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Price Effects Associated with Changes in the Standard & Poor's 500 Index Composition: The Removal and Replacement of Seven Non-U.S. Companies

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Abstract

This paper examines price effects associated with additions and deletions to the Standard and Poor's (SP) 500 index. The results are by and large consistent with those found in previous studies such as Beneish and Whaley (1996; 2002), Lynch and Mendenhall (1997), and Harris and Gurel (1986). That is, firms that are added to the Index experience positive price effects and firms that are deleted experience negative price effects. The price adjustments in this study exhibit short-run patterns that appear on the surface to be inconsistent with market efficiency. However, the existence of structural impediments in the price adjustments does not necessarily imply that abnormal returns are there for the picking. This paper concludes by discussing investor psychology and how it complicates the process of trying to create trading strategies to gain excess returns on the observed price effects.

> "It is usually agreed that casinos should, in the public interest, be inaccessible and expensive. And perhaps the same is true of Stock Exchanges."
>
> - John Maynard Keynes (1936, p.159)

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1. Introduction

This paper examines the price effects associated with additions and deletions to the Standard and Poor's (SP) 500 index. In particular this paper analyses the price effects related to the removal and replacement of seven non-U.S. companies in the SP 500 index on July 19, 2002. This research is interesting, because it provides a setting in which the companies being added or removed from the index are independent from the normal distorting factors.[1] As a result, it provides an opportunity to investigate the effects of being added or removed from the SP 500 index. It is not often that the market provides us with such unique experimental conditions.

The results of this research help to further our understanding of the price effects associated with companies that are added to or deleted from the SP 500 index. Previous studies such as Beneish and Whaley (1996; 2002), Lynch and Mendenhall (1997), and Harris and Gurel (1986) have shown that firms that are added to the index experience positive price effects and firms that are deleted experience negative price effects. Thus the price effects associated with additions and deletions are well known. However, there still remains ambiguity as to what exactly drives these price effects. The next section deals with some of the hypotheses that have been developed to help explain these price effects.

2. Explanations for Price Effects

A number of conflicting hypotheses have been developed to help explain the observed price effects associated with index composition changes. According to efficient

[1] This is explained further in Section 3 of this paper.

market theory, being added or deleted from the index would not affect the expected future returns of a company, so the price should not be affected. Market efficiency is a key issue in finance because if market efficiency does not hold, then the models that rely on it become questionable.[2] Using the semi-strong form of the *efficient market hypothesis*, and the fact that investors know that in the past index additions and deletions have been associated with high abnormal returns, on the announcement that a stock is going to be added or deleted from the index, the price should adjust to its expected change day price. Most index funds will not be adjusted until the change date but rational investors should not sell for less than the expected change day price. Any abnormal price movement from "one day after the change announcement" to the "change day" would be in violation of this hypothesis.

Temporary price effect:

According to the *price-pressure hypothesis* (Harris and Gurel, 1986), heavy index fund buying (selling) will cause the stock price to increase (decrease). Passive investors who accommodate this demand must be compensated for selling (buying) securities that they otherwise would not usually trade. These liquidity providers are compensated for their services when prices reverse to their full information levels, as index fund trading subsides (price reversion). The price effect is temporary under this hypothesis.

[2] For example, in the capital asset pricing model (CAPM), investors measure risk in terms of return standard deviation and hold correct beliefs about the covariance matrix and expected returns for all securities. Inefficient markets allow investors to hold incorrect beliefs.

Permanent Price effects:

The *downward sloping demand curve hypothesis* (DS hypothesis) was first examined by Shleifer (1989). This hypothesis is driven by the notion that securities are not close substitutes for each other.[3] Thus when a company is added to (removed from) the index, index fund buying (selling) will reduce (increase) the available float of shares and hence permanently increase (decrease) the price.[4] Alternatively, if the demand curve for securities is horizontal (not downward sloping), a change in the available float of shares would not affect the price permanently.

The *liquidity hypothesis* (Amihud and Mendelson, 1986) suggests that the price of a stock will be permanently affected if the stock's liquidity is permanently affected after entering or leaving the index. The increase (decrease) in liquidity (e.g., bid/ask spread and volume traded) is a result of being included in (excluded from) a widely followed index such as the SP 500. An increase (decrease) in the liquidity of a stock would cause the present value of all expected trading costs to fall (rise) and as a result the stock price would increase (decrease) accordingly.

The *information content hypothesis* is based on the concept that when SP adds a stock to the 500 index it conveys positive information about the stock. Inclusion will affect the level of scrutiny and analyst coverage of the stock. This may be used as a marketing tool, a "product attribute" which is unrelated to other characteristics of the

[3] Hence it is also known as the *imperfect substitutes hypothesis*.

[4] The supply of stock available for trading in the non-index marketplace (as index fund managers buy and hold).

firm. This idea can be seen in a study by Bos (2000) in which he observed that, of the stocks being added to the SP 500, stocks that were not previously in an index (the SP MidCap 400 or the SP SmallCap 600) experienced greater price increases than those that were already in an SP index. In opposition to the information content hypothesis, the *selection criteria hypothesis* states that evidence of abnormal returns are not robust, since the stock selection process followed by the index committee uses historical returns. Therefore any anticipated stock price performance does not influence the selection process.

3. The SP 500 Index

The SP 500 is "the most-widely benchmarked index in the world" (Dash, 2002). It focuses on the large cap sector of the market and is designed to reflect the United States (U.S.) equity market; as a result it also represents the U.S. market. SP has an index committee, which meets on a regular basis to "ensure that the SP 500 remains a leading indicator of U.S. equities" (SP, 2003). In doing this the index committee must make changes to the index composition from time to time. There are three main reasons for making changes, which are as follows:

1) Bankruptcy (firm files for Chapter 11);
2) Mergers, acquisitions or significant restructuring such that the company no longer meets the inclusion requirements;
3) The company in question is no longer representative.

The first two reasons are self-evident: if a company ceases to exist (e.g., it goes bankrupt, is merged, acquired or changes significantly) then it must be replaced. In relation to the third reason, Beneish and Whaley (2002) noted that in 1996, SP began to "actively replace firms that it deemed to no longer represent the U.S. market in general or not represented the industry within which they operated in particular." This makes sense, as the companies which represent the market will change over time and accordingly one would expect the index to be adjusted for this. This can also be thought of as the need to make room for up and coming companies.

