The S&P 500 Effect: Not such good news in the long run

Daniel Cooper
Board of Governors of the Federal Reserve System

Geoffrey Woglom
Amherst College*

* This paper is a revision of the first author's senior honors essay at Amherst College [Cooper(2001)]. We thank Jason Cummins, Michael Palumbo and Steve Rivkin for comments and suggestions. The views expressed in the paper are not necessarily those of the Board of Governors of the Federal Reserve System or its staff.

Abstract

This paper analyzes the effect on a company's stock price when it is added to the S&P500 Index. A simple theoretical model is developed to show how trading effects and changes to fundamentals should affect the price of S&P500 additions upon announcement and in the long run. This model predicts that a company added to the S&P500 should experience an initial price increase followed by a reversal of this price increase owing to the predicted increased stock price volatility of companies post-addition. All of these effects should be growing over time because of the increasing importance of S&P500 indexed mutual funds. We then test the predictions of the model using a sample of 303 S&P500 index additions between 1978 and 1998. We find results generally consistent with the model, particularly in the most recent period when it appears that the post-addition increase in stock price volatility reverses almost all of the initial price increase.

I. Introduction

The stock price behavior of firms added to the Standard and Poor's 500 Stock Index (S&P 500) has long been an area of interest to financial economists (see for example Beneish and Whaley [1996] (B&W) and Lynch and Mendenhall [1997] (L&M). In particular, a number of authors have observed significant abnormal returns immediately after S&P's announcement of a company's addition to the S&P 500, followed by at least a partial reversal of the initial price increase. The key puzzle in this literature is to explain this pattern of abnormal returns and its relationship to the efficient markets hypothesis (EMH). In general, previous authors' explanations for this so called S&P 500 effect can be divided into two categories: 1) trading effects; 2) fundamental effects.

Those authors who emphasize trading effects relate the initial price increase (or price pop) of S&P 500 additions to the literature on large block trading (e.g., see Kraus and Stoll [1972]). Following the announcement of an addition, index funds will need to execute substantial purchases of the addition's stock, and upon announcement arbitrageurs bid up the price of these shares in anticipation. Such a pure "price pressure" effect, however should not lead to a permanent change in the added company's stock price. To explain the apparent permanent increase in price (i.e., the price reversal is only partial), some authors appeal to a downward-sloping, long-run demand curve for stocks (e.g., see L&M [1997]). This hypothesis is included as a trading effect because the negative slope of the demand curve is due to trading effects, which are independent of fundamentals.

Other authors have proposed explanations for the apparent, permanent price increase based on changed fundamentals. For example, some argue that a company's addition to the S&P 500 represents "good news" about its long-term prospects. This hypothesis runs directly counter to Standard and Poor's claim that S&P 500 additions are not based on an evaluation of a company's future performance (see Boss and Ruotolo [2000]). A second fundamental hypothesis focuses on agency costs. It is argued that a S&P 500 company has more press coverage than other companies, which lowers its agency costs and raises future profits. (Dhillon and Johnson [1991]). While these fundamental explanations make the permanent price increase consistent with EMH, they provide no explanation for the pattern of an initial price increase followed by a subsequent price reversal.

Most recently, however, the belief that companies added to the S&P 500 enjoy a permanent stock price increase has been challenged. Malkiel and Radisich [2001] find that the price reversal is larger the longer the event window studied, and that just as the initial price increase has grown over time, so too has the price reversal. They conclude that a company's addition to the S&P 500 has no permanent effect on its stock price. Their evidence would suggest then that only trading effects are important in explaining the pattern of price changes for S&P 500 additions.

Given that trading effects must be at least a part of the S&P 500 effect story, we believe that these effects need to be examined in more detail. If the trading effects are contributing to the size of the initial price pop of S&P 500 additions, they should also cause a permanent increase in stock price volatility. The initial price increase is at least partially a result of the short-run excess demand for a company's shares upon announcement of its addition to the S & P 500. This short-run excess demand is also associated with a permanent reduction in the tradable supply of the company's stock. Consequently, shocks to a downward sloping, short-run demand curve should lead to increased stock price volatility for the company post-addition. Therefore, one would expect that the larger the initial price increase the greater the increase in stock price volatility. In addition to the increased price volatility due to the reduction in the net tradable supply, one may also expect stock price volatility to increase post-addition because of the observed increase in trading volume. For example, Beneish and Whaley (1996) report that the trading volume of S&P additions appears to rise permanently by up to 30 percent post-addition. The trading effects that cause increased stock price volatility can contribute to the observed price reversal to the extent that this increased volatility raises risk-adjusted discount rates.

The relationship between trading effects and the size of the price reversal is particularly interesting because its importance should be increasing over time with the growth in S&P 500 index funds (see Table I). Consequently, trading effects have the potential simultaneously to explain the growing S&P 500 announcement effect over time along with the recent evidence of a growing price reversal. Notice that the increased price volatility hypothesis provides an explanation of the price reversal, that while based on trading effects, is not a direct violation of the information arbitrage efficiency. In particular, even though a firm's future cash flows may be unaffected by S&P's announcement, the increased price volatility of its shares post-addition leads to a higher risk premium, so that the firm's unchanged cash flows have a lower present discounted value. Such increased price volatility post-addition could be viewed as an example of the importance of "noise trading," as proposed by De Long et al (1990), which causes stock prices to deviate from their fundamental values without generating arbitrage profit possibilities.[1]

In this paper, we look at S&P additions from 1978 to 1998 to test for the importance of trading effects. We find that the initial price pop upon announcement is positive, statistically significant and appears to be growing over time. The behavior of the price reversal is more varied, but in the most recent period it is substantial and statistically significant. As a result, for many firms in the most recent period, being added to the S&P 500 does not lead to a permanent price increase. We also find that a company's addition to the S&P 500 leads to a permanent increase in its stock price volatility and the size of that increase appears to be growing over time. Finally, we relate the cross-sectional variation in the announcement price increase, the permanent price increase and the post-addition price volatility increase. In the most recent period our evidence strongly suggests that the announcement price increase of S&P additions comprise both permanent price effects and temporary trading effects. In addition, the increased stock price volatility of companies added to the S&P 500 index, a trading effect, is negatively related to the permanent price increase. If the importance of these trading effects continues to grow, we would expect a company's permanent stock price change following its addition to the S&P 500 to become increasingly negative.

