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The Price Response to S&P 500 Index Additions and Deletions: Evidence of Asymmetry and a New Explanation

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ABSTRACT

We study the price effects of changes to the S&P 500 index and document an asymmetric price response: There is a permanent increase in the price of added firms but no permanent decline for deleted firms. These results are at odds with extant explanations of the effects of index changes that imply a symmetric price response to additions and deletions. A possible explanation for asymmetric price effects arises from the changes in investor awareness. Results from our empirical tests support the thesis that changes in investor awareness contribute to the asymmetric price effects of S&P 500 index additions and deletions.

THE LONG-HELD ASSUMPTION that stocks have perfect substitutes, and the perfect elasticity of demand that follows from it, is central to modern finance theory. If securities have (almost) perfectly elastic demand, then any supply or demand shocks that are devoid of information should have no effect on the prevailing price. Early empirical research on whether price changes occur in the absence of new information focused on block trades, equity issues, and stock splits, but was unable to exclude information effects around these events.

Since there is no obvious reason to believe, ex ante, that index changes contain new information, they constitute a natural framework for testing whether stocks have almost perfectly elastic or horizontal demand curves. A stock's excess return around such changes could be consistent with a downward sloping demand curve. With the advent of indexed mutual funds in 1976, and the public announcement of S&P index changes in the same year, there is much evidence that such announcements are accompanied by an increase in price for firms added to the index.

If stocks have a short-term downward sloping demand curve, the price should be momentarily affected by a demand shock due to indexing, but that effect

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should dissipate once the excess demand is satisfied. Work by Harris and Gurel (1986), and Blouin, Raedy, and Shackelford (2000) is consistent with the price pressure hypothesis. If, on the other hand, stocks have a long-term downward sloping demand curve, the excess returns should be permanent. Shleifer (1986), Beneish and Whaley (1996), Lynch and Mendenhall (1997), Kaul, Mehrotra, and Morck (2000), Blume and Edelen (2001), and Wurgler and Zhuravskaya (2002) present evidence consistent with this hypothesis.

The excess return however is also consistent with an almost perfectly elastic demand curve if the observed change in stock price is due to (i) a change in expected future cash flows or (ii) a change in the discount rate applicable to that stock.

An increase in expected future cash flows could occur for at least three reasons: First, inclusion in the S&P 500 might convey positive information about the longevity and prospects of that firm, because of the certification hypothesis (Dhillon and Johnson (1991); and Jain (1987)). A second and third source of improvement in future cash flows is related to enhanced investor awareness. Greater interest in the firms included in the S&P 500 index could lead to the expectation of higher future cash flows, in that these firms may be forced to perform more efficiently and make more value-enhancing decisions if monitoring by investors and analysts becomes more effective (Denis, McConnell, Ovtchinnikov, et al. (2003)). Membership in the S&P 500 may also increase the ability of firms to attract new capital if financial institutions or investors are more willing to lend to firms in the index. The additional capital may enable the company to grow at a rate higher than the rate prior to inclusion in the index.

A decrease in required return could accompany an index addition for several reasons. First, there may be an improvement in liquidity due to higher trading volume (Hegde and McDermott (2003); and Chordia (2001)). Second, the greater interest in the S&P 500 firms may engender greater information production resulting in reduced information asymmetry, and consequent improvement in liquidity. A third explanation for a price response from a lowered required rate of return derives from increased awareness in Merton's (1987) model of market segmentation. In his model, if some investors know only of a proper subset of all stocks, and hold only the stocks they are aware of, those investors will be inadequately diversified and demand a premium—a shadow cost—for the nonsystematic risk they bear. If a stock's addition to the S&P 500 index alerts more investors to its existence and consequently increases its breadth of ownership, the required rate of return on that stock should fall due to a reduction in the shadow cost.

In this paper, consistent with prior work, we find a permanent price increase for firms added to the S&P 500 index. On the other hand, we find that firms deleted from the index do not experience a permanent negative price effect. Initially, the firms deleted from the index lose value, but that loss is recouped in the three months following the deletion. The absence of a permanent price effect for deletions is robust to different methods of computing excess returns.

A major characteristic of generally accepted explanations for the observed excess returns surrounding changes to the S&P 500 index is that they all imply

a positive price response to additions and a negative response to deletions. In other words, they require symmetric excess returns for additions and deletions. Our results reveal that additions to the index and deletions from the index do not have symmetric effects. This asymmetric price response to index additions and deletions is not totally consistent with the downward sloping demand curve, certification, and trading volume-related liquidity hypotheses.

The asymmetric response can be better explained if investor awareness is introduced as a possible factor. Investor awareness can increase following a stock's addition to the index, but awareness does not easily diminish when a stock is deleted from the index. In this paper, we document a rise in investor awareness for stocks added to the index, but find a much smaller decline for stocks deleted from the index. The rise in awareness is consistent with Denis et al. (2003), who find that intensified monitoring makes the added firm more efficient. Though they examine only additions, it is reasonable to suggest that scrutiny and efficiency do not decline by the same magnitude for deleted firms. A similar argument can be made that while added firms have improved access to capital, deleted firms do not necessarily experience a significant change in that access. An asymmetric price response stemming from a lower discount rate is consistent with Merton's (1987) model of market segmentation, and we find that abnormal returns around index changes are significantly related to changes in Merton's shadow cost.

This paper contributes to the literature in several ways. First, we study a large sample of index changes, including deletions, in three different regimes beginning in 1962. Most prior studies tend to ignore deletions because it is difficult to obtain a clean yet reasonable-sized sample.[1] Second, and most importantly, the study documents an asymmetric price response to index additions and index deletions. Finally, we are able to provide a partial explanation for price changes around index additions and deletions that is consistent with the asymmetric price response. The question of causality however remains unresolved. There exists the possibility of an endogenous relationship between returns and awareness, and possibly one where returns drive awareness, instead of changes in awareness being responsible for abnormal stock returns. Denis et al. (2003) also grapple with the issue without resolving it.

The rest of the paper is organized as follows: We describe the construction of our sample in Section I. Excess returns and abnormal volume turnover associated with changes to the index are documented in Section II, together with a reconciliation of results with other papers. We discuss hypotheses that purport to explain the excess returns following S&P 500 index changes in Section III. In Section IV, we introduce and test the implications of new hypotheses that are consistent with the asymmetric price responses of additions and deletions. Section V concludes.

[1] Prior studies that examine the impact of deletions include Goetzmann and Garry (1986) (7 deletions); Harris and Gurel (1986) (13 deletions); Lynch and Mendenhall (1997) (15 deletions); Dash (2002) (59 deletions); Beneish and Whaley (2002) (49 deletions); and Mase (2002) (66 deletions from the FTSE).

I. The Sample

To facilitate an understanding of our initial and final samples, we begin by describing the methodology followed by Standard and Poor's for making changes to the index.

A. Changes to and Membership in the S&P 500 Index

Changes to the 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.

While S&P 500 companies are generally large, such is not always the case. At the end of 2001, only 345 firms in the S&P 500 were in the top 500 firms by market cap. There are many large companies not in the S&P 500, such as USA Networks ($9 billion market cap at end of 2001), and Liberty Media ($21 billion). Also, the generally held belief that S&P 500 companies are well-known firms is not necessarily true. The typical investor is usually aware of consumer product firms such as Coca-Cola, Johnson & Johnson, and WalMart, or of firms with media coverage, such as Enron (dropped from the index in 2001). S&P 500 firms specializing in nonconsumer oriented products such as Fifth Third Corp ($35 billion) and Automatic Data Processing ($36 billion) are hardly ever recognized.