The removal and replacement of the seven non-U.S. companies examined in this study do not fall into any of the categories listed above. SP's reason was simply that the seven companies did not support the role of the SP 500 as a measure of the U.S. equity market. They also violated the addition criteria by not being U.S. companies, thus meeting the deletion criteria of companies that substantially violate one or more of the addition criteria. The non-U.S. companies removed were added to the index at various points in time with the latest being Barrick Gold in 1993 and the earliest Alcan Aluminum in 1935.[5]

In an email, David Blitzer the managing director and chairman of the index committee explained: "From about 1994 on, SP stated that it would not add any more non-U.S. companies to the SP 500." In regards to removing the non-U.S. companies, David Blitzer wrote, "Our concern, often stated to the press, was that dropping the

[5] The majority of the seven firms removed from the index were added to the index more than 24 years ago. When these firms were added to the index it was seen as a broad-base measure of the U.S. equities market (Blitzer, 2002).

companies would cause turnover in the index and might be disruptive to the overall market." Given that turnover in the index was historically low for the first half of 2002 and at the same time there was an "unusual number of large companies eligible for inclusion in the SP 500" (Blitzer 2002, p.6), SP decided to take advantage of the circumstances and make the changes on July 19, 2002.

The companies that are examined in this paper include a surprise effect. Unlike normal changes to the index composition as described above, SP could control the timing of these particular changes. It would also be hard to predict, unless there was an information leak. For example with a merger, SP cannot control the timing of this event; moreover, it may be predicted in advance.

It is also worth noting that prior to October 1989, if SP needed to make a change to the index they would announce and implement the change on the same day, after trading had closed. In October 1989, SP changed this process such that there is (when possible), approximately one week between the announcement day and the change day.[6]

4. Index Funds

Over recent years, investors have come to realise that active investment fund managers cannot continuously beat the market.[7] Given this, investors have come to

[6] This change was made after a recommendation from the U.S. Securities and Exchange Commission to do so, in the hope of reducing the abnormal price movements associated with index composition changes.

[7] Active investment fund managers are those who attempt to earn superior returns through stock selection and market timing.

realise that their best option is to, at least, continuously earn the same as the market.[8] This line of thought has lead to an overwhelming increase in the demand for index funds. Index funds hold a considerable proportion of total market capitalization of the index; the SP 500 has nearly one trillion dollars indexed to it (Dash, 2002).[9] Thus it is no surprise that changes to the index's composition are accompanied by price effects on the stocks added or removed. When SP makes a change to the SP 500, index fund managers adjust their portfolios accordingly and do so in a manner that will minimise their tracking error. Tracking error is the measure by which most index fund managers are judged. It is calculated by subtracting the performance of a given index fund from the SP 500.

The impact of index funds on the results of this study are interesting, as index fund managers will only want to adjust their portfolios on the change date (CD), in order to minimise tracking error. This provides a potential window of opportunity for speculators. The announcement of the changes was made after the market had closed on the announcement date (AD). On the opening of trade on the day after the announcement date (AD+1), Wednesday 10 July 2002, speculators can buy (short sell) the stocks that are going to be added (deleted) in anticipation that the prices will increase (decrease); due to buying (selling) pressure from index fund managers on or before the CD.[10]

[8] This concept is driven by the Sharpe (1964) and Lintner (1965) capital asset pricing model, in which the optimal risky portfolio is the market portfolio.

[9] The Vanguard Group alone (one of the biggest SP 500 index fund providers), as of the 30 September, 2003 had $88.9 billion worth of assets indexed to the SP 500.

[10] This is also know as the "SP game" (Beneish and Whaley, 1996)

5. Data and Methodology

The Sample:

The data for this study were taken from the Centre for Research in Security Prices data base (CRSP). The companies added and removed from the index on July 19, 2002 and their corresponding market capitalizations, are shown in Table 1 below.

Table 1: Changes In The SP 500 Composition Announced On July 9, 2002 (Effective as at the close of the market on July 19, 2002)

Deletions	Market Cap ($B)	Additions	Market Cap ($B)
Royal Dutch Petroleum(RD)	110.11	United Parcel Service (UPS)	71.18
Unilever N.V. (UN)	34.85	Ebay Inc (EBAY)	37.78
Alcan Inc (AL)	12.21	Goldman Sachs Group (GS)	33.92
Barrick Gold Corp (ABX)	9.13	Prudential Financial (PRU)	16.76
Nortel Networks (NT)	5.25	Electronic Arts (ERTS)	9.31
Placer Dome Inc (PDG)	4.64	Principal Financial Group (PFG)	9.17
Inco Ltd (N)	3.77	SunGard Data Systems (SDS)	6.40
Total	**179.95**	**Total**	**184.51**

The market capitalization figures (Table 1) are of particular interest, as they are large in comparison to the usual market capitalizations figures of additions and removals. These unusually large market capitalization figures are related to the unusual reasoning of these seven removals and additions as described in section 3.

Methodology Used to Detect Abnormal Returns:

Two different methods are used to analyse the results for both additions and deletions. In the first set of results an event study methodology is used. In the second set of results matching portfolio methodology is used. Both of these methods are employed for the same purpose: to detect abnormal returns. The event study software "Eventus ®"

is used to draw the data from the CRSP (Center for Research in Security Prices) database, conduct the event studies and to calculate the matched portfolio results.

The two event dates of interest, for both of the methods used, are: the announcement date (AD) Tuesday July 9, 2002; and the change date (CD) Friday July 19, 2002. The announcement of the changes was made after the market had closed on the announcement date (AD), thus the effects of the changes are shown on the day after the announcement date (AD + 1). The changes were made effective as at the close of the market on the change date (CD). As with the AD, the effects of the changes are shown on the day after (CD + 1).

