Price Pressure on the NYSE and Nasdaq: Evidence from S&P 500 Index Changes

William B. Elliott and Richard S. Warr*

Using additions of NYSE- and Nasdaq-listed firms to the S&P 500, between 1989 and 2000, we explore the price effects of noninformation related demand shocks. After controlling for various firm characteristics, index fund growth, and arbitrage risk, we find that NYSE stocks suffer less pronounced price effects than do Nasdaq stocks on the day stocks are added to the Index. For NYSE stocks, this effect is reversed immediately, but Nasdaq stocks, show a partial reversal taking place over several days. We interpret this result as evidence of the superiority of the specialist system over the dealer system in mitigating price pressures.

An important facet of any stock market is its ability to absorb large demand shocks for stocks while minimizing any resulting change in price. In this article, we compare the price effects for Nasdaq and NYSE stocks added to the S&P 500 Index. Our experiment allows us to study the impact of exchange listing on the effects of large demand shocks that are relatively clean of confounding information.

This issue is more than an academic curiosity, since both the NYSE and the Nasdaq claim that their respective systems are better able to absorb such shocks (*Wall Street Journal*, July 26, 2000). The arguments of both sides have validity. The NYSE argues that the centralized specialist can see the big picture and manage supply more effectively than can a dispersed network of dealers. The NYSE also has the benefit of investor-supplied liquidity in the form of the limit order book (Cochrane, 1993), and the specialist is committed to taking offsetting positions in each stock he is assigned.

Nasdaq claims that its dispersed dealer system is better able to minimize the price impact of additions for several reasons (see Groth and Dubofsky, 1987). First, there is greater competition for order flow among the dealers. Second, greater minimum depths are offered across numerous dealers, which results in higher depth overall. Third, dealers can diversify their positions and are therefore more willing to make a market in the newly added stock. Finally, dealers can adjust inventory levels by trading directly with each other.

The relative ability of the NYSE and Nasdaq to absorb these shocks is an empirical question that has a direct relevance to index additions, to other large demand shocks, and to the debate over the pros and cons of market fragmentation.

After controlling for firm characteristics, arbitrage risk, and index fund demand, our results indicate that additions to the S&P 500 Index of firms traded on the Nasdaq experience a 2.5% higher price reactions than do additions of firms traded on the NYSE. On average, our results

We would particularly like to thank the two anonymous referees for their very useful suggestions. This paper also benefited from discussions with Ed Dyl, Tom Gosnell, Tim Krehbiel, Jose Suay, and Robert Van Ness and Mark D. Walker. Seminar participants at the Midwest Finance Association meetings (2001), the Financial Management Association meetings (2001), Auburn University, Florida Atlantic University, University of Missouri, North Carolina State University, and Southern Illinois University provided many helpful comments. The usual disclaimer applies.

[*]William B. Elliott is an Assistant Professor of Finance at Oklahome State University. Richard S. Warr is an Assistant Professor at North Carolina State University.

Financial Management • Autumn 2003 • pages 85 - 99

equate to an increased cost of close to $300 million to investors who purchase a Nasdaq stock added to the index, compared to the average NYSE stock. We interpret this finding as evidence that the NYSE specialist system is better able to absorb demand shocks than is the Nasdaq dealer system. Our results also indicate that although other researchers find that close substitutes are an important determinant of abnormal returns, we find that this effect is not significantly related to listing-day returns when we control for the listing exchange.

The paper proceeds as follows: Section I discusses previous literature and motivates the issues, Section II discusses data, Section III presents results, and Section IV presents our conclusions.

I. Motivation and Literature Review

Previous studies, such as Harris and Gurel (1986), Lynch and Mendenhall (1997), and Wurgler and Zhuravskaya (2002), document the increased demand and subsequent price reaction for a security when it is added to the Index. This demand is due in part to attempts by index mutual funds that track the S&P 500 to add this security to their portfolios. Because an index fund's performance is based on minimizing tracking error, it is important that the fund managers purchase the added securities on the first day they are included in the Index. Blume and Edelen (2001) argue that most index funds follow a full replication strategy. They report that of 3,110 domestic index funds in their study, all but five held 499 stocks or more. Thus, the demand shock is not driven by new information. In fact, the S&P Index Committee, which is responsible for stock selection, states that: "… the decision to include a company in the S&P 500 Index is not an opinion on that company's investment potential."[1] Despite this claim and with the goal of reducing forced turnover in the Index, S&P screens potential candidate firms based on their operating and financial condition.