B. Sample Construction

The sample period begins in July 1962, concurrent with the start of the daily CRSP (Center for Research in Security Prices at the University of Chicago) files, and covers three distinct periods in the history of S&P 500 index changes. The first period extends from July 1962 to August 1976, when indexing was not popular and not considered important. Until that time, no public announcements of index changes were made. Investors could call Standard and Poor's and obtain information about changes, but according to Harris and Gurel (1986), not more than five to ten investors called to inquire. The second period extends from September 1976, when Standard and Poor's began to formally announce changes to interested investors and the media through its S&P Notification Service, to September 1989. During the second period 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. Since index funds are concerned with minimizing tracking error, they must buy (sell) the stock at the time of its addition to (deletion from) the index. However, with the growth in indexing, orders from index funds at the opening bell increased order imbalances and volatility. To ease these order imbalances, Standard and Poor's began pre-announcing index changes from October 1, 1989 onward. Thus, the third period covers changes to the S&P 500 index from October 1989 to December 2000. The date of a change is announced by Standard and Poor's after the market closes on the announcement date and the change takes place at the close of the effective day. The period between announcement day and effective day varies from one day to about one month.

Data for construction of the sample are obtained from various sources: Effective dates of changes to the S&P index are obtained from CRSP, which obtains these dates from Standard and Poor's; announcement dates after September 1989 are obtained from annual issues of S&P 500 Directory and from Standard and Poor's S&P 500 Index Focus Monthly Review (for 1998, 1999, and 2000). All announcement dates and effective dates (after September 1989) are verified with Dow Jones Newswire and the *Wall Street Journal* as reported on Dow Jones Interactive.

The initial sample consists of 305 additions for the July 1962 to August 1976 period, 297 additions for the September 1976 to September 1989 period, and 303 additions for the October 1989 to December 2000 period. As there is one deletion for every addition, the initial sample consists of 905 additions and 905 deletions during the July 1962 to December 2000 period.

To be included in the final sample, any firm added to or deleted from the S&P 500 index is required to have at least 60 trading days of pre-event and 90 trading days of post-event data on CRSP. We impose this screen to enable computation of abnormal returns and to facilitate volume comparisons. In addition, the screen eliminates index changes that do not require a change in index fund holdings or that are cosmetic in nature. For example, the addition of the AT&T offspring to the S&P 500 index in 1984 did not require an adjustment to index fund holdings. The reduction in AT&T's size was exactly offset with new Baby Bell shares issued by AT&T and held by index funds.

B.1. Additions Sample

The data requirement screen reduces the number of additions to 822. We further exclude firms whose addition to the index was caused by a significant contemporaneous event. For example, Washington Mutual acquired Great Western Financial on July 1, 1997. As a result, Great Western Financial, a member of the S&P 500, was deleted and replaced by Washington Mutual, with Washington Mutual's perm number. Both firms are deleted from the sample since the merger contaminates the index change. To screen for such events, we go through the *Wall Street Journal* Index over a three-month period prior to the addition announcement beginning in July 1962 and ending in December 1979. For the period after 1979, we use Dow Jones News Wire and the *Wall Street Journal*.

As a result of the above criteria, the final additions sample consists of 760 firms. The decrease is due to 20 mergers, 11 spinoffs, 30 additions where the CRSP perm number is unchanged, and one case where only the class of shares represented in the index is changed.

B.2. Deletions Sample

While controlling for pre-event occurrences (such as 60 trading days of pre-listing) does not create a bias, the requirement of a post-change screen (of 90 trading days) can potentially introduce a survivorship bias, particularly for deletions.[2] Imposition of a post-change screen creates an upward bias in reported returns for firms likely to go bankrupt at the time of the index change announcement. The bias occurs because firms that survive remain in the sample while firms that actually go bankrupt get dropped due to the post-change data requirement. To avoid this bias, we consider the status of a firm on the date of deletion announcement and exclude firms that are likely to cease to exist.[3] This is done in two steps. First, we drop all firms that stop trading within two trading days after deletion, because they are clearly merger targets. For the remaining 421 deletions, we follow a process similar to that for additions and go through the *Wall Street Journal* Index/Dow Jones Newswire/*Wall Street Journal* over a three-month period prior to the deletion announcement. We find and delete 7 firms that were suspended or delisted from the NYSE, 125 firms with a final merger offer that had been or was likely to be accepted by stockholders, 3 firms in liquidation proceedings, 17 firms under Chapter 11, 22 spinoffs, and 6 firms that underwent a leveraged buy out. Additionally, 1 firm where the class of shares was changed is excluded from the sample. Two other firms (1 each in 1966 and 1967) for which we could find no news and 3 other firms (1 each in 1967, 1972, and 1975) that stopped trading prior to their deletion from the index are also excluded from the sample.

The final sample, free of any survivorship bias but with adequate return and volume data, consists of 279 additions and 145 deletions for the October 1962 to August 1976 period, 263 additions and 28 deletions for the September 1976 to September 1989 period, and 218 additions and 62 deletions for the October 1989 to December 2000 period, making a total of 760 additions and 235 deletions.

II. Results: Excess Returns and Abnormal Volume Turnover

In this section we document the price effects and volume changes as a result of changes to the S&P 500 index. We report results based on abnormal and cumulative abnormal returns measured relative to the S&P 500 index.[4]

[2] By design, firms added to the index are likely to (and do) survive for the next 90 days.

[3] Lynch and Mendenhall (1997) follow a similar criterion to create a sample of clean deletions.

[4] We also 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. The methods used to compute abnormal returns yield conclusions similar to those reported using the S&P 500 index as the benchmark. Details are available upon request.

Changes in trading volume are measured in the spirit of Harris and Gurel (1986) and Elliott and Warr (2003). We use volume turnover (trading volume divided by shares outstanding) instead of trading volume, so that unusually high volume in a few large stocks does not disproportionately affect the market volume. The turnover ratio is calculated as given by equation (1). The denominator is the reference period turnover standardized by market turnover during the reference period, while the numerator is the event period turnover standardized by market turnover during the event period. In equation (1), T_{it} is the turnover for firm i at time t, the subscript m refers to the market, and AD represents the announcement day, which is the first trading day following announcement. For the purpose of measuring turnover, the definition of "market" is restricted to NYSE stocks.[5] The post-change turnover ratio is the 60-day average trading turnover (with a minimum of 30 days) beginning 61 trading days after the effective date. Thus, trading after the effective date must last for at least 90 days:[6,7]

$$\text{Turnover ratio} = \frac{\sum_{t=1}^{N} \frac{T_{it}}{T_{mt}}}{\sum_{t=-60}^{AD-1} \frac{T_{it}}{T_{mt}}}. \tag{1}$$

A. Additions

Excess returns and abnormal volume turnovers are reported in Table I for each of the three subperiods. We first focus on additions as reported in Panel A of Table I and make three observations with respect to excess returns. The first observation relates to the announcement day return. During the period from 1962 to 1976, the excess return is not significantly different from zero. For the 1976 to 1989 period however the average announcement day abnormal return is a significantly positive 3.2%, with 93% of added firms experiencing positive returns. The mean announcement day abnormal return increases to over 5% for the 1989 to 2000 period, with 94% of sample firms experiencing positive returns. Despite differing sampling periods and sample sizes, post-1976 announcement returns in our paper are similar to those found in earlier studies.

The second observation relates to the change in price from the announcement day until the effective day. Since Standard and Poor's only began preannouncing changes after September 1989, there is no difference between the

[5] The variation in Nasdaq turnover is likely to be very large due to a large number of Nasdaq initial public offerings; also, CRSP began reporting volumes for most Nasdaq stocks only in 1983. Consistent with the literature, we adjust the Nasdaq volume by dividing by 2.

[6] However, no firms in the sample survive less than 120 days.