Event study methodology:

This section draws heavily on the Eventus® User's Guide (2001). Event study methodology is used to assess the effects of removal from, or addition to, the index. Event studies measure security price changes in response to events. This method was employed due to its common use within past studies in this area of research. In this event study the following market model is used as a benchmark:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt}$$

where,

R_{jt} = the rate of return of the common stock of the j^{th} firm on day t;

R_{mt} = the rate of return of the SP 500 index (market index) on day t;

ε_{jt} = a random variable, that must have an expected value of zero and is assumed to be uncorrelated with R_{mt}, uncorrelated with $R_{kt,k\neq j}$, not autocorrelated, and homoscedastic;

β_j = a parameter that measures the sensitivity of R_{jt} to the SP 500 index;

α_j = a constant.

Given the above, an *estimation period* of 510 trading days (2 years), ending 35 days before the first event date (AD), is used to find the ordinary least squares estimates of the market model parameter coefficients $\hat{\alpha}_j$ and $\hat{\beta}_j$. Thus the *abnormal return* for the common stock of the j^{th} firm on day t, is defined as follows:

$$A_{jt} = R_{jt} - (\hat{\alpha}_j + \hat{\beta}_j R_{mt})$$

The *average abnormal return* AAR_t is the sample mean:

$$AAR_t = \frac{\sum_{j=1}^{N} A_{jt}}{N}$$

And over an interval of two or more trading days beginning with day T_1, and ending with T_2, the *cumulative average abnormal return* (or *mean cumulative abnormal return*) is:

$$CAAR_{T_1,T_2} = \frac{1}{N}\sum_{j=1}^{N}\sum_{t=T_1}^{T_2} A_{jt}$$

Refer to Appendix 1 for details of test statistic calculations used in this event study methodology.

Matching portfolio methodology:

Matching portfolio methodology is used as an extension to the above event study methodology. The benefit of using the matching portfolio methodology is that it should in theory provide a better benchmark against which to make comparisons: it makes an adjustment for the industry-specific effects at the time of the event. The matching portfolios (one for the additions and one for the deletions) for this study are constructed by a process of elimination, starting with the top companies (which are not included in the SP 500 index) within the relevant sectors. Of these possible matches, the ones with the lowest betas over the estimation period are used; when long the stock in question and short the corresponding match. The final matches are shown in Appendix 2, for both the additions and the deletions. The betas support these matches, as they are very close to zero over the estimation period.[11] Given that these matches sufficiently represent the firms in question, to obtain the price effect of being added to (deleted from) the index, the raw difference between the additions (deletions) portfolio and the matched additions (deletions) portfolio is taken. This is represented by the following equation:

$$A_{jt} = R_{jt} - R_{jt,match}$$

where,

R_{jt} = the rate of return of the common stock of the j^{th} firm on day t;

$R_{jt,match}$ = the rate of return on the corresponding matched common stock of the j^{th} firm on day t;

Hence A_{jt} will reveal the existence of any abnormal returns. The *average abnormal return* and *cumulative average abnormal return* are calculated in the same

[11] This method, unlike the event study method, does not actually use the estimation period in determining abnormal returns.

manner as in the event study methodology. Refer to Appendix 1 for details of the test statistic calculations used in this matching portfolio method.

Zero Cost Portfolio Methodology:

A zero cost portfolio is formed to test the profitability of a simple trading strategy. The trading strategy, created to take advantage of the expected price movements, comprises two parts. The first part comprises going short on the opening of trade, 10 July 2002, $10,000 (U.S.) in each of seven stocks which are to be removed from the index. The second part comprises using these funds ($70,000) to go long $10,000 (U.S.) in each of seven stocks which are to be added to the same index. This creates a zero cost portfolio (no funds are used to create this portfolio). Note transaction costs have been ignored. This portfolio is created using the opening prices on the day after the announcement (AD+1) and has a value of zero dollars on its creation. If the stock prices move in their expected directions, then the zero cost portfolio will gain in value.

7. Results

In Appendix 3 the *abnormal returns* for the additions are presented in Table 4 using the event study methodology, and in Table 5 using the matching portfolio methodology. Tables 6 and 7 (Appendix 3) present the same results for the deletions, using the two aforesaid methodologies. Table 8 (Appendix 3) displays the results of the zero cost portfolio. Figure 1 through Figure 4 as displayed in Appendix 4 graphically display the *mean cumulative abnormal returns* over the period from 10 days before the announcement day (AD-10) through 10 days after the change day (CD+10, or AD+20),

for the additions and deletions using both methods. Figure 5 graphically displays the daily values of the zero cost portfolio from announcement day (AD) through 20 days after the change date (CD+20).

In itself, the fact that significant abnormal returns are shown provides evidence against efficient market theory. The results also suggest that there is no information leaked prior to the announcement day; this is evidenced by the lack of significant abnormal returns in the expected directions during the pre-Announcement Day periods. Figure 1 through Figure 4 support the hypotheses in the sense that all of the hypotheses predict that the price effects should be roughly symmetric for additions and deletions.

The price effects on the day after the announcement day (AD+1), for all of the results (additions and deletions using both methods), are statistically significant at the 0.1% level. These effects are in agreement with all of the given hypotheses (e.g., semi-strong form efficient market, price-pressure, downward sloping demand curve, liquidity, and information content). For example the *mean abnormal return* on AD+1, using the event study (matching portfolio) methodology for the additions is 5.92% (2.96%), and -5.04% (-2.48%) for the deletions, all of which are significant at the 0.1% level.

The results also reveal the existence of significant abnormal returns between the day after the announcement day (AD+1) and the day before the change day (CD-1). For all of the results, the cumulative abnormal returns over this period are significantly positive for additions, and significantly negative for deletions. For example looking at

the event study (matching portfolio) methodology results, over this period the additions have a mean cumulative abnormal return of 14.07% (5.43%) and the deletions -17.19% (-5.36%), significant at the 0.1% (1%) and 0.1% (1%) level respectively. These results are consistent with the price-pressure and downward sloping demand curve hypotheses but inconsistent with the semi-strong form efficient market hypothesis. These results also suggest that the liquidity and information content hypotheses, by themselves, cannot be used to fully explain the observed price effects. This is because, under these hypotheses, the price effects should not be observed over an extended period (AD+1, CD-1), but rather on a single day such as AD+1.