The paper proceeds in the following 4 sections. In the next section we formalize our trading hypothesis in a very simple model of the short and long-run demand for stocks. Section III describes the data and the methods used for measuring abnormal returns. In Section IV, we describe the average behavior of S&P 500 additions in terms of abnormal returns and price volatility and how this behavior appears to be changing over time. Section V presents the cross-sectional evidence on the pattern of abnormal returns and the increases in price volatility. We present our conclusions in Section VI.

II. Price Changes for S&P 500 Additions: Trading Effects and Long-run Equilibrium Effects

In this section, we analyze a very simple model that explicitly accounts for trading effects as well as changes in the long-run equilibrium price of a stock. The model is a simple way to organize the theoretical predictions about the average behavior of the cumulative abnormal returns (CARs) of S&P 500 additions, as well as the cross-sectional variation in these CARs. The idea behind trading effects is that due to the limits of risky arbitrage there is a downward sloping, short-run demand curve for stocks (as is described in Wurgler and Zhuravskaya [1999]). As a result, the short-run excess demand for a stock can be written as:

$$(1) \qquad EXD = \frac{-TS\left[\frac{P-P^*}{P^*}\right]}{h} + u$$

where TS is the total tradable supply of the stock (the shares not held by index mutual funds); P is the current price of the stock; P* is the long-run equilibrium value of the stock and is also equal to the risk-adjusted present discounted value of the stock's dividends; u is a measure of random excess demand shocks, due to trading imbalances, "noise" traders and other factors, and h is a parameter that the measures the extent of close substitutes for this stock. In the presence of risk neutral arbitrageurs, h would approach zero, so that P would always equal P*. As Wurgler and Zhuravskaya (1999) argue the costs of risky arbitrage cause h to be positive. Setting (1) equal to zero and rearranging yields the short-run equilibrium price as a percentage of its long-run equilibrium value:

$$(2) \qquad \frac{P-P^*}{P^*} = \frac{hu}{TS}$$

but assuming that (P-P*)/P* is small, the left-hand side can be approximated by ln[1+(P-P*)/P*] = ln(P/P*), so that (2) can be written as:

$$(2') \qquad \frac{P}{P^*} = e^{hu/TS}, \text{ and } P = P^* e^{hu/TS}.$$

Consequently, percentage changes in P comes from changes in P* and from short-run excess demand shocks:

$$(3) \qquad \frac{dP}{P} = \frac{dP^*}{P^*} + \frac{hdu}{TS} = v + \frac{hdu}{TS},$$

where v are random shocks to the long-run equilibrium values and $du = u - u_{-1}$[2]. On the day of the announcement that a firm is being added to the S&P 500 index, there is an unusually large excess demand shock because of the new demand for shares of the company by S&P 500 mutual funds, (i.e., dTS). There is also the possibility of an unusual shock to the firm's long-run equilibrium value (i.e., v_f). To keep the algebra simple we assume that these two shocks dominate any other excess demand shocks or shocks to P* that are not related to the company's addition to the S&P 500 Index:

(4) $$\left[\frac{dP}{P}\right]_0 = v_f + \frac{hdTS}{TS} = v_f + h\theta_t,$$

where $[dP/P]_0$ is the announcement price effect from a firm's being added to the S&P 500 Index, and θ_t is the fraction of tradable supply of the firm's shares that are removed from the market as a result of the acquisitions of S&P 500 index mutual funds. The parameter, θ, has an explicit time subscript to reflect the growth in the size of S&P 500 index mutual funds over time. Thus the initial price increase can be separated into factors affecting the firm's long-run equilibrium value and trading effects, where the importance of the latter should be growing over time.

Notice also that (3) can be used to express the standard deviation over time in the return on the stock of a given company as:

(5) $$\sigma_R = SDDEV\left(\frac{dP}{P}\right) = \sqrt{\sigma_v^2 + \frac{h^2\sigma_{du}^2}{TS^2}},$$

where we assume that excess demand shocks and shocks to P* are uncorrelated over time and to each other and that the parameters h and TS are constant for a given company. Thus the variances in (5) reflect time series variation for a given firm. Given (5) the ratio of the post to pre announcement standard deviations can be written as:

(6) $$\frac{\sigma^{POST}}{\sigma^{PRE}} = \frac{\sqrt{\sigma_v^2 + \frac{h^2\sigma'^2_{du}}{TS'^2}}}{\sqrt{\sigma_v^2 + \frac{h^2\sigma_{du}^2}{TS^2}}}$$

$$= \frac{\sqrt{\frac{TS^2\sigma_v^2}{\sigma_{du}^2} + \frac{h^2\sigma'^2_{du}}{\sigma_{du}^2(1-\theta_t)^2}}}{\sqrt{\frac{TS^2\sigma_v^2}{\sigma_{du}^2} + h^2}}$$

$$= \frac{\sqrt{A + \frac{h^2\sigma'^2_{du}}{\sigma_{du}^2(1-\theta_t)^2}}}{\sqrt{A + h^2}}$$

where ' indicates variables that are measured post-addition, TS' = (1-θ)TS, and A is just a positive constant. We have assumed that the variance of shocks to a company's fundamentals is unaffected by its addition to the S&P 500 index. The measure of the change in price volatility in (6) will be greater than one when $\sigma'^2_{du} / \sigma^2_{du}(1-\theta_t)^2$ is greater than 1. This condition for increased price volatility is likely to occur due to two factors: 1) As previously noted, trading volume appears to rise permanently after its addition to the S&P 500, so that σ'_{du} is likely to be greater than σ_{du}; 2) The tradable supply of a company's shares decreases post-addition, so that excess demand shocks lead to more price volatility. Notice that the latter effect should also be growing over time as θ_t increases. In addition and importantly, if the ratio of standard deviations is greater than one, then this ratio is a positive function of h, so at times it will be convenient to express $\sigma^{POST}/\sigma^{PRE}$ as equal to $f(h,\theta_t)$, where both first partial derivatives and the cross partial derivatives are positive.