[7] Based on Lo and Wang (2000), we also evaluate abnormal trading volume using a market model for turnover. The conclusions are similar to those using the turnover ratio.

announcement day and the effective day until that time. During the October 1989 to December 2000 period, we observe a further increase in the price of stocks added from the announcement day to the effective day: The mean abnormal return increases from 5.4 to 8.9%. The rise in abnormal return suggests the presence of price pressure up to the effective date that is relieved after the stock is added to the index. One possible explanation is that, with the preannouncement of index changes, quasi-arbitrageurs enter the market by buying (selling) added (deleted) stocks in the hope of flipping around on the effective

Table I

Abnormal Returns and Volume Turnover around Changes in the S&P 500 Index

The initial sample consists of all additions to and deletions from the S&P 500 index from July 1962 to December 2000. To be included in the final sample, firms must have return data for at least 60 trading days before the date of announcement and for at least 90 trading days after the effective day. Abnormal returns are calculated relative to the S&P 500 index's total return. Anndate is the abnormal return for the first trading day following the announcement. Anndate to Effdate is the cumulative abnormal return from the day following announcement to the effective day. 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. The normal turnover (Pre) for the firm and the market is taken to be the average turnover 60 trading days prior to the announcement date. All turnover estimates are adjusted for the market, where the market is restricted to NYSE stocks. Announcement day and effective day turnover are turnovers on those days, respectively. The post-change turnover (Post) is the 60-day average trading turnover (with a minimum of 30 days) beginning 61 trading days after the effective date. For returns, the first line in each cell reports the mean (%) and the second line reports the proportion of returns that are positive. For turnover ratios, the cells report medians and proportions greater than one, respectively. The significance of the mean (median) is tested with a standard *t*-test (sign test), while the significance of the proportions is tested using the binomial distribution.

Panel A. Additions			
	196207–197608	197609–198909	198910–200012
Initial sample	305	297	303
Final sample	279	263	218
Cumulative Abnormal Returns			
Anndate	−0.047	3.171***	5.446***
	0.495	0.932***	0.940***
Anndate to effdate			8.899***
			0.927***
Anndate to effdate + 20 (CAR20)	−0.742	3.123***	6.396***
	0.470	0.681***	0.688***
Anndate to effdate + 60 (CAR60)	0.588	3.556***	6.189***
	0.505	0.635***	0.615***
Turnover Ratios			
Anndate/Pre	0.763***	3.741***	3.703***
	0.363***	0.918***	0.991***
Effdate/Pre			12.323***
			0.995***
Post/Pre	0.906**	0.992	1.080***
	0.431**	0.492	0.601***

Table I—*Continued*

Panel B. Deletions			
	196207–197608	197609–198909	198910–200012
Initial sample	305	297	303
Final sample	145	28	62
Cumulative Abnormal Returns			
Anndate	−0.407*	−1.168	−8.462***
	0.469	0.393	0.016***
Anndate to effdate			−14.436***
			0.032***
Anndate to effdate + 20 (CAR20)	1.189*	−1.642	−4.710
	0.593**	0.357	0.339**
Anndate to effdate + 60 (CAR60)	2.172	−1.715	0.394
	0.572*	0.429	0.452
Turnover Ratio			
Anndate/Pre	0.691***	3.523***	3.487***
	0.386***	0.857***	0.952***
Effdate/Pre			16.495***
			1.000***
Post/Pre	1.030	0.966	0.938
	0.531	0.429	0.403

*, **, and *** denote significance at the 10%, 5%, or 1% level, respectively.

day at more favorable prices (see Beneish and Whaley (1996) and Madhavan and Ming (2002)).

The third observation relates to the permanence of the price effect. The results show that until 1976, cumulative excess returns, from the announcement day to 20 days and 60 days after the effective day (henceforth referred to as CAR20 and CAR60) are not significantly positive. But after 1976, the mean CAR60 is 3.6% during 1976 to 1989, and 6.2% during 1989 to 2000. The persistence of the abnormal return suggests that the price effect of additions to the index is permanent—evidence inconsistent with the price pressure hypothesis.

There are two important patterns with regard to turnover. First, the turnover ratios in post-1976 periods are dramatically different from the ratios up to 1976. In the pre-1976 period, the median turnover around the announcement day is considerably less than the "normal" turnover. For the second period (1976 to 1989), the median announcement day turnover is 274% higher than a normal day's trading volume turnover, with 92% of the added stocks exhibiting an increase in turnover. With the pre-announcement of index changes after September 1989, the announcement day volume turnover is similarly high: 270% higher than the normal turnover for the firm. On the effective date, the turnover is 11 times higher than normal. The volume turnover ratios reported here are similar to those found in previous research.

The second observable pattern is that the abnormal increase in volume turnover tapers off after the effective date. While still statistically significant in

the 1989 to 2000 period, the median turnover ratio is close to one, and the proportion of firms with ratios greater than one approaches 0.5. This implies that the increase in volume turnover for additions to the index is modest at best and is in evidence only in the post-1989 period. In contrast to our 1976 to 1988 results, Dhillon and Johnson (1991) find that the post-change volume ratio is 1.084 for their sample of 101 additions during 1984 to 1988. However, our larger sample over the longer 1976 to 1989 period suggests no permanent change in volume due to additions, but volume turnover does increase by 8% during 1989 to 2000.

B. Deletions

Results for the deletions sample are reported in Panel B of Table I. We make three observations. First, as with additions, we note an increasing announcement reaction (albeit negative) to deletions in later subperiods. Firms deleted before September 1976 experience an economically insignificant excess return of −0.4%. In the 1976 to 1989 period, the excess returns are statistically insignificant at −1.2%. However, the loss upon announcement is more than 8% in the 1989 to 2000 period. Second, in a manner similar to additions and probably due to arbitrage activity, we find that deleted firms lose an additional 6% between the announcement day and the effective day in the 1989 to 2000 period when changes are pre-announced. Third, in a result markedly different from that for additions, there is a lack of permanence in the excess return. The negative effect of deletions disappears completely 60 days after the effective date. The cumulative abnormal return from announcement to 60 days after the effective date is not significantly negative, and always economically small.[8]

On examining volume turnover for deletions, we can draw conclusions similar to those for additions. First, the turnover around the announcement day/effective day is significantly different from the normal pre-announcement turnover during the three periods. Turnover is lower than normal during 1962 to 1976 and higher than normal during 1976 to 1989 and 1989 to 2000, with the turnover ratios having magnitudes similar to those for additions during the respective periods. Second, there is no permanent change in the turnover

[8] The final sample of 235 deletions excludes 186 firms with contemporaneous events. It is true that index funds had to sell these firms and probable that information contained in the contemporaneous event would have been impounded in the price upon the first news announcement. Therefore, any further abnormal return from the deletion is probably attributable to a downward-sloping demand curve. To test this, we augment our sample with these firms to a total of 421 firms. In the computation of abnormal returns, whenever a firm ceases trading, we assume that the proceeds are invested in the S&P 500 index from the day trading ceased. The cumulative abnormal returns for this augmented deletions sample from announcement to 60 days after the effective date are +3.16% (significant at the 1% level with 197 firms) for the 1962 to 1976 period, −2.78% (significant at the 10% level with 96 firms) for the 1976 to 1989 period, and +5.62% (significant at the 10% level with 128 firms) for the 1989 to 2000 period. The finding that there are no strongly negative abnormal returns supports our conclusion that the downward-sloping demand curve hypothesis cannot be a complete explanation for the price effects of index changes.

ratios when measured three months later. This is a result only slightly different from that observed for additions.

It is evident from the results in Table I that pre-1976 results are weak. In view of the small abnormal returns for that period and the greater difficulty in obtaining other data, our remaining tests focus on the post-1976 sample.

C. Reconciliation with Other Studies of Deletions

As noted earlier, most researchers examining S&P 500 index changes have focused on additions. The empirical evidence is quite strong that additions to the index experience positive long-term abnormal returns and indeed the results in this paper support that position.

Our key result however is that deletions are not associated with a permanent negative excess return. There are three main studies of deletions. In this section, we discuss the three studies and examine the reasons for any divergence in the results.

C.1. Lynch and Mendenhall (1997)

Lynch and Mendenhall (1997) examine a sample of 15 deletions from the March 1990 to April 1995 period. Though the process of identifying qualifying deletions in their paper and our paper is similar, our clean sample contains 16 deletions. Possibly we are able to pick an extra deletion because we find news relating to all deletions. Lynch and Mendenhall lose three firms due to lack of information.

