflected in the tracking error. We estimate this to be at least 20 basis points per year, which could be saved by an active manager following a less crowded strategy even at a much higher turnover.

Introduction

Standard and Poor's (S&P) define computation rules for their index which amount to calculating the profit and loss (P&L) of a trading system, where the manager of an equity fund is following the S&P's guidelines for changing the composition of the portfolio and the reinvestment of cash proceeds. Further to this effect, since October 1989, S&P announce changes in the composition of their index early enough to allow index fund managers to buy (or sell) stocks added to (or removed from) the index in a timely fashion. This is true for all S&P indices, as well the majority of indices provided by the other index providers such as MSCI or Nikkei.

In this paper, we focus on the most prominent stock index: the S&P 500, and analyse its turnover. For equity fund managers turnover is associated with costs, and costs can be split into two components. The first is commissions that have to be paid for brokerage services and the second is market impact, often referred to as 'slippage'. Buying large blocks of shares in a single company normally causes the price of the shares to increase, forcing one to purchase them at a premium.

In this paper we analyse the costs involved when tracking the S&P500 index. In section 1, we detail the data we use for this analysis, and how it was collected. In section 2, we analyse the turnover of the S&P index since 1989, and give a rough estimate of the amount of commissions that have to be paid for this turnover. In section 3, we estimate the price impact that such a large amount of turnover will induce, focusing on a subset of events: additions to and deletions from the index. We conclude with a discussion in section 4.

1 Data

Most of the stock level data (and especially index membership information) is provided by S&P, together with various amounts of index level data (market capitalisation, price and total return index values). We checked the data against other providers, and apart from very minor or temporary glitches in earlier years, the data is very consistent and of good quality.

It is worth noting that S&P have conventions about the definition of price and dividend returns that might be misleading at first glance. For instance, S&P's methodology is to incorporate large special dividends (such as the one paid by Microsoft in 2004) in the price return and not in the dividend return.

In order to assess price impact, we needed historical prices for individual stocks outside of their lifespan within the S&P

500 index, which S&P do not provide. For that, we used data provided by the Centre for Research in Security Prices (CRSP).

Finally, we collected data on S&P announcements. Whenever possible, since 1989 S&P have announced changes to index constituents 5 days in advance, but in practice this can vary substantially. In order to accurately compute the past performance of an arbitrage strategy it is important to have accurate announcement dates. S&P provided us with data they had collated for earlier academic studies, and for the remaining announcements we collected the original press-releases from various sources (S&P archives, S&P online site, internet news archives), using a combination of automated and manual searches.

2 Turnover analysis

On most days, a manager replicating the S&P 500 price index need do no transactions. The index is market capitalisation weighted, so variations in price of the stocks do not make any rebalancing necessary. Replicating the total return index creates a little extra turnover when the dividends have to be reinvested.

However, some changes to the index do necessitate rebalancing by the manager. The most important case is when S&P decide to modify the constituent list of their index. The manager then has to sell the stocks removed from the index, and buy the newly added ones. Further, since the market capitalisation of the added and deleted companies rarely matches exactly, some rebalancing of all remaining stocks must take place – buying or selling an identical fraction.

Another case is when a company is issuing new shares, or buying back those in issue. The manager then has to buy or sell stocks to adjust the weight of that company, and then also rebalance the weights of all other stocks accordingly.

A final (relatively minor) case is when S&P changes the fraction of what they consider to be the freely floating shares of a company. This changes the weight of the company in the index and is also a source of turnover for the manager.

The following table gives an estimate of the resulting turnover caused by the various types of changes listed above.

Nature of change	Turnover incurred
Additions and deletions	1.9%
Share issues and buybacks	1.7%
Free float changes	0.3%
Reinvestment of cash proceeds	1.1%
Net rebalancing	1.8%
TOTAL	**6.8%**

Table 1: *Average annual turnover caused by different types of events for the S&P 500 total return index from 2000 to 2008.*

According to the above table, the manager has to buy stocks on average for a value of 6.8% of the portfolio, and to sell for the same amount. Even assuming a high commission rate of 10 bps for all transactions, the resulting commission costs are very low (less than 2 basis points per year).

To most managers though, the bulk of costs caused by transaction are not commissions, but slippage caused by price impact.

3 Price impact analysis

We focus here on changes to the index that are concentrated on a few stocks, because this is where any price impact will be most visible. We thus discard all rebalancing trades or cash reinvestments which are diluted over the whole set of constituents.

Remaining changes are free float changes, which amount to a minimal turnover, share issues and buybacks, and additions and deletions. Share issues and buybacks require the manager to buy or sell stocks, but we discard these events in this analysis, because we believe that the market impact of the manager's trades are offset by the corresponding supply or demand by the company itself.