Finally, it is assumed that the risk-adjusted discount rate rises with an increase in price volatility, so that in the long-run an increase in price volatility leads to a decrease in P*[3]:

(7) $$\frac{dP*}{P*} = -\phi \frac{\sigma^{POST}}{(\sigma^{PRE} - 1)},$$

where $-\phi$ reflects the effect of an increase in price volatility on the risk-adjusted discount rate. The relationship in (7) shows why we have been using the awkward term, long-run equilibrium price, rather than the more familiar fundamental value. The permanent price change in (7) occurs despite the fact that there has been no change in the distribution of the firm's future cash flows. Therefore, even though the fundamental value of the firm's physical capital is unchanged, the value of the firm's stock has fallen. This change in the long-run equilibrium price is similar to the effects of noise trading in the model of De Long et al (1990).

The algebra in (3)-(7) allows one to express the permanent price change, which will be measured by a long-window, cumulative abnormal return, or CAR, as:

(8) **CAR** $$= \left[\frac{dP}{P}\right]_0 - \phi \frac{\sigma^{POST}}{(\sigma^{PRE} - 1)} - h\theta_t + \sum_1^T v_t + \frac{hu_T}{TS}$$

$$= v_f - \phi f(h,\theta_t) + \sum_1^T v_t + \frac{hu_T}{TS},$$

where T is the terminal date of the CAR.

Thus our simplified model has the following implications about the average behavior of firms added to the S&P 500 Index as θ_t increases and trading effects become more important: 1) The average announcement price effects should be rising over time; 2) The average increase in price volatility should be rising over time, and 3) the average permanent price increase should be falling over time because of increases in the risk-adjusted discount rate. These predictions are based on everything else being held equal, such as the average value of v_f, which measures the fundamental effect on P* from a firm being added to the S&P 500 Index.

The simple model also has implications about the cross-sectional correlations between the price announcement effect, the increase in price volatility, and the permanent price increase. From the perspective of a cross section at a given time, v_f, h, Σv_t, and hu_T/TS can be considered random variables. Therefore, the simple, cross-sectional regression coefficient from the regression of the announcement price, $[dP/P]_0$, on the change in price volatility, $\sigma^{POST}/\sigma^{PRE}$, which for later convenience we will label b_{23} can be written (using (4) and (6)) as:

$$(9)\quad b_{23} = \frac{COV[h\theta_t, f(h,\theta_t)]}{VAR[f(h,\theta_t)]} > 0,$$

where the variances and covariances stand for cross-sectional variation. From (9) one would expect that in a simple regression that the coefficient b_{23} would be positive, although it is unclear whether or not it would increase over time, since θ_t, affects both the numerator and denominator of (9).

Similarly, in a simple regression of the permanent price increase on the price announcement effect, the regression coefficient (which we label b_{12}) can be written (using (4), (6) and (8)) as:

$$(10)\qquad b_{12} = \frac{\sigma_{V_f}^2 - \phi COV[h\theta_t, f(h,\theta_t)]}{\sigma_{v_f}^2 + \theta_t^2\sigma_h^2},$$

In the limiting case, where trading effects are unimportant, b_{12} equals 1. We would expect b_{12} to fall below 1 as trading effects became more important, say as a result of the increase in θ_t over time. In the special case where only trading effects are important (i.e., where $\sigma^2_{Vf} = 0$), b_{12} would be less than zero. We would expect that b_{12} would be positive. As we compare the regression coefficients from later cross sections we should expect b_{12} to be smaller because of the increase in trading effects as reflected by the increase in θ_t, and thus an increase in both $COV[h\theta_t, f(h\theta_t)]$ and $\theta_t^2\sigma^2_h$.

Finally, the simple regression coefficient (which we label b_{13}) from the regression of the permanent price increase on the increase in price volatility is given by (using (6) and (8)):

(11) $b_{13} = -\phi < 0.$

Given our labeling of the simple regression coefficient, we can make some predictions about the coefficients of the multiple regression of the permanent price increase on the price announcement effect and the increase in price volatility. In particular , (see Johnston [1960]), the absolute values of the multiple regression coefficients have to be bigger than the following combinations of the simple regression coefficient:

(12) $\text{ABS}(b_{12\bullet 3}) > \text{ABS}(b_{12} - b_{13}\, b_{23})$

(13) $\text{ABS}(b_{13\bullet 2}) > \text{ABS}(b_{13} - b_{12}\, b_{23})$,

where $b_{12\bullet 3}$ is the coefficient on the announcement price effect in the regression of the permanent price increase on the announcement price effect and the increase in price volatility. Given the assumed signs of the simple regression coefficients, however, $b_{12} - b_{13}\, b_{23} > b_{12} > 0$, and $0 > b_{13} > b_{13} - b_{12}\, b_{23}$. Therefore our model predicts that in the multiple regression of the permanent price increase, the coefficient on the announcement price effect will be a larger positive number and the coefficient on the increase in price volatility will be a smaller negative number (i.e., negative, but larger in absolute value).

To summarize, the theoretical predictions of the model with both trading effects and changes to the long-run equilibrium value of P* are:

Average Behavior:

1) The announcement price effect should be positive and increasing over time;

2) Stock price volatility should be greater post-addition for company's added to the S&P 500, and the increase in price volatility should be growing over time.

3) The permanent price increase should be positive, but decreasing over time.

Cross-Sectional Correlations:

1) $b_{23} > 0$, $b_{12} > 0$, $b_{13} < 0$, and b_{12} should be smaller in later time periods

2) $b_{12\bullet 3} > b_{12} > 0$ and $b_{13\bullet 2} < b_{13} < 0$.