To further investigate the presence of the price-pressure hypothesis, the post-change day periods are examined for abnormal returns (price reversion). According to the price-pressure hypothesis the abnormal returns should be negative for the additions and positive for the deletions over the post-change day periods. Unlike past studies (e.g., see Lynch and Mendenhall, 1997) these results do not provide strong support for the price-pressure hypothesis. Using the event study methodology, for the period CD through CD+10 (CD through CD+20), the additions do provide support for the price pressure hypothesis with an abnormal return of -7.36% (-9.25%) significant at the 1% (5%) level. In opposition to the above, using the matching portfolio methodology for the post-change day periods, CD through CD+10 and CD through CD+20, the additions do not support the price pressure hypothesis, with positive abnormal returns of 3.04% and 4.78% significant at the 5% and 1% levels, respectively. For the deletions, only the event study methodology over the post-change day period CD through CD+10 is shown to be

significant at the 10% level. However, the corresponding abnormal returns over this period (CD through CD+10) for the deletions is -6.10% significant at the 10% level, once again in opposition to the price pressure hypothesis. The latter results challenge the price-pressure hypothesis as a reliable explanation of the abnormal returns observed.

An interesting observation from the deletions results, which conflicts with the price pressure hypothesis, is that there seems to be a momentum effect. This is demonstrated by the significant negative abnormal return for the deletions over the period CD through CD+10 using the event study methodology (as described above). Furthermore the additions showed significant positive abnormal returns over both post – change day periods (also as described above). This finding is surprising, as one would expect the price pressure hypothesis to be more evident than normal in this study, due to the nature of the removals.[12] The downwards sloping demand curve hypothesis cannot explain the observed post-change day momentum effect, as index funds should have finished all their rebalancing on CD. Therefore no changes to the available float of shares should occur after CD and, as implied by the downward sloping demand curve hypothesis, there should be no price changes. The same sort of logic can be used to rule out the liquidity and information content hypotheses as an explanation. Perhaps this observed momentum effect is an example of market inefficiency.

[12] To illustrate this point, consider instead what could be concluded if the companies had been removed for one of the other reasons as listed in Section 3. For example no longer being representative (due to poor performance). Then one could claim that the observed momentum effect was just a follow-through effect from companies performing poorly before they had been removed.

The results from examining the permanent price effects associated with additions and deletions are relatively consistent with the corresponding permanent price effect hypotheses (downward sloping demand curve, liquidity, and information content). The abnormal return over the period AD through CD+10 is positive but insignificant for the additions, when using the event study methodology. Using the matching portfolio methodology over the same period, the abnormal return is 7.55% for the additions, significant at the 0.01% level. For the deletions the abnormal return over this period, using the event study methodology (matching portfolio methodology), is -21.52% (-4.27) both significant at the 0.01% level.

Over the long-run, the addition results predominantly show significant evidence of price reversion, however the deletion results do not. The existence of reversion is inconsistent with the permanent price effect hypotheses (downward sloping demand curve, liquidity, and information content). Over the periods CD through CD+30 and CD through CD+122, the abnormal return for the additions, using the event study methodology, is –11.23% and -21.86% both significant at the 5% level. Using the matching portfolio methodology over the same periods the abnormal return for the additions are 5.69% and 5.10% significant at the 5% and 10% levels respectively. For the deletions, only the abnormal returns over the period CD through CD+30 are significant (3.90% significant at the 5% level). Thus in dealing with both the short-run (post-change day periods) and long-run price reversions (as described above), the results suggest that the additions experienced price reversion in both the short- and long-run using the event study methodology. However, there is no price reversion when using the

matching portfolio methodology. The deletions experienced no significant reversion in the short-run or the long-run.

The zero cost portfolio only showed one negative value over the period AD+1 (opening) through CD+20. The one negative value of -$777.03 (U.S.) was at the end of the first day AD+1 (close). The rest of the values were large and positive, with the highest value of $16,338.85 (U.S.) being reached on the 29th day after the zero cost portfolio had been created (AD+29 or CD+19). In hindsight, this provides strong evidence that by using this simple trading strategy, one may have been able to make large abnormal returns from these predicted price movements.

8. Conclusion

This paper examines the price effects related to the removal and replacement of seven non-U.S. companies in the SP 500 index on July 19, 2002. This research is interesting because it provides a setting in which the companies being added or removed from the index are independent from the normal distorting factors.

As in past studies, the results illustrate that firms which are added to the index experience positive price effects, and firms that are deleted experience negative price effects. The results show that firms added to the index on the 19 June, 2002, experienced significant positive mean cumulative abnormal returns, over the 10 days (8 business days) from the day after the announcement day (AD+1) through to the day before the change day (CD-1), of 14.07% (5.43%) using the event study (matching portfolio)

methodology. The deletions over the same period experienced significant negative mean cumulative abnormal returns of -17.19% (-5.36%) using the respective methods. These results are consistent with the price-pressure and downward sloping demand curve hypotheses, but inconsistent with the semi-strong form efficient market hypothesis.

The permanent price effects associated with additions and deletions are relatively consistent with the corresponding permanent price effect hypotheses (e.g., downward sloping demand curve, liquidity, and information content). The abnormal return over the period AD through CD+10 is positive but insignificant for the additions, when using the event study methodology. Using the matching portfolio methodology over the same period, the abnormal return is 7.55% for the additions, significant at the 0.01% level. For the deletions the abnormal return over this period, using the event study methodology (matching portfolio methodology) is -21.52% (-4.27%), both significant at the 0.01% level.

A momentum effect was discovered, which none of the given hypotheses could explain. Unlike past studies, the results did not show significant price reversal. This suggests that the price pressure hypothesis, as a justification for the abnormal price effects, is less useful than previously thought. The results of this research have helped to further our understanding of the price effects associated with companies that are added to or deleted from the SP 500 index. However, there still remains ambiguity as to what exactly drives these price effects.

It is highly probable that these price effects are associated with abnormal trading volumes; however, they are not examined in this paper. Future research on these abnormal trading volumes may further the understanding of the observed price effects. It would also be interesting to examine the option prices surrounding the event days. The option market could in fact adjust to this new information more efficiently. However, the data is not readily available.

The price adjustments in this study exhibit short-run patterns that appear on the surface to be inconsistent with market efficiency. However the existence of structural impediments in the price adjustments does not necessarily imply that abnormal returns are there for the picking. A model specification problem exists, due to the fact that the model may not be fully specified. There may be other elements that have not been captured, such as a risk element. There are other important issues that also need to be taken into consideration such as the tax implications and short-selling restrictions.