Hence, we only focus on additions or deletions of index constituents in this paper.

Additions

Additions to the index are caused by two kinds of events. The first kind is when S&P decide to add into the index an already listed and traded stock, such as Yahoo. In this case, the managers have to actively buy the newly added stock. Note that a stock must be listed for some minimum period before it can be considered for entry in the index.

The second kind of addition is when a company already listed in the S&P 500 index spins off a new entity, and S&P decide to include the spin-off directly into the index. These new spin-offs do not require any trading from the manager (except for the corresponding deletion to keep 500 stocks), since the manager naturally receives stocks in the new company.

Between January 1990 and December 2011, 537 stocks have been added to the S&P 500 index. Of these, 483 (90%) are additions of the first kind, and 54 (10%) are of the second kind.

Deletions

Deletions from the index are of three kinds. Firstly there are deletions decided by S&P that require the manager to trade out of their stock positions. Secondly, there is the situation where stocks are acquired by a company either inside or

outside of the S&P 500 index. These do not require any action from the manager, except some rebalancing or reinvestment of cash proceeds. Then, there is rare case where deletions occur because a stock has been delisted. This corresponds to a variety of situations, but since they represent fortunately few cases, we do not analyse this further.

Between January 1990 and December 2011, 537 stocks have been deleted from the S&P 500 index. Of these, 220 (41%) are deletions of the first kind, and 317 (59%) are deletions of the second or third kind.

In the following analysis, we only consider additions of the first kind (90% of all additions) and deletions of the first kind (41% of all deletions).

Price impact curves

In the following we show the cumulated excess returns of stocks added to the index, conditioned on the offset to the addition date.

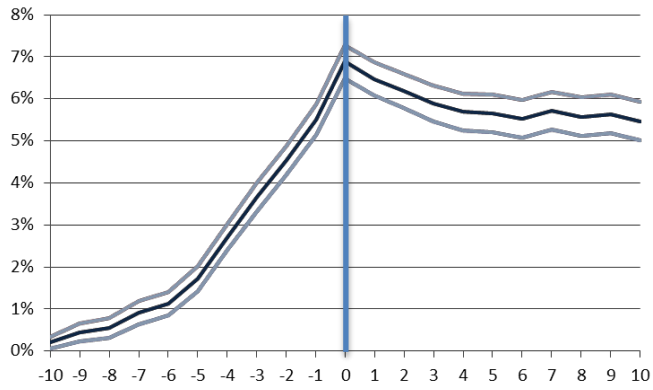

Figure 1: *average (across stocks) of cumulated (across time) excess returns of stocks with standard errors. Day 0 is day of addition to the index.*

Similarly, we can compute an average price impact for stocks deleted from the index, conditioned on the offset to the deletion day. We obtain the following graph.

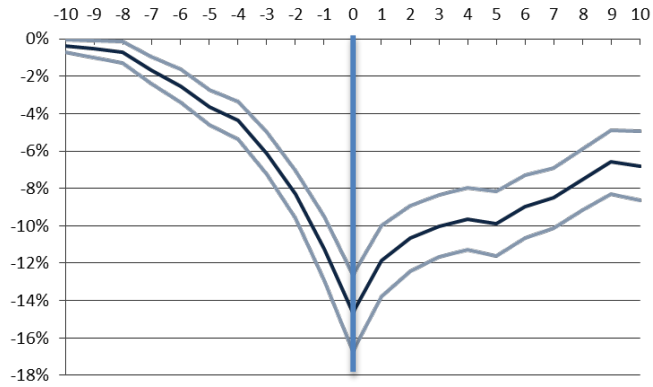

Figure 2: *average (across stocks) of cumulated (across time) excess returns of stocks with standard errors. Day 0 is day of deletion from the index.*

Looking at both curves, it is apparent that the additions of stocks to the index as well as their deletion have a marked impact on the equity prices. Index trackers are buying the newly added stocks at a premium, and selling the deleted stocks at a discount.

Cost analysis

It is not straightforward to come up with an accurate estimation of the amount lost by an index tracker because of this effect. In order to assess this, we need to define how the price relative to the market would have changed if the stock had not been added to the index; the 'reference price profile'. We also need to separate what is a permanent impact (lasting forever) from a reverting impact (pointing to a clear loss the manager can book as slippage).

Two different views are represented in the literature. The first one uses a reference price profile of zero relative to the market. In the case of additions in Figure 1, a simple fit finds an impact of 6.9% from 10 days prior to the addition. This reverts to 5.3% by 10 days after the addition, indicating a reverting impact over this period of 1.6%, as shown below in Figure 3.