One should note, however, that the individual firm CARs are very noisy and thus we are most likely to observe the theoretical predictions in later cross sections, when θ_t is large due to the growth of S&P 500 Index mutual funds.

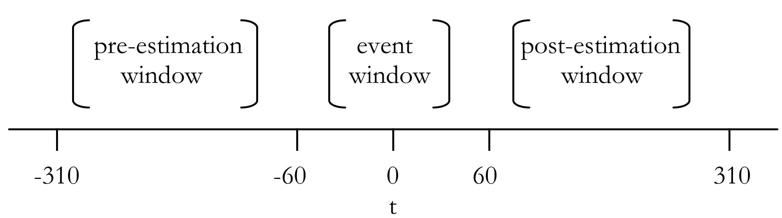
III. Data and Methods

For our study, we obtained Standard and Poor's lists of additions to the S&P 500 Index along with their announcement dates for the period between 1978 and 1998.[4] Data on daily stock price returns were taken from the Center for Research in Security Prices (CRSP) tapes, and the daily return on the CRSP (NYSE/AMEX/NASDAQ) value-weighted index served as our proxy for the market return.

Our final sample consists of 303 additions. This sample excludes companies added to the S&P 500 for which no daily return data were available on the CRSP tapes. We also eliminated companies whose addition was the result of a merger or other corporate restructuring. Moreover, in keeping with the practice of previous authors, we removed companies that experienced other news concurrent with S&P's announcement of their addition to the S&P 500 (see for example B&W).[5] The rationale behind removing such firms is that simultaneous news might contaminate the price effects of S&P's announcement of a change to the S&P 500.

Prior to October 1989, the announcement and effective dates of changes to the S&P 500 were the same. Subsequently, S&P began pre-announcing the changes in order to ease the trading order imbalances created by index funds' demand for shares of an added company's stock. As a result, much of the initial price pressure for firms added after October 1989 occurred prior to the effective date as arbitrageurs bid up their stock prices in anticipation of the S&P 500 index funds' need to purchase large blocks of their shares near the effective date.

The diagram below depicts the event window for our study, where event time is measured in days relative to the announcement date:



We used daily return data from the pre and post-estimation windows to make the pre and post-addition empirical comparisons that will be discussed in the next section. The post-announcement cumulative abnormal returns (CARs) for the S&P 500 additions are the sum of the abnormal returns over the event window (t_1,t_2). We chose to examine CARs for the following windows: (0,1), (0,5), (0,59), (6,59). The CAR (0,1) reflects the initial price pop of a company's stock following S&P's announcement of its addition to the S&P 500.[6] According to EMH, this two-day event window should be sufficient to capture whatever permanent price effect of being added to the S&P 500 will have on a security. But with the possibility of trading effects, it is conceivable, that not all of the price pop would occur immediately, particularly given the post 1989 practice of pre-announcing additions. Consequently, CAR (0,5) provides an alternative measure of the price pop, which allows trading effects to influence an added company's stock price over a number of days. CAR (0,59) measures the permanent price effect associated with a company's addition to the S&P 500. [7] Finally, the CAR (6,59) measures the size of the price reversal following the initial price pop.

We calculate both beta-adjusted and beta-unadjusted post-announcement, abnormal returns. The beta-adjusted returns come from the market model, which for security *i* and day *t* can be written as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

Consequently, a company's abnormal return on any day *t* is simply its actual return minus the return predicted by the market model.

$$AR_t = R_{it} - \hat{R}_{it} = R_{it} - \alpha_i - \beta_i R_{mt}$$

$$\textit{where}: \; R_{it} \textit{ is the actual return} \text{ and } \hat{R}_{it} \textit{ is the predicted return}$$

The β_i and α_i used in the company's predicted return come from estimating the market model over the pre-estimation window, (-310,-60). For the unadjusted abnormal returns α_i was set to zero and β_i to 1.

IV. Cumulative Abnormal Returns of S&P Additions

Some basic information about the distribution of abnormal returns is provided in Tables II and III. The former table presents measures of the β-adjusted abnormal returns. The latter table provides the same information where abnormal returns are measured by the difference in companies' raw returns and the return on the market portfolio. The difference in the measure of abnormal returns is irrelevant for the short-window CARs (i.e., CAR(0,1) and CAR(0,5)), but makes a substantial difference in the longer-window CARs. The reason for this difference is apparent in Table IV, where it is shown that the short-window CARs are almost identical, while the degree of correlation in the long-window CARs is substantially lower. This pattern of correlations is not surprising: If the abnormal returns measures are almost the same, the differences will be more apparent with the long-window CARs that allow more of these differences to accumulate.

Fortunately, the qualitative story told by the two measures of CARs is the same. The price increase upon announcement is statistically significant and growing over time. In addition, the return over the first week is positive and statistically significant in all periods and it appears to be growing over time. The difference between the announcement effect and the first week effect appears to be greater in the latter two periods, which probably reflects the preannouncement of S&P 500 additions starting in October of 1989. Finally, it is interesting to note that the percentage of net gainers over the first week, while still substantial is also reduced relative to the number of gainers immediately post announcement.

The qualitative story told by the long-window CARs also does not depend upon the measure of the abnormal return, but the quantitative story does. The price reversal (as measured by CAR(6,59)) is substantial and statistically significant in the most recent period. The price reversal is the smallest in the middle period (and in fact the unadjusted CARs show a small price increase). Thus, in terms of the price reversal, the first and third periods look more similar. In addition, the quantitative size of the price reversal is about 3 to 5 percentage points larger for the β-adjusted CARs. As a consequence, the permanent price change (as measured by CAR(0,59)) is estimated to be on average negative for the first and third period with the β-adjusted CARs. Thus in the most recent period there is evidence that the average firm's addition to the S&P 500 does not lead to a permanent price increase. And, even with the unadjusted CARs, a substantial minority of the firms (36%) in the most recent period experienced a permanent price decrease.