A comparison of the Lynch and Mendenhall results and our results is presented in Panel A of Table II. It can be seen that our abnormal returns are similar to the Lynch and Mendenhall returns of −14.44%, if an observation period extending from announcement to 10 days after the effective date is considered. However, once a longer post-change period is evaluated, we find that part of the initial losses suffered by the deleted firms is recouped. The cumulative abnormal return from announcement day to 60 days after the effective day for the 16 deletions is −6.32%, which, while not trivial, is not significantly different from zero in a statistical sense, possibly due to low power associated with the small sample size. However, taken in the broader context of other sample periods, including the 1989 to 2000 period that encompasses the Lynch–Mendenhall sample, the result does not detract from the more compelling general evidence that the abnormal returns following deletions are economically small. Thus, we conclude that the Lynch and Mendenhall results, when extended to a longer post-deletion window, do not conflict with those in this paper.

C.2. Dash (2002)—A Study by Standard and Poor's

Standard and Poor's itself (Dash (2002)) studies 59 firms that were deleted from the S&P 500 between January 1, 1998 and June 25, 2002, solely because

Table II
Reconciliation of Results for Deletions in Previous Papers

Panel A: With Lynch and Mendenhall (1997)

	Sample of Lynch and Mendenhall	Sample in This Paper	Explanation
1. Tested sample	15	16	Firms deleted between March 1990 and April 1995.
2. Announcement day (AD) abnormal return.	−6.26%	−7.82%***	All L-M returns are adjusted based on the CRSP value-weighted index until 1993, and on the S&P 500 daily return for 1994 and 1995. All our returns are adjusted for the S&P 500 daily return. The CARs with CRSP value-weighted index are smaller in magnitude.
3. CAR from AD to effective day (ED) + 10 trading days.	−14.44%	−18.30%***	
4. CAR from AD to ED + 20 trading days.	Not reported	−16.03%**	
5. CAR from AD to ED + 60 trading days.	Not reported	−6.32%	

Panel B: With Beneish and Whaley (2002)

CAR Period	Beneish and Whaley (2002) $N = 49$	Our Sample $N = 46$	Our Sample without Top Five Outliers, $N = 41$	Our Sample without Top Five and Bottom Five Outliers, $N = 36$
AD	#−9.9***	−8.9***	−7.7***	−7.6***
AD to ED	#−10.8***	−12.5***	−10.4***	−9.9***
ED to ED+20	+14.5**	+15.7**	+4.1	+7.2*
ED to ED+40	+23.7***	+25.8***	+6.9*	+12.8***
ED to ED+60	Not reported	+23.0**	+8.4	+15.7***
AD to ED+60	Not reported	+4.7	−3.1	+3.6

#These returns are calculated by the authors from the Beneish and Whaley paper, and not directly reported by them.
*, **, and *** denote significance at the 10%, 5%, or 1% level, respectively.

the firms failed to meet the S&P index criteria for inclusion in the S&P 500. Dash finds that stocks lose 11.7% between announcement and completion, but then recoup 10.0% over 10 trading days after the effective day. By six months after the effective day, Dash finds that the excess returns to the deleted firms are a positive 13.8%. He reports that "there is no long-term price impact of deletions" (p.1). These findings are consistent with those reported in this paper that firms deleted from the index do not suffer permanent loss.

C.3. Beneish and Whaley (2002)

Like Dash (2002), Beneish and Whaley (2002) examine a sample of 49 firms deleted from the index during 1996 and 2001 for failing to meet inclusion criteria. They find that the deleted firms lose 10.8% from announcement day to

the effective day, but gain an adjusted 23.7% during the 40 trading days after the effective day, more than recouping their original loss. However, they find that much of the gain is driven by five firms in their sample, which if excluded would make the post-effective day return statistically insignificant, suggesting the possibility that deleted firms do not fully recoup their losses.

In Table II, Panel B, we report results for 46 firms in our sample during their sample period and find that deleted firms recover their losses 60 days after the effective date.[9] Further, we redo the Beneish–Whaley analysis by excluding the five big gainers not only from the post-effective day period but also *from the pre-effective day period* for a proper comparison. The results in the penultimate column of Panel B of Table II reveal that the cumulative abnormal return from the announcement day to 60 days after the effective date is marginally negative, but not statistically different from zero. These returns are consistent with our general conclusions, despite a biased sample with the best-performing deletions excluded. We also report results for a symmetrically truncated sample with five top and five bottom performers excluded. For that sample, the abnormal returns from the announcement day to 60 days after the effective day are positive and insignificant. Thus, we interpret the Beneish and Whaley (2002) deletions findings as not inconsistent with those in this study.

III. Existing Hypotheses on the Price Effects of Index Changes

In this section we discuss existing hypotheses that have been advanced as explanations for the price effects of S&P 500 index changes, and examine them in the context of an asymmetric price response to those changes.

A. Long-Term Downward Sloping Demand Curve

Since index funds must buy (sell) the stock added to (deleted from) the index in order to minimize tracking errors (see Blume and Edelen (2001)), an index change creates an excess demand that can be satisfied without a price change only if stocks have perfect substitutes. Thus, an excess return upon an index change, in the absence of alternative explanations, must arise due to imperfect substitutability or a downward sloping demand curve. Based on different sample periods following the surge in popularity of indexing as an investment vehicle, Shleifer (1986), Beneish and Whaley (1996), Lynch and Mendenhall (1997), Blume and Edelen (2001), and Wurgler and Zhuravskaya (2002) find support for the downward sloping demand curve. Other than Lynch and Mendenhall, these studies' results are based only on additions. Kaul et al. (2000) also report results consistent with the downward sloping demand curve but based on weight changes in the Toronto Stock Exchange index, TSE 300.

[9] For comparison purposes, we augment our sample with index changes from 2001. We do not retain the 2001 changes for the remainder of the paper, as we need post-change data for further analysis. Though the total number of deletions in our sample is slightly smaller at 46 than their sample of 49, the results in columns 2 and 3 in Panel B of Table II are similar.

The empirical evidence in our study is not consistent with a permanent price effect implied by a downward sloping demand curve. This kind of curve suggests a symmetric response to additions and deletions. We see from Table I that while the excess return for additions to the index is significantly positive, deletions do not have a significant excess return, though they are announced and occur at the same time as the additions. The results in Table I for deletions are robust and consistent with the results in several other studies, such as Lynch and Mendenhall (1997), Beneish and Whaley (2002), and Dash (2002), as discussed in Section II.C.

The result in Kaul et al. (2000) deserves special mention. They report that weights of 31 stocks in the TSE 300 index were increased as a result of a redefinition of float that was announced by the exchange on August 6, 1996, with the actual change occurring on November 15, 1996. The affected stocks earned a permanent abnormal return of 2.34% during the week of November 15, though there was no change in the bid-ask spread.[10] This evidence is consistent with a downward sloping demand curve. It is surprising however that no arbitrage activity is observed. Possible explanations for the permanent price effect occurring only on the effective date of change include the following: A lack of widely disseminated information about the impending change, since the media announced the change on November 15, 1996, and not in August 1996; and, as noted by Kaul et al. (2000), the long lag between the announcement and effective dates introduced considerable uncertainty about the weight for each firm in the index.

B. Price Pressure

The price pressure hypothesis posits a downward sloping demand curve, but only in the short term. Long-term demand is fully elastic. Thus, according to the price pressure hypothesis, the excess demand from indexing generates an upward price pressure to persuade investors to sell the stock prematurely. Price pressure abates once the momentary demand is satisfied.

Support for the price pressure hypothesis is provided by Harris and Gurel (1986), who find a systematic reversal of the initial price increase, and by Blouin et al. (2000), who base their arguments on capital gains taxes payable by sellers. Elliott and Warr (2003) also document price pressure, but only around the effective date. A study by Mase (2002) on changes to the FTSE 100 index between 1992 and 1999 also finds support for the price pressure hypothesis.