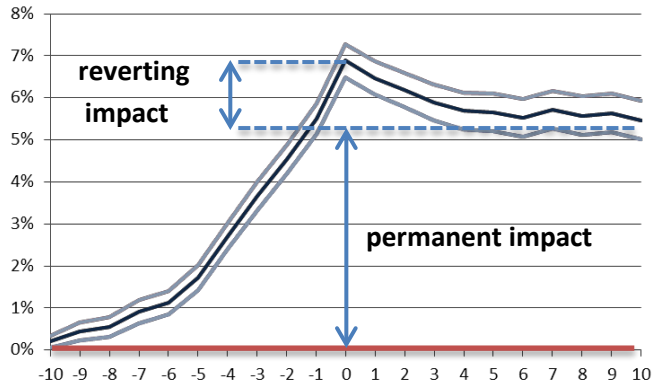

Figure 3: *price impact analysis when considering that the price of the stocks added to the index would have moved like the market (red line). We can then split the price impact into 2 components: a permanent impact and reverting impact.*

A similar graph can be drawn for deletions. The following table summarises the permanent and temporary price impacts and the resulting cost to the investor.

	Additions	Deletions
Permanent impact	5.3%	-6.5%
Temporary impact	1.6%	-8%
Traded per year	2.57%	1.27%
Cost to the investor	4.1 bp/yr.	10.1 bp/yr.

Table 2: *permanent and temporary impact corresponding to a flat surrogate view of the no-impact price profile.*

Note that for this study we only looked 10 days either side of the event, however it is possible that any price impact

extends outside of this period. Sticking with this view, the price impact and cost to the investor would amount to a total of 14.2 bp of the portfolio per year.

The authors of [1] and [4] provide arguments against this point of view. Intuitively, the momentum of a stock conditional on its entry in the index is not 0. The stock has been selected because its market capitalisation has become significant, so over the past months and weeks, it must have being going up to make it into the index. Therefore, on average, stocks due to be added to the index exhibit *positive momentum*. Similarly, to warrant its deletion from the index, a stock must have gone to the bottom of the index in the past few weeks or months. We therefore expect deletions to have negative momentum.

Further, in [4] the authors argue that price impact of an addition to the index is fully reverting. They see no permanent impact.

This framework implies a different reference price profile, and a modification to the diagram of permanent and reverting impact, as shown in Figure 4 below.

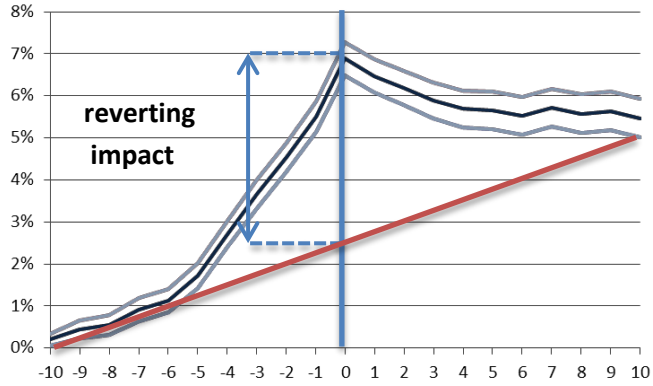

Figure 4: *price impact curve and depiction of the amount of reverting impact when taking into account the biased expected momentum of stocks added to the index.*

Assuming this framework the permanent impact is zero, and the temporary impact is larger than before. We get the following table.

	Additions	Deletions
Permanent impact	0%	0%
Temporary impact	4.4%	-11.9%
Traded per year	2.57%	1.27%
Cost to the investor	11.3 bp/yr	15.1 bp/yr

Table 3: *permanent and temporary impact corresponding to a reference price profile that incorporates momentum.*

The total cost to the investor according to these estimates is 26.4 bp per year, compared to 14.2 bp using the initial framework.

Arbitrage analysis

Another way to assess this cost is to compare the performance of a less naïve buying and selling strategy with one that simply minimises the tracking error by buying exactly at the close of the addition or deletion day.

We call this alternative method an arbitraging tracker strategy. For any addition, it amounts to buying a new constituent stock in the following way:

- Buy at the first possible closing once the addition is announced
- Sell the stock at closing of the announced addition day where trackers are supposed to buy
- Buy again 5 days after the marked addition day.

By doing so, the arbitraging tracker would potentially increase their tracking error, but this tracking error would be a beneficial one. A similar method (with reversed trades) is used for deletions from the index.

In order to properly simulate this, we collected data from S&P announcements from various sources, including Standard and Poor's press release archives, and used automated search and parsing techniques as well as manual fixes to obtain a comprehensive database of all announcement dates for all additions and deletions for the S&P 500 index since 1990.