One last feature to note in Tables II and III is the dispersion in the price reversal (as measured by the inter-quartile range of CAR(6,59)). In terms of the β-adjusted CARs this range is about 17 percentage points and for the unadjusted CARs it is over 14 percentage points.[8] These ranges span substantial negative and somewhat smaller positive CARs. Thus, while on average, there is a substantial stock price reversal for S&P additions, which is statistically significantly different from zero in the most recent period, the behavior of individual firms is quite diverse. This dispersion in returns may help to explain why the price reversal is not arbitraged away, since such arbitrage is likely be very risky.

Given the sensitivity of the quantitative story in Tables II and III to the measure of abnormal returns, we thought it was worth comparing our results to prominent recent studies by B&W and L&M. B&Ws measure of abnormal returns differs from either of our measures in two ways: 1) They measure the market rate of return by the price change of an S&P 500 futures contract; 2) They calculate compound rates of return for the CARs, rather than the simple arithmetic sum of the abnormal returns that we use. Nevertheless, B&W use what we would call an unadjusted abnormal return. L&M also use an unadjusted abnormal return measure, where they do not specify the market rate of return. They report similar results using a "market model," essentially the β-adjusted procedure that we used. As is apparent from Table V, the diversity in our results for the two different measures of CARs is no greater than the diversity of results in the published literature for a sample over a similar period.

Again, our hypothesis is that trading effects have become increasingly important in the stock price behavior of S&P additions because of the growth of index funds. Our evidence that the initial price increase has apparently grown over time is consistent with this hypothesis. In addition, however, we believe that these increasingly important trading effects should also be leading to increased post-addition volatility. The evidence related to this part of the trading hypothesis is contained in Table VI, where price volatility is measured by 3 different ratios: 1) the post to pre estimated β in a market model regression (i.e., estimated systematic risk); 2) the post to pre standard errors of the market model regressions used to estimate the post to pre estimated β, and finally 3) the ratio of the standard deviations of company returns for the pre and post periods. In each case the estimation period is 250 days, for the pre period starting 310 days before the announcement and for the post period starting 60 days after the announcement. Average price volatility is higher in the post than pre period for all 3 measures. The estimates of β, however, are somewhat anomalous because the increase in the ratio of the β seems to be smallest in the most recent period. For the other two measures, price volatility is not only higher in the post periods, but the ratio appears to increase with time, a result one would expect with the growing size of index funds.

Overall, however, our sample of firms added to the S&P 500 from 1978 to 1998 suggests that the announcement price increase has grown over time, while at the same time these firms have experienced an increasingly important increase in price volatility. While the behavior of the average subsequent price reversal is not uniform over time, it does appear, at least most recently, that S&P additions suffer a statistically significant price reversal, so that the average permanent price change for S&P additions is small, if not negative. Thus the evidence on average price announcement effects and price volatility is consistent with the predictions of the model in Section II. The evidence on the permanent price change is more complex, but at least for the most recent period trading effects appear to be increasingly important in explaining the permanent price change of firms added to the S&P 500 Index. In the next section we use cross-sectional regression analysis to examine whether the cross-sectional predictions of the model are consistent with the data.

V. Cumulative Abnormal Returns and Increased Price Volatility: A Cross Sectional Analysis.

While the individual firm CARs are very volatile, our sample of 303 additions allows us to use cross sectional-correlations to draw inferences about causation in the patterns of abnormal returns. In trying to estimate these correlations with regressions, however, we have to account for two issues: 1) Our theory and the evidence from Tables II, III and VI suggests that the process driving abnormal returns for S&P additions is not stationary over time; 2) Much of our information regarding the added firms is derived from estimates; e.g., pre and post sample standard deviations, estimated CARs. Clearly, our regressors are stochastic and measure the true underlying variables with error. The first problem we deal with by estimating over different sample periods and by using time dummies. The second problem has been analyzed by Pagan [1984], where he shows that when the null hypothesis is that the coefficient on the estimated variable is zero (which is the case for much of our analysis) the OLS estimate of the variance of that coefficient is consistent and the "asymptotic t-statistics" are valid.[9]

Tables VII and VIII present our results in four columns; first for the entire sample period and then for each of the 3, seven-year sub-sample, periods. The top panel for each table presents the results using the β -adjusted CARs and the bottom panel for the unadjusted CARs. Table VII and VIII differ because of the inclusion of time dummies. The theory developed in Section II did not suggest that the constant terms should be changing over time, but given that some of the regressors (e.g., the price announcement CAR and the price volatility measures) are changing over time, we felt that it was appropriate to include time dummies to make sure that the regression coefficients were not picking up other time series variation in the data. Fortunately, the qualitative story is invariant to the different specifications.

The results in the first column, for the entire sample period, show that the point estimates of all the simple regression coefficients are consistent with the theory. The relationship between the point estimates of the simple regressions and the multiple regression coefficients are also consistent. None of the coefficients of the price volatility measure in the simple regressions, however, are statistically significant.

The results in columns (2)-(4) suggest that the full-sample point estimates are being driven by the latest period, again except for the coefficient on the price announcement effect. In the two earlier sub-periods, the "t" statistics on the regression coefficients for the price volatility measure are all less than one and/or the coefficients have the incorrect sign.[10] The coefficients on the price announcement effects all have the right sign and size (i.e., between 0 and 1), but none are significantly different than zero in the earlier sub-periods. In addition, the prediction that the simple regression coefficient between the permanent price change and the price announcement effect should fall over time is generally not apparent in Tables VII and VIII. Thus in the pre-1991 regressions the model of Section II is not generally consistent with the data. The results for the last sub period, however, are dramatically different. All of the theoretical predictions are fulfilled and most of the coefficients are statistically significant.