Examining the pattern of excess returns in Table I, we find that the returns are generally small and that there is little evidence of price reversal in the 1962 to 1976 period. During the 1976 to 1989 period, there is a statistically significant abnormal return of 3% around announcement for additions but no subsequent reversal. The CAR 60 days after the effective date is around 3.6%.

[10] The comparison sample for computation of the abnormal return consists of the remaining firms in the TSE 300 index whose weights are revised downward.

For deletions, the abnormal returns are not significant during 1976 to 1989 and there is no associated reversal.

For additions, in the 1989 to 2000 period when changes are pre-announced, we observe that the abnormal return increases from 5.4% on the announcement day to almost 9% by the effective day, but the price reverses partially, leaving a net gain of 6.2% 60 trading days following the effective date. In the case of deletions, the abnormal return goes from −8.5 to −14.4% by the effective date, but completely reverses itself 60 days later. The findings around the effective date are similar to those in Elliott and Warr (2003).

However, price pressure for additions in the period from 1989 to 2000 does not have a good explanation other than the start of pre-announcements by Standard and Poor's in 1989. Given that modification, the price change between the announcement date and the effective date in the 1989 to 2000 period probably occurs due to the activities of quasi-arbitrageurs, and then reverses once they close their positions on or around the effective day (see Beneish and Whaley (1996)). Therefore, it seems reasonable to conclude that evidence in support of the price pressure hypothesis is limited at best.

C. Certification

The certification hypothesis suggests that the addition of a stock to the S&P 500 index conveys new positive information about the stock. Though Standard and Poor's relies on publicly available information in attempting to achieve their twin objectives of minimizing index changes and selecting firms that represent the economy, their analysis of that information could suggest the potential for an added firm's longevity and/or leadership in that firm's industry.

Dhillon and Johnson (1991) study related securities (options and bonds) of the firms added to the index. Absent new information, these related securities should not be affected by index changes, yet the authors find a significant excess return. Jain (1987) finds that additions to supplementary indexes where the level of indexing is small or nonexistent also experience abnormal returns similar to those for additions to the S&P 500 index. Together, these findings suggest that index changes are consistent with the certification hypothesis.

Evidence presented in this paper calls the certification hypothesis into question. We know from Table I that there is no observable price effect prior to 1976. If Standard and Poor's certification is valuable, then stocks added to the index prior to 1976 should also have experienced a positive abnormal return around announcement. Like previously discussed hypotheses, the certification hypothesis implies a symmetric effect for index changes that is inconsistent with the evidence. Moreover, the results in Dhillon and Johnson (1991) and in Jain (1987) may be interpreted to be consistent with either a downward-sloping demand curve or improved investor awareness following additions to the S&P 500 index.

D. Liquidity without Information Production

In our examination of the liquidity effects of changes to the S&P 500 index, we separate our discussion into two distinct areas: liquidity changes with information production discussed in Section IV, and liquidity changes without information production discussed here. Liquidity can improve without information production if there is an increase in the trading volume. An increase in trading volume tends to lower the inventory costs of market makers, resulting in a lower cost of trading. On the other hand, it may be argued that indexing could reduce liquidity. As index funds generally buy and hold shares, the number of shares available for trading should fall. The reduction in the available float may negatively impact liquidity.

The results in Table I suggest only a small permanent increase in volume turnover following additions, and no decrease following deletions. Moreover, liquidity without information production also requires a symmetric price response to index additions and deletions, an outcome not evident in Table I.

Hegde and McDermott (2003), who study a sample of 91 additions and 27 deletions between January 1993 and October 1998, report that the direct cost of trading, which depends on trading volume, decreases for additions but increases for firms deleted from the index. They document a permanent mean increase of 27% in the post-period standardized trading volume for additions. The median daily trade frequency increases from 126 in the pre-period to 178 in the post-period. For deletions, in contrast, the median trade frequency drops from 64 to 50. Changes in trading volume for deletions are not reported. Hegde and McDermott interpret their overall results as supporting a long-term increase in liquidity for additions and a decline for deletions from the index. A closer inspection of their analysis however reveals that they compare the $(-60, -10)$ period with the $(+10, +60)$ period. We believe that the post-change period, beginning only 10 days after the change, is too close to the event and probably captures turnover before it reaches a steady-state level. On the other hand, our analysis of volume turnover begins 60 trading days after the effective date.

IV. Explaining Asymmetric Excess Returns

Section III illustrates that existing explanations for the asymmetric price effects of S&P 500 index changes are not consistent with the results in Table I. One line of reasoning that is consistent with the evidence is based on changes in investor awareness. An increase in investor awareness, for example, can affect the stock price in several ways. First, the firm's operating performance may improve because of increased monitoring by investors and/or by enhanced access to capital markets. Second, the firm's liquidity may improve due to a lower cost of information asymmetry as a result of greater production of information by investors and analysts. Finally, the required rate of return for the firm could fall in segmented markets because of a drop in Merton's (1987) shadow cost following increased investor recognition.

While more investors become aware of stocks added to the index, the number of investors aware of deleted stocks may not actually fall because it may be difficult for investors to become "unaware" of those stocks.[11] Thus, based on the asymmetric effects of investor awareness, the price increase due to index additions should be larger in magnitude than the price decrease due to index deletions, as reported in Table I. Moreover, investor awareness can be reconciled with the inconsequential price effects on index changes prior to the beginning of public announcements in 1976. As no additional investors became aware of a stock added to the S&P 500 in the absence of a public announcement of index changes, there were no significant price effects in the pre-1976 period.

A. Evidence in Support of Investor Awareness around Index Changes

Assessing investor awareness presents a major difficulty in that there is no direct measure. Thus, we rely on proxies for investors' recognition. In particular, we evaluate and report the change in the number of registered shareholders, number of institutions, and institutional ownership as factors that indicate investor awareness.

A.1. Number of Shareholders

The number of shareholders before announcement of the index change is compared with the number of shareholders after the effective date of the change. We expect to see an increase in the number of shareholders post-addition as more investors become aware of the stock. For deletions, on the other hand, the breadth of ownership should fall only slightly because individual investors may be less willing to shed the stock upon its deletion from the index since its absence from the index does not lessen its diversification benefits or negate the reasons for holding it in the first place.

The number of shareholders before the change is obtained as late as possible but prior to the announcement date. The number of shareholders after the effective date is obtained at least nine months after that date to allow individual investors to change their portfolios.[12] The initial source for data on the number of shareholders is Standard and Poor's COMPUSTAT. If COMPUSTAT data are either not available or the change is too large (where large is defined as an increase of more than 50% or a decrease of more than 33% in the number of shareholders), Moody's manuals are used. If data are not available either from COMPUSTAT or Moody's manuals, then the S&P 500 Market Encyclopedia is used. Finally, and especially for the more recent period,

[11] In practical terms, firms that are deleted from the index and continue to exist as independent and solvent entities may gradually fade into obscurity and their capital costs may rise.

[12] The nine-month period is shortened when a firm ceases to exist, or when data limitations cause the delay to extend beyond two years.

Table III
Number of Shareholders

This table reports changes in the number of shareholders around S&P 500 index changes. The number of shareholders prior to the announcement date is taken at a time as late as possible but before the announcement date. The number of shareholders after the change is taken to be the number of shareholders at a time at least nine months after the effective date. Shareholder data are obtained from COMPUSTAT, Moody's Manuals, the S&P Market Encyclopedia, and from 10-K filings on SECs EDGAR, in that order.