Investor psychology also complicates the process of trying to create trading strategies to gain excess returns on the observed price effects. This is driven by the fact that this information is public knowledge. Therefore the expectations of other investors and their corresponding trading strategies should be considered when determining an optimal trading strategy. The following extract describes Keynes' famous beauty contest metaphor, which he used to illustrate some of the problems an investor faces in relation to the above issue:

> It is not a case of choosing those which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth and higher degrees.
>
> - Keynes (1936, p.156)

Keynes also mentions the beauty contest metaphor in the *Treatise on Probability* (1921), which in this instance was used to illustrate the impossibility of calculating an appropriate prior (logical) probability in situations where expectations of other people's expectations are involved. The same implication applies to the trading strategies, which one may want to use in trying to earn excess returns on the publicized price effects associated with additions and removals from the SP 500.

Appendix 1

Significance Tests (This section draws heavily on the Eventus® User's Guide, 2001)

Event Study Methodology

In this event study the Patell (1976) test is used to test the significance of the abnormal returns. This test has been used in many published studies. The calculations of this test statistic are as follows.

Under the null hypothesis, each A_{jt} has a mean zero and a variance $\sigma^2_{A_{jt}}$. The maximum likelihood estimate of the variance is:

$$s^2_{A_{jt}} = s^2_{A_j}\left[1 + \frac{1}{D_j} + \frac{(R_{mt} - \overline{R}_m)^2}{\sum_{k=T_{D_b}}^{T_{D_e}} (R_{mk} - \overline{R}_m)^2}\right]$$

where

$$s^2_{A_j} = \frac{\sum_{k=T_{D_b}}^{T_{D_e}} A^2_{jk}}{D_j - 2}$$

and

R_{mt} = the rate of return of the SP 500 index (market index) on day t;

$\overline{R}_m$ = the mean market return over the estimation period;

D_j = the number of non - missing trading day returns in the D - day interval T_{D_b} through T_{D_e} used to estimate the parameters for firm j.

The standardized abnormal return is defined as:

$$SAR_{jt} = \frac{A_{jt}}{s_{A_{jt}}}$$

Under the null hypothesis, each SAR_{jt} follows a Student's t distribution with $D_j - 2$ degrees of freedom. Summing SAR_{jt} across the sample, we obtain:

$$TSAR_t = \sum_{j=1}^{N} SAR_{jt}$$

The expected value of $TSAR_t$ is zero and the variance is:

$$Q_t = \sum_{j=1}^{N} \frac{D_j - 2}{D_j - 4}$$

The test statistic for the null hypothesis that $CAAR_{T_1,T_2} = 0$ is:

$$Z_{T_1,T_2} = \frac{1}{\sqrt{N}} \sum_{j=1}^{N} Z^j_{T_1,T_2}$$

where

$$Z^j_{T_1,T_2} = \frac{1}{\sqrt{Q^j_{T_1,T_2}}} \sum_{t=T_1}^{T_2} SAR_{jt}$$

and

$$Q^j_{T_1,T_2} = (T_2 - T_1 + 1)\frac{D_j - 2}{D_j - 4}$$

Under cross-sectional independence of the $Z^j_{T_1,T_2}$ and other conditions (Patell, 1976), Z_{T_1,T_2} follows the standard normal distribution under the null hypothesis.

Matching Portfolio Methodology

The cross-sectional standard deviation method (or paired difference test) is used to determine the test statistics when using the matching portfolio methodology. The portfolio test statistic for day t in event time is:

$$t = \frac{AAR_t}{\hat{\sigma}_{AAR_t} \Big/ \sqrt{N}}$$

where

$$\hat{\sigma}^2_{AAR_t} = \frac{1}{N-1} \sum_{i=1}^{N} \left(A_{it} - \frac{1}{N} \sum_{j=1}^{N} A_{jt} \right)^2$$

The estimated variance of $CAAR_{T_1,T_2}$ is:

$$\hat{\sigma}^2_{CAAR_{T_1,T_2}} = \frac{1}{N-1} \sum_{i=1}^{N} \left(CAR_{i,T_1,T_2} - \frac{1}{N} \sum_{j=1}^{N} CAR_{j,T_1,T_2} \right)^2$$

The test statistic for $CAAR_{T_1,T_2}$ is:

$$t_{CAAR} = \frac{CAAR_{T_1,T_2}}{\hat{\sigma}_{CAAR_{T_1,T_2}} \Big/ \sqrt{N}}$$

For further details please refer to Brown and Warner (1985).

Appendix 2

The two tables below (**Table 2** and **Table 3**) show the companies added to and deleted from the index and their corresponding matches. The seven companies listed on the left hand side of **Table 2 (Table 3)** represent the composition of the additions (deletions) portfolio. Correspondingly, the seven companies listed on the right hand side of **Table 2 (Table 3)** represent the composition of the matched additions (deletions) portfolio.

Table 2: Additions and their respective company matches

Additions	Matches
United Parcel Service (UPS)	British Airways (BAB)
Ebay Inc (EBAY)	Amazon.com Inc (AMZN)
Goldman Sachs Group (GS)	ING Groep NV (ING)
Principal Financial Group (PFG)	Manulife Finl (MFC)
Electronic Arts (ERTS)	Pacific Century Cyberworks Ltd (PCW)
Prudential Financial (PRU)	Nomura Holdings Inc (NMR)
SunGard Data Systems (SDS)	DST Systems, Inc (DST)

Table 3: Deletions and their respective company matches

Deletions	Matches
Royal Dutch Petroleum (RD)	BP PLC (BP)
Unilever N.V. (UN)	Kraft Foods Inc (KFT)
Alcan Inc (AL)	Cameco Corporation (CCJ)
Barrick Gold Corp (ABX)	Anglogold Ltd (AU)
Nortel Networks (NT)	Alcatel (ALA)
Placer Dome Inc (PDG)	Anglogold Ltd (AU)
Inco Ltd (N)	Noranda Inc. (NRD)

Note: Anglogold Ltd had to be used twice as a match due to the lack of adequate matches in the relevant industry. This is not expected to alter the reliability or accuracy of the results.