We don't have an explanation for why we find so little evidence for the importance of trading effects in the earlier sample periods. It is not surprising, however, that the importance of trading effects should be most evident in the latest sub period, when theory suggests these effects should be the largest. The results for the β-adjusted CARs are particularly interesting in this regard. The point estimates of the regression coefficients (in last column of the top panel of Tables VII and VIII) show that addition to the S&P 500 appears to lead to a price announcement effect that is positively correlated with the subsequent increase in price volatility, so that permanent price increase includes only a fraction of the price announcement effect. Therefore in the multiple regression it appears that once one controls for trading effects through the inclusion of the price volatility measure, the permanent price increase includes all of the remaining price announcement effects due to changes in fundamentals (i.e., due to v_f in (4))

VI. Conclusion

On average, when a firm is added to the S&P 500 Index, its stock price rises on announcement, its stock returns become more volatile, and a fraction (which has been growing over time) of the announcement gains are reversed in the subsequent weeks. All of these effects appear to have increased dramatically in the most recent period.

The cross-sectional evidence suggests that these findings can be explained, particularly in the most recent period, based on a combination of fundamental effects and trading effects that result from a firm being added to the S&P 500. In particular, our cross-sectional evidence suggests that there are important effects of a company being added to the S&P 500 that affect its stock price immediately and at least in part permanently. Our evidence, however, is silent about the source of these fundamental effects. The permanent price change also includes a price decrease that is related to the increased volatility of a company's stock returns post-addition. Therefore these permanent price decreases appear not to be the result of fundamental changes to the distribution of the firms' cash flows, but rather to increases in the firm's risk-adjusted discount rates given the increased volatility in its stock price. This latter effect appears to be consistent with the theoretical arguments first raised by De Long et al (1990), and appears to be growing over time. As a result, the news that a firm is being added to the S&P 500 is no longer good news, at least in the long run.

References

Beneish, Messod, D. and Robert B. Whaley. 1996, "The Anatomy of the 'S&P Game': The Effects of Changing Rules," *The Journal of Finance*, 51, December, pp.1909-30.

Bos, Roger, J. and Michele Ruotolo. 2000, "General Criteria for S&P US Index Membership," Standard & Poor's, mimeo,

Cooper, Daniel. 2001, "The Standard and Poor's 500 Effect: Evidence of Noise Trading and a Failure of Fundamental Value Efficiency in Financial Markets, Senior Honors Essay, Amherst College.

De Long, J. Bradford, Andrei Shleifer, Lawrence Summers, and Robert J. Waldman. 1990, "Noise Trader Risk in Financial Markets," *Journal of Political Economy*, 98, no.4, pp. 703-38.

Dhillon, Upbinder and Herb Johnson. 1991, "Changes in the Standard and Poor's 500 List, *Journal of Business*, 64, pp. 75-85.

Johnston, J..1960, *Econometric Methods*, New York: McGraw-Hill Book Co..

Kraus, A. and H. R. Stoll. 1972, "Price Impacts of Block Trading on the New York Stock Exchange," *The Journal of Finance*, June 1972, pp. 569-88.

Lynch, Anthony W. and Richard R. Mendenhall. 1997, "New Evidence on Stock Price Effects Associated with Changes in the S&P 500 Index," *Journal of Business*, 70, no. 3, pp. 351-83.

Malkiel, Burton, G. and Aleksander, Radisich. 2001, "The Growth of Index Funds and the Pricing of Equity Securities," *The Journal of Portfolio Management,* Winter, pp. 9-21.

Pagan, Adrian, 1984. "Econometric Issues in the Analysis of Regressions with Generated Regressors," *International Economic Review*, 25, no. 1, pp. 221-47.

Wurgler, Jeffrey and Katia Zhuravskaya. 1999 "Does Arbitrage Flatten Demand Curves for Stocks," Yale School of Management, mimeo.

TABLE I: Index Fund and S&P 500 Index Capitalization						
	1976	1980	1984	1988	1992	1996
S&P 500-tracking index fund capitalization ($ billion)	19	35	68	135	255	475
S&P Total Capitalization ($ Billion)	662	926	1217	1897	3015	5626
Size of Index Funds as % of total S&P Capitalization	2.9	3.8	5.6	7.1	8.5	8.4

(Source: Wurgler and Zhuravskaya, 1999)

*Table II. β Adjusted CARs**				
	1978-1998	1978-1984	1985-1991	1992-1998
N	303	101	108	94
Car(0,1)				
Q1	0.013	0.010	0.014	0.017
Median	0.032	0.023	0.035	0.042
Q3	0.057	0.045	0.055	0.070
Mean	0.035	0.027	0.035	0.045
Weighted Mean	0.036	0.027	0.033	0.048
	(15.12)	(9.89)	(10.41)	(8.18)
% > 0	87	86	88	87
Car(0,5)				
Q1	0.005	-0.003	0.008	0.014
Median	0.035	0.024	0.037	0.050
Q3	0.071	0.052	0.065	0.100
Mean	0.037	0.024	0.038	0.049
Weighted Mean	0.039	0.027	0.039	0.053
	(12.54)	(6.26)	(9.30)	(7.16)
% > 0	79	73	84	79
Car(6,59)				
Q1	-0.127	-0.128	-0.110	-0.142
Median	-0.030	-0.042	-0.004	-0.041
Q3	0.051	0.057	0.067	0.026
Mean	-0.045	-0.037	-0.023	-0.077
Weighted Mean	-0.039	-0.035	-0.017	-0.071
	(4.66)	(2.34)	(1.26)	(4.61)
% > 0	38	37	46	31
Car(0,59)				
Q1	-0.090	-0.100	-0.065	-0.091
Median	0.008	-0.011	0.038	-0.005
Q3	0.097	0.074	0.110	0.100
Mean	-0.008	-0.013	0.015	-0.029
Weighted Mean	-0.000	-0.001	0.022	-0.018
	(0.01)	(0.56)	(1.65)	(0.99)
% > 0	52	48	60	47

*Weighted means are Cars weighted by the standard error of the regression estimating beta in the pre-event period. "t" statistics in parentheses are the absolute value of the weighted observations using the cross sectional variation in the CARs