Period	Sample Size in Table I	Sample Size for This Table	Mean (Median) of Pre-Event Number of Shareholders	Mean (Median) of Post-Event Number of Shareholders	Percent Change in Mean (Median)	Mean (Median) of Paired Changes
Panel A. Changes in Number of Shareholders—Additions						
197609—198909	263	243	17,728	18,560	4.7	831**
			8,568	10,000	16.7	145**
198910—200012	218	187	17,745	20,681	16.5	2,936**
			4,840	6,077	25.6	426***
Panel B. Changes in Number of Shareholders—Deletions						
197609—198909	28	20	25,584	25,192	−1.5	−391
			12,428	12,469	0.33	−515
198910—200012	62	54	7,870	7,464	−5.2	−406***
			6,046	5,504	−9.0	−215***

*, **, and *** denote significance at the 10%, 5%, or 1% level, respectively.

each firm's 10-K filings with the Securities and Exchange Commission are searched.[13]

The number of shareholders before and after the index change is reported in Table III. We report paired changes, in that we calculate the change for *each* firm before computing means and medians of the change. From Panel A, we see that the median increase in the number of shareholders is 145 during the 1976 to 1989 period and 426 during the 1989 to 2000 period as a result of additions to the index.[14] The mean number of shareholders also increases by 831 during the 1976 to 1989 period and by 2,936 during the 1989 to 2000 period. Thus, the change in the number of shareholders in a firm following its addition to the index is large and statistically significant.[15]

The sample of deletions in Panel B of Table III is small, so results should be interpreted with caution. However, in contrast to the significant increase

[13] The question of noncomparability arises when many sources are used for the shareholder data. We select every tenth addition and every other deletion from our final sample and compare shareholder data from COMPUSTAT and Moody's (only eight observations in our final sample have data from the other sources mentioned). We conclude that the data from these two sources are very similar.

[14] The focus of the discussion is on medians due to skewness of the number of shareholders.

[15] The numbers reported here are similar to those in Chordia (2001). He studies only additions to the index.

in the number of shareholders with additions, there is no significant change in the median number of shareholders with deletions during 1976 to 1989. During 1989 to 2000, the mean and median decrease significantly, but in both periods, as expected, the percentage drop in shareholders for deletions is considerably smaller than the percentage rise in shareholders for additions.[16]

Two observations are appropriate with regard to the above results. Since index funds are likely to buy (sell) large blocks following addition (deletion), and given the likelihood of there being noninstitutional investors on the opposite side of these trades, pressure is actually exerted in the direction of reducing the number of shareholders in the case of additions and increasing them for deletions, absent any countervailing forces such as investor awareness. The fact that the number of shareholders increases following additions to the index and diminishes somewhat following deletions, as shown in Table III therefore is evidence in favor of the asymmetric nature of changes in investor awareness. The second observation relates to new stock issuance following additions to the index. As there is greater demand for shares of the added firms, do the added firms step up issuance of new equity? To address this possibility, we examine the secondary equity offering patterns of these firms. Specifically, we look at equity offerings one year and three years before addition and compare them to offerings one year and three years after. The variables we examine are the fraction of additional shares raised, the frequency of new offers, and the number of new offers. Our results show that there is no increase in security issuance by firms added to the index either for the 1976 to 1989 period or the 1989 to 2000 period.

A.2. Number of Institutions and Institutional Stockholding

In a manner similar to that for individual shareholders, an increase in the number of index-fund institutional investors for added firms is expected because although they are more sophisticated and probably aware of the firm's existence before its addition to the index, they have relatively low interest in it until it is included in the index. For deletions, on the other hand, the breadth of ownership should fall as indexers would no longer own the stock.

The number and fraction of shares held by an institution in the quarter immediately prior to the announcement date is compared with that institution's holding at least one quarter after the effective date. Holdings data are obtained from the 13f filings available from Thomson Financial from the first quarter of 1980. Accordingly, we exclude index changes up to March 1980.

Results for additions are reported in Panel A of Table IV. It can be seen that the number of institutions as well as the fraction of the firm's shares held by

[16] The change in the number of shareholders—larger for additions, smaller for deletions—is possibly related to a general increase in the number of shareholders over time. To rule out this possibility, we examine shareholdings in a sample of firms matched on the basis of industry and size as in footnote 4. We find that the median increase in shareholdings for our added sample is significantly greater than the median change for the matched sample. The median change in shareholdings for our deletions sample is indistinguishable from the change in the matched sample.

Table IV
Institutional Ownership

This table reports changes in the number of institutions and in the percentage of institutional shareholding around S&P 500 index changes. The number and fraction of shares held by institutions in the quarter immediately prior to the announcement date is compared with institutional holdings at least one quarter after the effective date. Institutional holdings data are obtained from 13f filings available from Thomson Financial from March 1980. Observations before March 1980 are excluded.

Period	Sample Size in Table I	Sample Size for This Table	Mean (Median) of Pre-Event Number of Institutions	Mean (Median) of Post-Event Number of Institutions	Percent Change in Mean (Median)	Mean (Median) of Paired Changes	Mean (Median) of Pre-Event Percent of Institutions	Mean (Median) of Post-Event Percent of Institutions	Mean (Median) of Paired Changes
Panel A. Change in Institutional Ownership—Additions									
198003—198909	221	203	96.2	115.2	19.7	19.0***	44.1	45.8	1.7***
			93.0	108.0	16.1	16.0***	43.2	45.6	1.6***
198910—200012	218	210	205.3	251.5	22.5	46.1***	60.0	61.1	1.1*
			204.0	237.5	16.4	38.0***	60.8	61.4	0.8***
Panel B. Change in Institutional Ownership—Deletions									
198003—198909	17	13	72.2	66.3	−8.2	−5.9*	25.8	24.7	−1.2
			56.5	40.5	−28.3	−3.5*	33.3	21.6	1.5
198910–200012	62	59	106.4	70.1	−34.1	−36.2***	52.7	46.0	−6.8***
			105.0	64.0	−39.1	−31.0***	54.6	48.1	−3.4***

*, **, and *** denote significance at the 10%, 5%, or 1% level, respectively.

institutions increase during both subperiods. During the 1980 to 1989 period, the mean number of institutions increases by 19, while the median number of institutions increases by 16. During the 1989 to 2000 period, the median increase in the number of institutions is 38 and the mean increase is 46. All changes are statistically significant. The mean (median) fraction of shares of the added firm held by institutions also increases significantly for both subperiods. Pruitt and Wei (1989), who study changes in institutional holdings for the 1973 to 1986 period, reach conclusions similar to those here. In contrast to additions, the number of institutions holding a stock falls after it is deleted from the index. From Panel B of Table IV,[17] the number of institutions decreases by 6 in the 1980 to 1989 period and by 36 in the 1989 to 2000 period.

A comparison of the changes in institutional holdings for additions and deletions reveals that the percent held by institutions increases by 1.7% around additions during the 1980 to 1989 period compared with a decrease of 1.2% for deletions during the same period. And the percentage of shares held by institutions increases by 1.1% around additions during the 1989 to 2000 period compared with a decrease of 6.8% for deletions. The decrease in the percentage held by institutions after deletion from the index suggests a reduction in institutional investor awareness due, perhaps, to indexers ceasing to participate. However, our focus remains more on individual shareholders than on institutional investors. Moreover, given that the decrease in institutional holding following deletions during 1989 to 2000 is much greater than the increase in institutional holding during the same period, if institutional demand due to indexing causes the price change, we should find that the price decrease for deletions during 1989 to 2000 is much greater than the price increase for additions. The results in Table I do not support this contention.

B. Change in Firm Operating Performance

The previous section provides evidence that additions to the index improve investors' awareness but that deletions have a smaller impact on awareness. As investors become aware of a firm following its addition to the index, they are more likely to own shares in the company, monitor the firm more closely, and exert pressure on the firm to improve performance. Denis et al. (2003) study the performance of 236 firms added to the S&P 500 index between 1987 and 1999 and report that "relative to various benchmark companies, newly-included companies experience significant increase in EPS forecasts and significant improvements in realized earnings" (p.1).

Inclusion in the S&P 500 could enable a firm to have better access to capital markets as well.[18] Bankers, capital markets, and other lenders who evaluate

[17] We also reconstruct Tables III and IV using only firms for which we have both shareholder and institutional holdings data. Our conclusions are unaltered.