Appendix 3

Table 4: Abnormal Returns for the Additions Portfolio - Event Study Methodology.

Interval		Mean Abnormal Return / Mean Cumulative Abnormal Return[a]	Test Statistic[b] t
Begins	**Ends**		
Pre-Announcement Day			
AD-30	AD	2.55	0.133
AD-10	AD	-2.42	-1.174
AD	AD (July 9)	0.10	-0.732
Announcement Day Through Change Day			
AD+1	AD+1 (July 10)	5.92	6.563 α
AD+1	CD-1	14.07	5.068 α
AD+1	CD	12.91	3.974 α
CD	CD (July 19)	-1.16	-2.636 β
Post-Change Day			
CD	CD+10	-7.36	-2.671 β
CD	CD+20	-9.25	-1.965 δ
Permanent Effect			
AD	CD+10	6.81	1.225
Long-run			
CD	CD+30	-11.23	-2.162 δ
CD	CD+122	-21.86	-2.173 δ

[a] When the interval extends over two or more trading days the *mean cumulative abnormal return* is displayed, other wise the *mean abnormal return* is displayed.

[b] The symbols δ, β and α denote statistical significants at the 5%, 1% and 0.1% levels, respectively, using a 1-tail test.

Table 5: Abnormal Returns for the Additions Portfolio - Matching Portfolio Methodology.

Interval		Mean Abnormal Return / Mean Cumulative Abnormal Return[a]	Test Statistic[b] t
Begins	**Ends**		
Pre-Announcement Day			
AD-30	AD	2.36	0.865
AD-10	AD	-2.33	-1.231
AD	AD (July 9)	-0.92	-1.528 †
Announcement Day Through Change Day			
AD+1	AD+1 (July 10)	2.96	5.311 α
AD+1	CD-1	5.43	2.730 β
AD+1	CD	5.16	2.371 β
CD	CD (July 19)	-0.28	-0.527
Post-Change Day			
CD	CD+10	3.04	2.109 δ
CD	CD+20	4.78	2.338 β
Permanent Effect			
AD	CD+10	7.55	4.390 α
Long-run			
CD	CD+30	5.69	2.191 δ
CD	CD+122	5.10	1.506 †

[a] When the interval extends over two or more trading days the *mean cumulative abnormal return* is displayed, other wise the *mean abnormal return* is displayed.

[b] The symbols †, δ, β and α denote statistical significants at the 10%, 5%, 1% and 0.1% levels, respectively, using a 1-tail test.

Table 6: Abnormal Returns for the Deletions Portfolio - Event Study Methodology.

Interval		Mean Abnormal Return / Mean Cumulative Abnormal Return[a]	Test Statistic[b] t
Begins	**Ends**		
Pre-Announcement Day			
AD-30	AD	-6.46	-1.052
AD-10	AD	-0.40	0.390
AD	AD (July 9)	1.77	1.627 †
Announcement Day Through Change Day			
AD+1	AD+1 (July 10)	-5.04	-6.367 α
AD+1	CD-1	-17.19	-7.698 α
AD+1	CD	-20.17	-8.497 α
CD	CD (July 19)	-2.98	-3.778 α
Post-Change Day			
CD	CD+10	-6.10	-1.459 †
CD	CD+20	-5.23	-0.667
Permanent Effect			
AD	CD+10	-21.52	-5.740 α
Long-run			
CD	CD+30	1.40	0.166
CD	CD+122	18.03	1.265

[a] When the interval extends over two or more trading days the *mean cumulative abnormal return* is displayed, other wise the *mean abnormal return* is displayed.

[b] The symbols † and α denote statistical significants at the 10% and 0.1% levels, respectively, using a 1-tail test.

Table 7: Abnormal Returns for the Deletions Portfolio - Matching Portfolio Methodology.

Interval		Mean Abnormal Return / Mean Cumulative Abnormal Return[a]	Test Statistic[b] t
Begins	**Ends**		
Pre-Announcement Day			
AD-30	AD	1.14	0.612
AD-10	AD	1.38	0.825
AD	AD (July 9)	-0.33	-0.443
Announcement Day Through Change Day			
AD+1	AD+1 (July 10)	-2.48	-5.442 α
AD+1	CD-1	-5.36	-3.796 α
AD+1	CD	-4.32	-3.118 α
CD	CD (July 19)	1.03	2.956 β
Post-Change Day			
CD	CD+10	1.41	1.026
CD	CD+20	1.02	0.787
Permanent Effect			
AD	CD+10	-4.27	-3.234 α
Long-run			
CD	CD+30	3.90	1.666 δ
CD	CD+122	4.59	0.706

[a] When the interval extends over two or more trading days the *mean cumulative abnormal return* is displayed, other wise the *mean abnormal return* is displayed.

[b] The symbols †, δ, β and α denote statistical significants at the 10%, 5%, 1% and 0.1% levels, respectively, using a 1-tail test.

Table 8: Zero Cost Portfolio Value (as at the end of the day)

Day	Value ($)
Announcement Day Through Change Day	
AD+1 (Open)	0
AD+1 (Close)	-777.03
AD+2	349.83
AD+3	2,451.98
AD+6	4,328.29
AD+7	4,834.01
AD+8	5,633.39
AD+9	4,179.35
CD	6,481.58
Post-Change Day	
CD+1	7,919.20
CD+2	7,722.37
CD+30	14,675.59

Appendix 4

Figure 1: Mean Cumulative Abnormal Returns for the Additions (Event Study Methodology) over the period, AD-10 through AD+20 (or CD+10).