Table III. Unadjusted CARs				
	1978-1998	1978-1984	1985-1991	1992-1998
N	303	101	108	94
Car(0,1)				
Q1	0.014	0.012	0.016	0.019
Median	0.032	0.025	0.040	0.042
Q3	0.055	0.048	0.054	0.069
Mean	0.036	0.028	0.036	0.045
Weighted Mean	0.036	0.028	0.034	0.048
	(15.50)	(10.25)	(10.66)	(8.32)
% > 0	88	89	89	86
Car(0,5)				
Q1	0.008	-0.003	0.016	0.015
Median	0.039	0.031	0.040	0.060
Q3	0.072	0.055	0.066	0.097
Mean	0.041	0.027	0.043	0.054
Weighted Mean	0.042	0.029	0.042	0.058
	(13.29)	(6.90)	(10.01)	(7.47)
% > 0	80	73	84	81
Car(6,59)				
Q1	-0.089	-0.108	-0.072	-0.105
Median	-0.003	-0.027	0.014	-0.007
Q3	0.069	0.076	0.076	0.054
Mean	-0.006	-0.004	0.010	-0.026
Weighted Mean	-0.009	-0.008	0.009	-0.030
	(1.10)	(0.55)	(0.79)	(2.13)
% > 0	48	45	56	45
Car(0,59)				
Q1	-0.050	-0.079	-0.037	-0.035
Median	0.040	0.017	0.071	0.040
Q3	0.123	0.115	0.125	0.132
Mean	0.035	0.023	0.053	0.028
Weighted Mean	0.034	0.021	0.051	0.027
	(4.16)	(1.42)	(4.27)	(1.69)
% > 0	62	52	69	64

Table IV. Correlations Between the Two Measures of CARs				
	1978-1998	1978-1984	1985-1991	1992-1998
N	303	101	108	94
CAR(0,1)	0.99	0.97	0.99	0.99
CAR(0,5)	0.97	0.94	0.97	0.99
CAR(6,59)	0.87	0.86	0.87	0.88
CAR(0,59)	0.86	0.83	0.85	0.91

Table V. Measures of CARs[a]				
	N	Ann. Price Change[b]	Price Reversal[c]	Total Permanent Return[d]
Beneish & Whaley (1996) 10/89-6/94	33	7.211	-4.504	2.707
Lynch & Mendenhall (1997) 3/1990-4/95	34	3.807 (79%)	-2.106 (32%)	1.701 (71%)
Unadjusted CARs 1/1990-12/94	41	5.024 (85%)	-2.467 (51%)	2.557 (66%)
β Adjusted CARs 1/1990-12/94	41	4.691 (83%)	-6.414 (34%)	-1.723 (51%)

a. Beneish and Whaley (1996) [B&W] measure CARs for a security in terms of the total return (including compounding) from holding the security minus the return on S&P 500 futures contracts. Lynch and Mendenhall (1997) [L&M] measure CARs in terms of the difference between the raw return on the security and the market return.
b. B&W's CARs are measured between the announcement date and the effective date. L&M's CARs are measured between the announcement date and the day before the effective date. Our CARs are measured between the announcement date and six days later.
c. B&W's price reversal is inferred as the difference between the CAR for the announcement date to the effective date and the CAR between the announcement date and the post effective date plus 60. L&M measures the reversal as the CARs between the effective date and 7 days later. Our CARs reversal is are measured between 6 days after the announcement date and 60 days after the announcement date.
d. B&W measures the permanent return as CARs between the announcement date and 60 days after the effective date. L&M measure this return as the CARs between the announcement date and 7 days after the effective date. Our "permanent" CARs are measured between the announcement date and 60 days after the announcement date.

Table VI Pre and Post Volatility				
	1978-1998	1978-1984	1985-1991	1992-1998
N	303	101	108	94
Ratio of Post to Pre Estimated β				
Q1	0.866	0.774	0.965	0.886
Median	1.130	1.058	1.299	1.051
Q3	1.486	1.397	1.599	1.319
Mean	1.254	1.440	1.259	1.050
	(2.23)	(1.50)	(2.75)	(0.32)
% > 1	62	57	71	55
Ratio of Post to Pre Regression Standard Errors from β Equations				
Q1	0.885	0.846	0.825	0.954
Median	1.063	1.017	1.069	1.087
Q3	1.242	1.232	1.254	1.272
Mean	1.093	1.046	1.100	1.134
	(4.84)	(1.62)	(2.64)	(4.36)
% > 1	61	53	60	70
Ratio of Post to Pre Standard Deviation of Returns				
Q1	0.897	0.847	0.847	1.002
Median	1.104	1.024	1.142	1.148
Q3	1.293	1.223	1.416	1.326
Mean	1.130	1.043	1.168	1.180
	(6.58)	(1.64)	(4.08)	(5.94)
% > 1	65	54	60	70

“t” statistics in parentheses test the null hypothesis that the true volatility ratio is one using the cross-section variation in the observed volatility ratios.

Table VII. Regression Results

β Adjusted CARs					
		1978-1998	1978-1984	1985-1991	1992-1998
	N	303	101	108	94
Dep Var:					
CAR(0,1)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	0.0067	-0.0014	-0.0053	0.0443
	b_{23}	(0.88)	(0.14)	(0.59)	(2.05)
CAR(0,59)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0243	-0.0010	0.0090	-0.1288
	b_{13}	(0.78)	(0.16)	(0.23)	(1.77)
	CAR(0,1)	0.8029	0.7776	0.7314	0.8424
	b_{12}	(3.35)	(1.33)	(1.71)	(2.40)
	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0297	0.0002	0.0129	-0.1742
	$b_{13\bullet 2}$	(0.97)	(0.00)	(0.33)	(2.43)
	CAR(0,1)	0.8152	0.7776	0.7398	1.0256
	$b_{12\bullet 3}$	(3.40)	(1.32)	(1.72)	(2.94)
UnAdjusted CARs					
		1978-1998	1978-1984	1985-1991	1992-1998
	N	303	101	108	94
CAR(0,1)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	0.0063	0.0003	-0.0074	0.0452
	b_{23}	(0.83)	(0.03)	(0.82)	(2.11)
CAR(0,59)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0291	0.0297	-0.0245	-0.1116
	b_{13}	(1.04)	(0.54)	(0.70)	(1.70)
	CAR(0,1)	0.4346	0.4239	0.5087	0.4042
	b_{12}	(1.98)	(0.78)	(1.33)	(1.25)
	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0319	0.0295	-0.0209	-0.1366
	$b_{13\bullet 2}$	(1.14)	(0.54)	(0.60)	(2.05)
	CAR(0,1)	0.4472	0.4230	0.4899	0.5526
	$b_{12\bullet 3}$	(2.03)	(0.78)	(1.27)	(1.69)