[18] It is important to note that to the extent that there are potential lenders who may be unaware of a firm prior to its addition, there is an imperfection in the full information context of capital markets. Moreover, there may be certification aspects to the addition that may encourage hitherto unwilling lenders to finance the added firms, without a similar effect being experienced by deleted firms. However, our other evidence is not consistent with the certification hypothesis.

a firm's creditworthiness are more likely to lend to a firm that is part of a major index than to another similar firm. As a result, S&P 500 firms would attract more capital at a lower cost, which would allow them to invest in more projects with a positive net present value.[19] Subrahmanyam and Titman (2001) model the feedback from stock prices to fundamental values and show that less mature firms have the incentive to facilitate information collection by analysts and encourage investor interest in their stocks.

On the other hand, the deletion of a firm from the S&P 500 index may not automatically reduce scrutiny of the firm by investors, nor does it necessarily impair the company's access to capital markets. Therefore, while a positive impact on a firm added to the index is predicted, the negative price effect on a firm deleted from the index may be much weaker.

C. Change in Liquidity Due to Information Production

If there is greater interest in the stock as a result of its addition to the index, there is likely to be an increase in the amount of information about it produced by analysts, the media, and other financial intermediaries. As a consequence of greater information production, uncertainty and information asymmetry may be reduced, causing liquidity in the stock to improve due to smaller adverse selection costs. The improvement in liquidity would be capitalized immediately upon announcement of an index addition, resulting in a positive price response. On the other hand, deletion of a firm from the index need not be associated with a decline in information production of an equal magnitude.

Hegde and McDermott (2003) find that the asymmetric information component of the bid-ask spread decreases for additions, while for deletions, the asymmetric information component remains unchanged. Their conclusions support those in this paper, though the caveat that their post-change window may not reflect the steady state still applies. Hegde and McDermott themselves caution against reading too much into the results for deletions due to the small sample size.

D. Change in Merton's Shadow Cost with Segmented Markets

Greater investor awareness for additions may also cause a price effect via Merton's (1987) investor recognition hypothesis (IRH). In Merton's model of segmented markets, which Shapiro (2002) extends in a dynamic, general equilibrium framework, investors fall into two categories: They are either informed or not informed about a security, and trade only in the securities of which they are aware.[20] In effect, with segmented markets, investors hold portfolios that are incompletely diversified. It follows that the equilibrium return demanded

[19] Also see the last paragraph of Section IV.A.1. where we report no change in the rate of secondary equity offerings by added firms. This, however, does not address their access to other means of funding such as debt offerings and bank loans.

[20] In practical terms, the weight of informed and uninformed investors in the economy, and hence the precise mechanism by which the IRH works, is difficult to determine. Another complication

by less than fully diversified investors will be higher than that demanded in the full-information capital asset pricing model. The difference between the two returns is Merton's "shadow cost."

With a stock's addition to the index, more investors become aware and now hold it for its diversification potential. As a result, the stock's shadow cost falls, causing the price to rise. On the other hand, and consistent with the evidence related to price effect of index changes, the Merton model does not predict an equal but negative abnormal return for deleted firms. To the extent that investors do not become "unaware" of a deleted stock, or that its potential to contribute to portfolio diversification remains undiminished, a stock deleted from the S&P 500 index need not necessarily experience a negative excess return.

The role of investor recognition in affecting prices is consistent with the empirical evidence of Arbel (1985), who examines neglected stocks; Chan, Jegadeesh, and Lakonishok (1995), who study glamour stocks; and Barber and Odean (2001), who investigate stocks featured in the media. Similarly, Kadlec and McConnell (1994) and Foerster and Karolyi (1999), respectively, document support for Merton's IRH by examining OTC stocks that transfer to NYSE and non-U.S. firms that cross-list on U.S. exchanges.

We present evidence suggesting that Merton's shadow cost changes around index additions and deletions. Further, we find that the shadow cost is directly related to abnormal returns earned by firms when they are added to or deleted from the index.[21]

D.1. Merton's Measure of Shadow Cost

Following Kadlec and McConnell (1994), we represent Merton's shadow cost of incomplete information as

$$ShadowCost = \frac{\text{ResidualStandardDev}}{\text{S \& P500MarketCap}} \times \frac{\text{Firm Size}}{\text{Number of Shareholders}}, \quad (2)$$

where firm size (market value of equity) and the S&P 500 market capitalization are measured on the announcement date of the index change, and the number of shareholders before and after the event are as defined in Section IV.A. Residual standard deviation is measured as the standard deviation of the difference between the firm's return and the S&P 500 total return in the 252-day period

arises if the weight of institutional investors becomes large enough for them to become price setters. The IRH appears most plausible when the weights of all agents are diffuse. In this sense, the IRH appears to be more of an individual investor (as opposed to an institutional investor) recognition story.

[21] There is no particular prediction about trading volume related to Merton's investor recognition hypothesis. However, the original investors may sell the stock to rebalance their portfolio and new investors may buy the stock after they become aware of it. Both parties could benefit because the old investors reduce their holding to a more optimum level, while new investors invest in a stock that was not in their previous portfolio.

Table V
Estimates of Merton's Shadow Cost

Merton's shadow cost is defined as below

$$ShadowCost = \frac{\text{ResidualStandardDev}}{\text{S \& P500MarketCap}} \times \frac{\text{Firm Size}}{\text{Number of Shareholders}},$$

where Firm Size (the market value of the firm's equity) and S&P 500 Market Cap are measured on the announcement day. The residual standard deviation is measured as the standard deviation of the difference between the firm's return and the total return of the S&P 500 index in the 252-day period before the index change announcement day (pre), and in the 252-day period after the effective day (post). The number of shareholders before the index change is obtained as late as possible prior to the announcement date. The number of shareholders after the change is obtained at least nine months after the effective date.

Period	Addition/ Deletion	Sample Size in Table I	Sample Size for This Table	Mean (Median) Shadow Cost before Change ($\times 10^9$)	Mean (Median) Shadow Cost after Change ($\times 10^9$)	Mean (Median) of Paired Changes
197609–198909	Additions	263	243	2.175	1.695	−0.480***
				1.491	1.337	−0.095***
	Deletions	28	20	0.283	0.313	0.030
				0.227	0.247	0.010
198910–200012	Additions	218	187	11.537	7.956	−3.581***
				3.595	3.040	−0.054***
	Deletions	62	54	0.450	0.563	0.112*
				0.256	0.278	0.055***

*, **, and *** denote significance at the 10%, 5%, or 1% level, respectively.

before the index change announcement for the pre-period, and in the 252-day period after the effective day for the post period.

D.2. Changes in Shadow Cost

Estimates of shadow cost before and after index changes are shown in Table V. As in earlier computations, we first calculate the change in shadow cost for a given firm and then compute means and medians of the changes for the sample. For additions, there is a decrease of 0.48 in the mean shadow cost from 2.18 to 1.70 during the 1976 to 1989 period. During the 1989 to 2000 period, the decrease in shadow cost of 3.58 is even greater. Both mean and median declines are significant. The decrease in shadow cost following additions in both periods indicates that there is greater awareness and a lower effect of market segmentation following additions, mainly because more investors then hold the firms' shares.[22]

For deletions, on the other hand, there is a slight increase in the shadow cost. For the 1976 to 1989 period, neither the median nor the mean is statistically

[22] Note that the size of a typical added firm increases post-addition. As a result, the post-addition shadow cost is biased upward and against the maintained hypothesis.

significant. The small sample size precludes strong conclusions. For the 1989 to 2000 period however the mean increase of 0.11 is statistically significant at the 10% level. The median increase is as large as the median decrease for additions, and is statistically significant, though the mean increase in shadow cost for deletions is much smaller than the mean decrease for additions.[23] The increase in shadow cost for deletions suggests that Merton's IRH is probably not the only explanation for the negligible abnormal returns for deletions documented in Table I. We further examine the relationship between the shadow cost and abnormal returns in the next section.