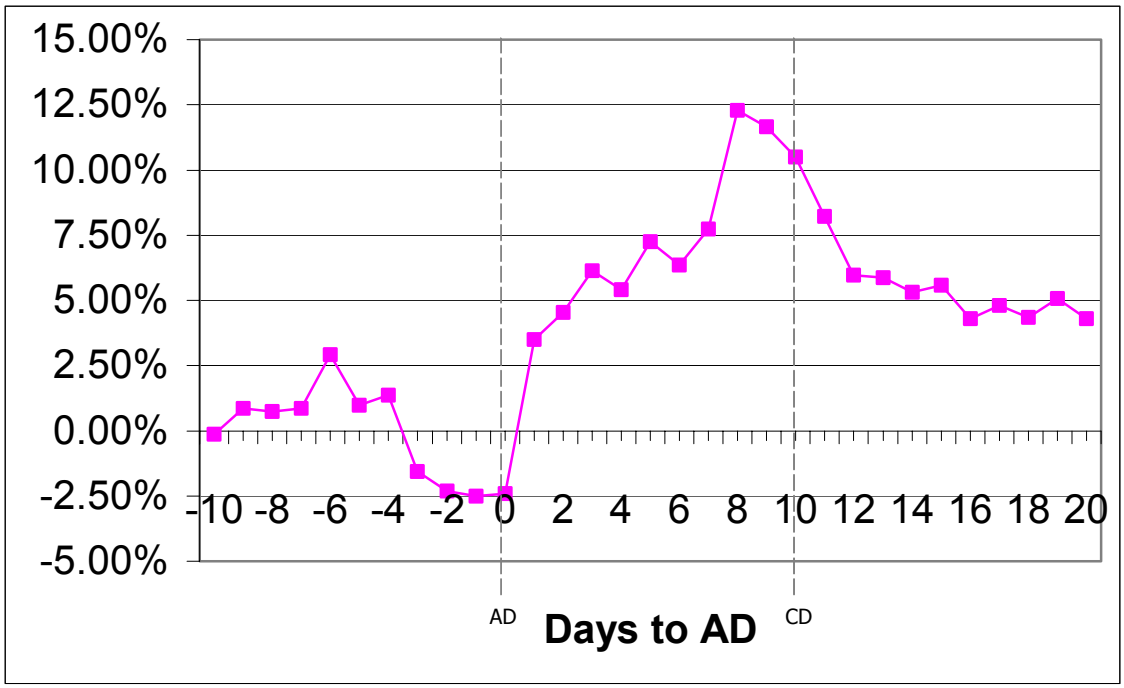


Figure 2: Mean Cumulative Abnormal Returns for the Additions (Matched Portfolio Methodology) over the period, AD-10 through AD+20 (or CD+10).

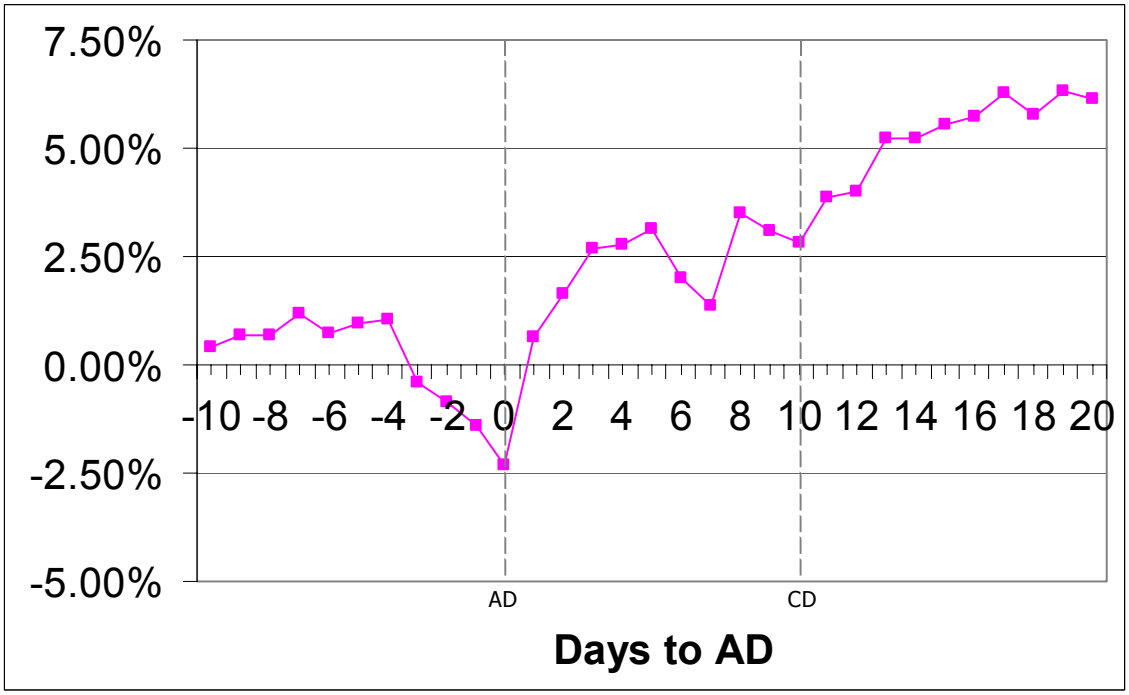


Figure 3: Mean Cumulative Abnormal Returns for the Deletions (Event Study Methodology) over the period, AD-10 through AD+20 (or CD+10).