Each row is a separate, weighted regression which includes time dummies for each year. The dummy takes on the value 1 for all observations in a given calendar year. The weights are given by the standard errors of the regression from the market model equation estimated from 360 to 60 days before the announcement of the addition. The absolute value of the "t" statistic is given in parentheses.

Table VIII. Regression Results (No Time Dummies)					
β Adjusted CARs					
		1978-1998	1978-1984	1985-1991	1992-1998
	N	303	101	108	94
Dep Var:	Simple Regress				
CAR(0,1)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	0.0109	-0.0023	-0.0094	0.0613
	b_{23}	(1.63)	(0.23)	(1.27)	(3.34)
CAR(0,59)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0132	0.0112	0.0223	-0.1449
	b_{13}	(0.51)	(0.20)	(0.71)	(2.45)
	CAR(0,1)	0.5687	0.6646	0.5806	0.6420
	b_{12}	(2.61)	(1.17)	(1.44)	(2.03)
	Multiple Regress				
	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0195	0.0128	0.0281	-0.2058
	$b_{13 \bullet 2}$	(0.77)	(0.22)	(0.89)	(3.44)
	CAR(0,1)	0.5844	0.6676	0.6251	0.9933
	$b_{12 \bullet 3}$	(2.67)	(1.17)	(1.53)	(3.15)
UnAdjusted CARs					
		1978-1998	1978-1984	1985-1991	1992-1998
	N	303	101	108	94
	Simple Regress				
CAR(0,1)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	0.0106	-0.0029	-0.0111	0.0620
	b_{23}	(1.59)	(0.03)	(1.49)	(3.34)
CAR(0,59)	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0074	0.0395	0.0035	-0.1041
	b_{13}	(0.32)	(0.74)	(0.12)	(1.94)
	CAR(0,1)	0.3927	0.3225	0.5259	0.3812
	b_{12}	(1.97)	(0.60)	(1.46)	(1.32)
	Multiple Regress				
	$\sigma_{S.D.POST}/\sigma_{S.D.PRE}$	-0.0117	0.0396	0.0095	-0.1433
	$b_{13 \bullet 2}$	(0.50)	(0.74)	(0.34)	(2.57)
	CAR(0,1)	0.4019	0.3237	0.5434	0.6314
	$b_{12 \bullet 3}$	(2.01)	(0.60)	(1.49)	(2.13)

These are the same regressions as reported in Table VII, except no time dummies have been included.

[1] Although the pattern of a price pop followed by a price reversal does suggest the possibility of arbitrage profits.

[2] Trading effects lead to apparent violations of informational efficiency, in this case the serial correlation in dP/P. The decay of the effect of demand shocks may be longer than one period and therefore more realistic, but for our purposes the pattern of the decay of excess demand shocks is not an important part of the analysis, so long as the demand shocks do not persist for the period over which we measure permanent price increases.

[3] If the information about the increase in price volatility is know at the time of the announcement the decrease in P* given in (7) would be a part of v_f. To keep the algebra simple we have assumed v_f does not depend on the increase in price volatility, but none of the qualitative predictions depend on this assumption.

[4] While some authors have studied the price effects of S&P 500 Index deletions (e.g., see L&M [1997]), we focused only on S&P 500 additions. Studying the deletions is difficult and not very insightful since most companies are removed from the S&P 500 due to mergers, bankruptcies or other corporate transformations.

[5] Concurrent news is firm-specific news releases that occurred two days prior until two days after the announcement date (i.e. news that might affect a company's perceived financial condition or expected future cash flows). Examples of such news include earnings announcements or changes, merger activity, marketing or other sales related agreements, takeover speculation, bond rating changes, initial or increased dividends, division divestiture, oil price changes, air traffic increase, debt offering, and a failed merger.

[6] As reported in Beneish and Whaley, (1996): Changes are announced around 4:30 EST after the market closes on day 0 so it would seem that any abnormal return would occur the following day. However trading still occurs on the Pacific and Arizona Stock Exchanges until 4:50 PM and 5:00PM respectively. Moreover, after hours trading until (6:30PM) on the electronic (ECN) networks became more commonplace during the 1990s so a company could technically experience an announcement related price pop on day 0.

[7] Looking at 60 day CARs to test for permanent price effects is the convention amongst most previous authors. The standard error of the CAR is proportional to the square root of the length of the event window. However, according to the EMH the expected value of the CAR does not change with the length of the event window. Therefore, the statistical tests about the implications of the CARs lose their power as the length of the event window increases and thus it is not practical to infer results from CARs much greater then 60 days.

[8] However, it should be noted that volatility in the CARs with longer windows is not unusual given the volatility of the underlying returns. The average standard error of the market model regression over the full sample is slightly under .02, so under EMH one would expect a CAR with an event window of 55 days to have a standard deviation of roughly $(55)^{0.5}(.02) = .15$

[9] It is still the case, however, that the estimated variables are measuring the true variables with error. Therefore, at least in the two variable case, the estimated coefficient is biased towards zero, which suggests that the power of rejecting the null is reduced.

[10] We also tried a specification using the ratio of the post to pre-estimated β as our measure of the increase in price volatility. Unfortunately, the results from this theoretically more appealing specification were not very robust.