D.3. Relation between Abnormal Returns and Changes in Shadow Cost

If Merton's model is at least partly responsible for the excess return around S&P 500 index changes, we should observe a correlation between changes in the shadow cost and abnormal returns. A simple model for testing the relationship is given by

$$AR = \alpha + \beta(dShadow) + \varepsilon, \quad \text{where}$$
$$dShadow = ShadowPost - ShadowPre. \tag{3}$$

Besides the change in shadow cost, other related factors may affect abnormal returns. For example, older firms are probably better known than young firms. Since we do not have the year of incorporation, we use the number of months of listing on CRSP as an approximation. Larger firms are generally better known than smaller firms. Firm size is measured relative to the S&P 500 index on the announcement date (firm size divided by the market cap of the S&P 500 index). Also, firms listed on NYSE are, in general, better known than firms on Nasdaq. We use an exchange dummy (*NYSEdum*) that is set to 0 for NYSE stocks, and 1 otherwise. Thus, in addition to equation (3), we also estimate equation (4), which includes control variables:

$$AR = \alpha + \beta_1 Log(RelSize) + \beta_2 Log(Age) + \beta_3 NYSEdum + \beta_4 dShadow + \varepsilon. \tag{4}$$

Since the excess return based on the investor recognition hypothesis is permanent, the dependent variable (abnormal return) must represent the permanent effect. For consistency across periods we use the cumulative abnormal return from the announcement day to 60 days after the effective day (CAR60).

Regression results are reported in Table VI.[24] For the 1976 to 1989 period, we find that the coefficient on *dShadow* is negative and statistically significant for

[23] While it is appropriate to focus on the change in shadow cost because the shadow cost is similar to return in the Merton model, the differences in shadow costs are less marked on a percentage basis. The mean shadow cost for the 1989 to 2000 period decreases by 31% following additions, while it increases by 25% following deletions in the same period.

[24] We eliminate one observation (Qlogic, added to the index on December 11, 2000, with a CAR60 of −87.64%) from the regression because of its extremely high influence. Including this observation reduces the significance of the regression.

Table VI

Abnormal Returns and Changes in Shadow Cost

This table relates abnormal returns to changes in shadow cost and control variables. Two equations are specified as below:

$$AR = \alpha + \beta(dShadow) + \varepsilon$$
$$AR = \alpha + \beta_1 Log(RelSize) + \beta_2 Log(Age) + \beta_3 NYSEdum + \beta_4(dShadow) + \varepsilon$$

The dependent variable is the cumulative abnormal return from announcement to 60 days after the effective date (*CAR60*). Firm size (*RelSize*) is measured as relative to the S&P 500 index on the announcement date (firm size divided by the market cap of the S&P 500 index). The measure *Age* is defined as the number of months of listing on CRSP. The measure *NYSEdum* is set to 0 for NYSE stocks, and 1 otherwise. The measure *dShadow* is the difference between post-change shadow cost and the pre-change shadow cost as more fully described in Table V and Section IV.D. The *p*-values are below coefficient values in each row.

Period	Addition/ Deletion	Intercept	Log(*RelSize*)	Log(*Age*)	ExchDmy NYSE = 0	*dShadow* ($\times 10^{-9}$)	Adjusted *R*-square	*N*
197609–198909	Additions	2.564				−1.899	0.035	243
		0.011				0.002		
		−7.182	−2.393	−1.528	1.302	−1.846	0.047	243
		0.574	0.073	0.288	0.634	0.003		
	Deletions	−4.405				−14.071	−0.047	20
		0.333				0.712		
		−69.219	−5.676	2.721		−28.133	0.053	20
		0.187	0.073	0.724		0.452		
198910–200012	Additions	4.805				−0.501	0.045	186
		0.010				0.002		
		−1.981	−2.791	−2.773	2.576	−0.447	0.045	186
		0.933	0.356	0.201	0.505	0.014		
	Deletions	4.220				−24.631	0.064	54
		0.460				0.036		
		−126.003	−9.565	5.626	16.965	−27.551	0.075	54
		0.114	0.094	0.541	0.363	0.021		

additions, as hypothesized. The negative coefficient suggests that the greater the reduction in the shadow cost, the greater is the abnormal return. All else being equal, a firm with a *dShadow* at the first quartile experiences an abnormal return that is about 1% higher than the firm with a *dShadow* at the third quartile for both the 1976 to 1989 and 1989 to 2000 periods. During the 1976 to 1989 (1989 to 2000) period, the inter-quartile range is 0.62 (1.97) and the coefficient on *dShadow* is around 1.89 (0.50), which implies a difference in abnormal returns around 1.17% (0.99%).

For the deletions that occur during 1976 to 1989 however we do not find the coefficient on change in the shadow cost to be statistically significant. The small sample size for deletions and the noise in the shadow cost measure are possible explanations for this result. During 1989 to 2000, the coefficient on the shadow cost variable is significant and negative. The negative coefficient is consistent with Merton's hypothesis that an increasing shadow cost adversely affects returns.

In the multiple regressions, control variables—relative size, age, and exchange dummy—are not consistently significant across the regressions.[25] Relative size is negatively related to abnormal returns. The negative correlation is expected, since larger firms would be less affected by addition to/deletion from the index. Age has differing signs for additions and deletions, but it is not significant, nor is the coefficient on the NYSE dummy.[26] We also note that the positive and significant intercept in the univariate regressions for additions is an indication that factors other than the change in shadow cost (and hence other hypotheses in conjunction with the IRH) are necessary to explain why the abnormal returns are positive.

One problem with equations (3) and (4) is that the shadow cost itself is affected by changes in many variables such as size, residual standard deviation, and the number of shareholders. Thus, the source of significance of the change in shadow cost coefficient cannot be surmised from the regression results in Table VI. Therefore, we re-estimate the regressions by decomposing the shadow cost into its components, so that the effect of the change in the number of shareholders can be gleaned after controlling for the influence of other factors. Though we do not report the results, we find that the change in the number of shareholders is significantly positively related to the abnormal return for additions and less strongly for deletions, as expected. The other control variables do not significantly affect returns. Thus, the change in the number of shareholders appears to be the main reason for the relationship between change in shadow cost and abnormal returns.

[25] For the deletions sample, the intercept changes dramatically with the addition of control variables. Since the mean value of the log of relative size lies between -7 and -10 with a negative regression coefficient and the mean value of the log of age lies between 5 and 6 with a positive regression coefficient, the intercept adjusts to accommodate these values of the control variables. If the control variables are adjusted for the mean, the intercepts in regressions with and without the control variables are almost equal.

[26] All 20 deletions in the sample during the period 1976 to 1989 were NYSE stocks.

V. Summary and Conclusions

An understanding of price effects around S&P 500 index changes is useful for evaluating assumptions relating to the structure of financial markets. In particular, index changes accompanied by demand shocks are a natural experiment to test whether stocks have downward-sloping demand curves. A significant amount of recent research has found evidence consistent with the notion of imperfect substitutes.

In this paper, we document an asymmetric price effect around additions to and deletions from the S&P 500 Index. Such a price response questions the validity of the downward sloping demand curve hypothesis, the information hypothesis, and the liquidity hypothesis, all of which predict a symmetric response. We are able to partly explain the asymmetric response by relying on changes in investor awareness and the consequent effect on investor behavior. We find that changes in awareness are asymmetric: There is an increased awareness for added stocks as investors learn about them, but a smaller drop in awareness for deleted stocks. We cite, posit, or provide evidence that the increased awareness following additions causes enhanced monitoring by investors, a reduction in information asymmetry component of the bid-ask spread, improved access to capital markets, and a reduction in Merton's cost of underdiversification. The negative effect of deletions is much smaller or nonexistent.

Our results suggest that the evidence against almost perfectly elastic demand curves for financial assets, at least based on changes to the S&P 500 index, is not particularly strong. If anything, the evidence seems to be more consistent with an investor awareness story.

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