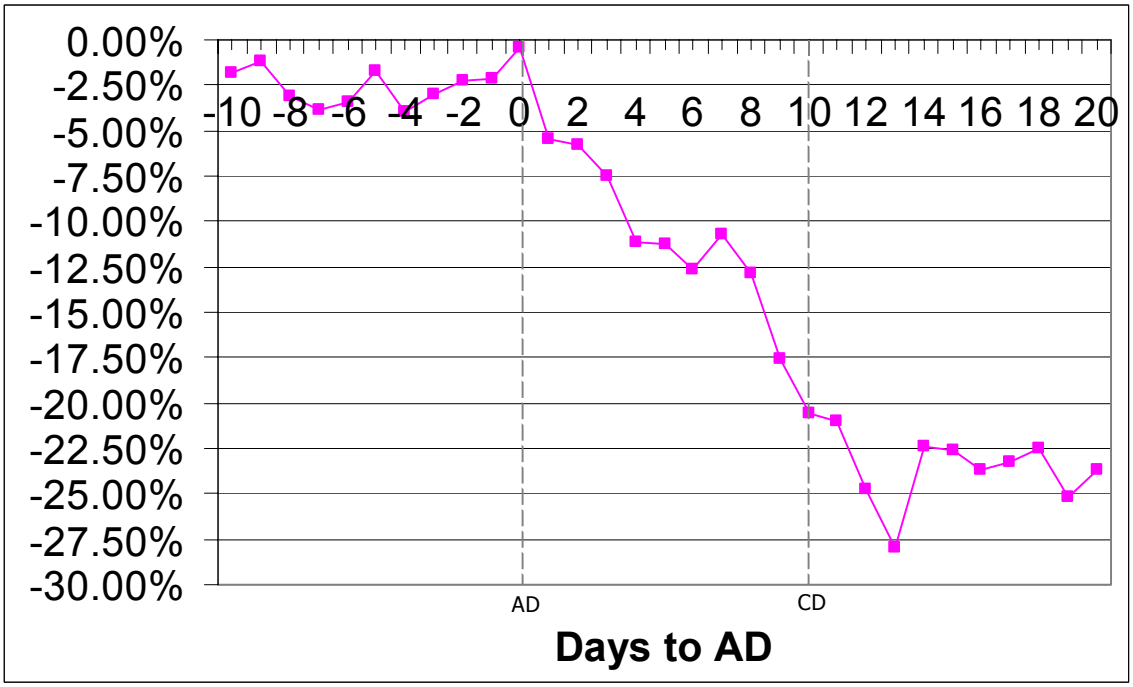


Figure 4: The Mean Cumulative Abnormal Returns for Deletions (Matched Portfolio Methodology), over the period, AD-10 through AD+20 (or CD+10).

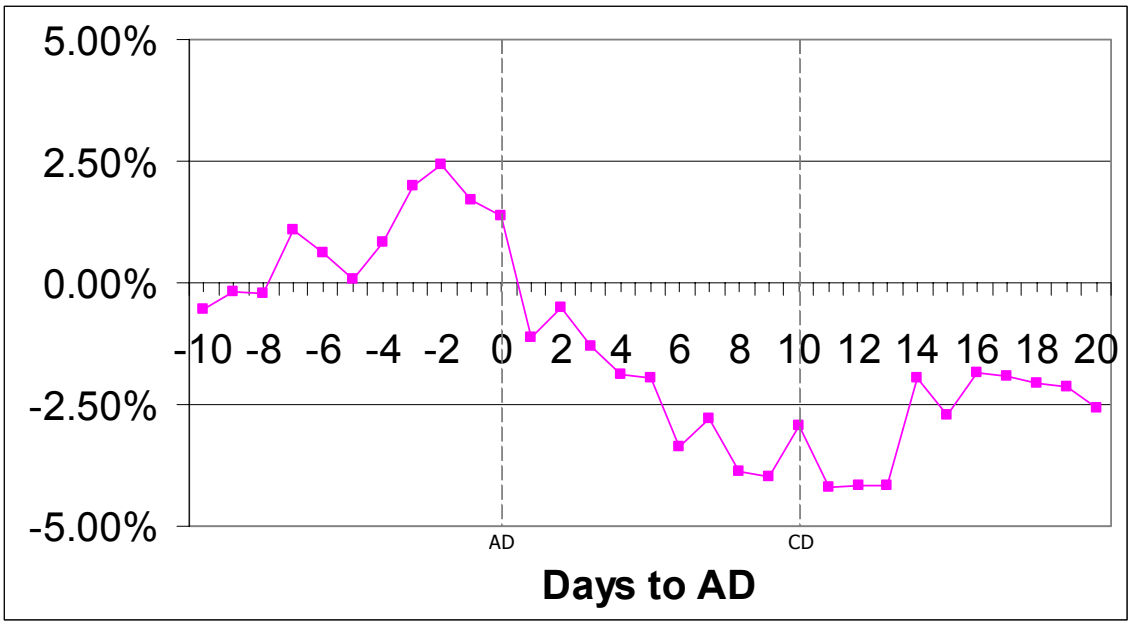
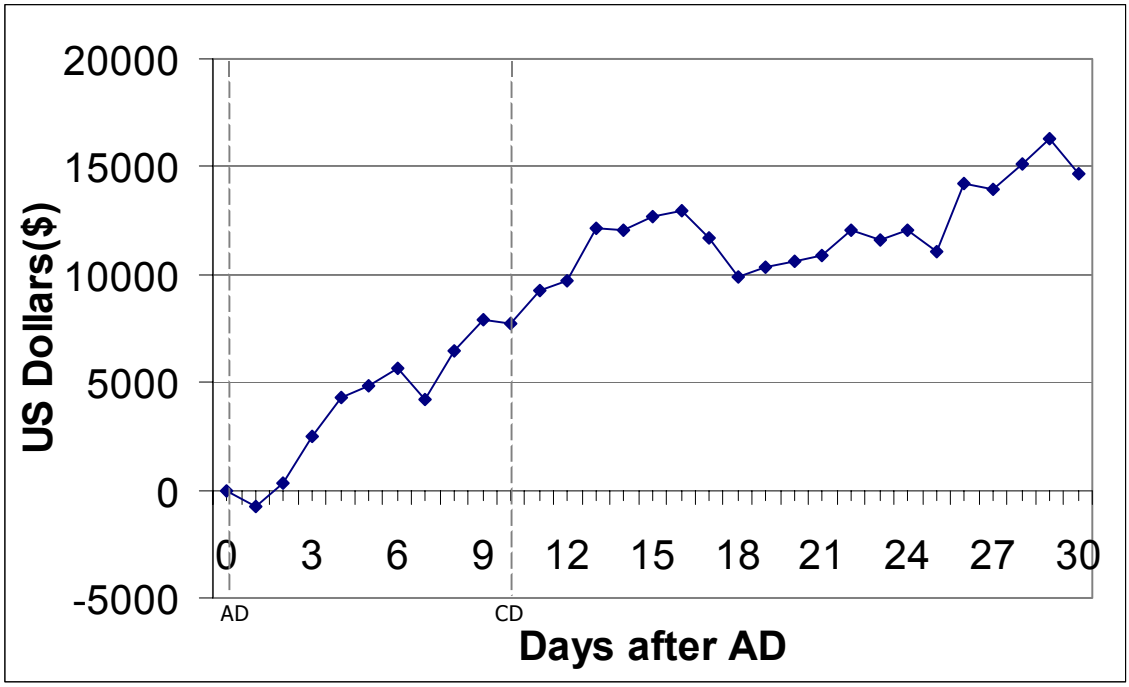


Figure 5: Value of the Zero Cost Portfolio, over the period, AD through AD+40 (or CD+30).



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