Interestingly, the delays in trading days from announcement to actual addition or deletion differ markedly in actual data from the 5 day guideline. Here is a histogram of counts of delay values for all addition and deletions since the beginning of 1990.

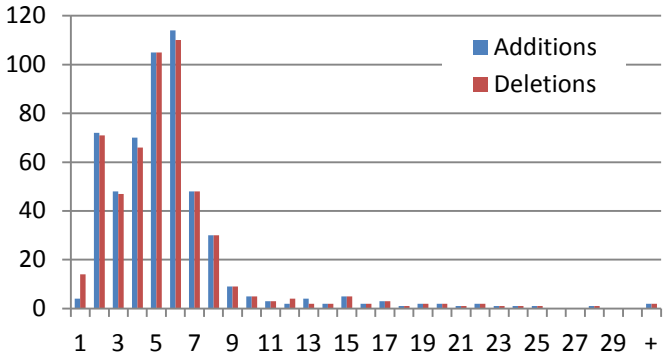

Figure 5: *counts for various delays in days between an announcement and an actual addition or deletion.*

The following graph shows the amount that can be gained by the arbitraging tracker w.r.t a standard tracker. We display another curve computed when assuming 1 day of hindsight. This other theoretical curve corresponds to an arbitraging tracker strategy where the manager buys or sells first at the close of the day of S&P's announcement, instead of the next

close. This is normally not possible since S&P are publishing their decision right *after* the closing.

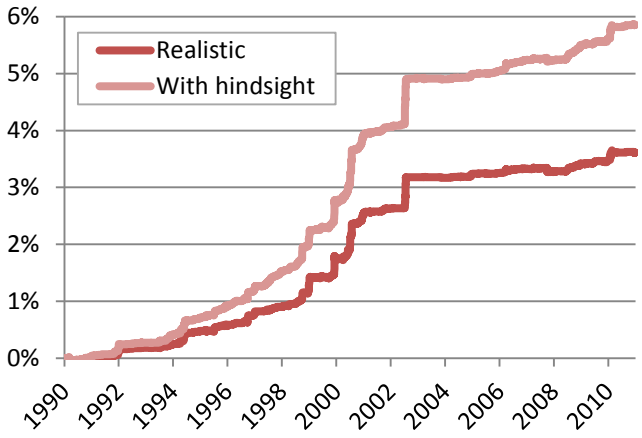

Figure 6: *cumulated gains for the arbitrage strategy overlay*

The realistic arbitraging tracker beats a naïve tracker by 17.2 basis points per year. The arbitraging tracker with 1 day of hindsight beats the naïve tracker by an additional 10.7 basis points, so a total of almost 28 basis points per year. This incidentally shows that the value of knowing S&P's decisions ahead of time is an additional 10 basis points per year.

The actual gain that can be made is between these extremes. A tracker can buy earlier than at the next closing (e.g. any time during the trading day), so 17.2 basis points figure is a lower bound.

4 Conclusion

We have presented two ways to measure the hidden cost that index tracking investors pay. We estimate it to be in the range of 14-26 bps and 17-27 bps according to the two different approaches. Therefore, a sensible estimate seems to be an impact between 17 to 26 bps.

It is interesting to note that an active manager could have a significantly higher turnover than an index tracker before incurring the same level of costs, assuming they are trading a less crowded strategy. More explicitly; a popular strategy such as index tracking, with a turnover of just 5-10%, incurs the same costs as an active strategy with a turnover of approximately 200% (if we assume the cost of selling or buying a stock is ~10 bps). Therefore an active manager can recycle the 20 basis points a year of saved tracking costs to pay for the transaction costs of a more active strategy which allows the manager to capture more opportunities at the same cost to the investor.

The focus of this study was just the short term effect 10 days before and after an index change, and we cannot rule out that the effect extends outside of this period. It is hard to quantify the effect on a longer timescale in particular because there exists an interplay with the underlying momentum of the stock price.

The effect that we document is well known within the quantitative investment community, where index arbitrage is a strategy that seeks to profit at the expense of index investors. Wherever large sums of money follow a prescribed set of investment rules we think it likely that other market participants will be motivated to profit by "trading ahead".

The deeper message is that we do not believe that there are an immutable set of rules that govern the financial markets. The rising popularity of tracking an index such as the S&P 500 makes it a worse investment because of a feedback effect. The Capital Asset Pricing Model would dictate that a market capitalisation weighted portfolio is an "optimal" strategy, but increasingly investors' attention is being drawn to new types of stock indices grounded in multi factor models of asset prices. It would seem possible that if very large sums of money are deployed to follow such strategies they too will in turn work less well.

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