An initial explanation of any differences in the price reaction of the Nasdaq compared to the NYSE might center on the perception that Nasdaq firms are smaller and faster-growing than are NYSE stocks. Therefore, one could argue that any differences between the two markets are a function of firm characteristics rather than market design. However, stock characteristics have little to do with the listing-day-return effect, because when a stock is added to the Index, the aggregate index fund demand is just dependent on the proportion of the S&P 500 that is held by indexers.

A price reaction can occur if there are differences in the supply of the stocks or in the depth of the market in these stocks, but the actual characteristics of the firms should have little impact. However, in our analysis we control for firm-specific characteristics and the overall increase in index fund demand over time. We note that although S&P's minimum requirements for the liquidity of the added stock implicitly control for supply, we explicitly control for close substitutes and shares outstanding.

Our study is related to two separate strands of the finance literature, the examination of demand curves for stocks and the effect of additions to the S&P 500 Index, and the ongoing comparison of dealer and auction-based stock markets. We combine these two strands of research by examining which market design (dealer or auction) is better able to absorb large demand shocks.

A. Permanent and Temporary Price Effects Surrounding Additions to the S&P 500 Index

There are many studies showing that additions to the S&P 500 Index are associated with

[1]"S&P 500 Index Methodology," Section 3, Criteria for Index Company Changes, page 32.

a positive abnormal price reaction. Previous work offers three explanations: 1) a permanent price increase associated with a permanent shift in the demand for the stock, 2) a permanent price increase associated with improved liquidity, and 3) a temporary price increase associated with the market's inability to immediately absorb the large demand shock from rebalancing index funds.

A permanent price increase following inclusion in the Index can indicate that index fund managers are unable to find perfect substitutes for the listed stock (i.e., a downward sloping demand curve). Wurgler and Zhuravskaya (2002) examine pre-1989 additions, when there was no difference in the announcement and listing day, to determine whether index fund arbitrageurs are able to profit from the price impact of additions by purchasing the added firm and shorting substitutes. They find that the abnormal return on the announcement day is positively related to the difficulty of finding a close substitute (so called arbitrage risk) and the overall increase in demand for S&P 500 stocks due to the rise of index funds over time. Their findings are consistent with the existence of a permanent component to the price reaction.

Improved liquidity may also result in a permanent positive price effect (see Amihud and Mendelson, 1986). Erwin and Miller (1998), using the spread as a measure, find a liquidity improvement for stocks added to the Index. They find this effect more pronounced for stocks that do not have listed options. They also find that the existence of options has no significant effect on the announcement return.

Recent work by Gosnell and Krehbiel (2000) and Hegde and McDermott (2003) also finds support for the liquidity argument, but Beneish and Whaley (1996) do not find any permanent liquidity effect in the bid-asked spreads of listed stocks. They argue that if anything, we would expect liquidity to decline following listing, because a significant portion of the float is purchased by buy-and-hold investors (index funds).

Yet another permanent price effect could be related to Merton's (1987) model of investor awareness. Chen, Noronha, and Singal (2002) find evidence of a permanent price effect due to an increase in the number of shareholders, which is consistent with Merton's story.

The inability of the market to absorb a sudden demand shock should manifest itself in an immediate price reaction that dissipates over the following days or weeks. This temporary price pressure is consistent with index funds rebalancing their portfolios to incorporate the new additions to the Index. Our article uses this temporary price pressure to examine the relative ability of the Nasdaq and NYSE to absorb noninformation-motivated demand shocks.

Previous authors find a temporary price effect. Harris and Gurel (1986), looking only at NYSE-listed stocks that are added to the Index, find an immediate price increase of 3% associated with the announcement, much of which dissipates over the following two weeks. Lynch and Mendenhall (1997) report significant positive announcement day returns that are only partially reversed following additions to the index. They interpret this result as evidence of temporary price pressure and downward-sloping demand curves for stocks. Pruitt and Wei (1989) find that changes in institutional holdings are correlated with changes in the index, providing further evidence for the price pressure hypothesis. Beneish and Whaley (1996) find a 2.2% price reversal in the days following an addition, which they ascribe to price pressure due to arbitrageurs "front running" the index funds. LaPlante and Muscarella (1997) study the impact of market structure on large block trades. They find that the NYSE provides greater liquidity for block trades than does the Nasdaq. Using a matched sample of NYSE and Nasdaq stocks, they report that a 0.14% price change difference in the Nasdaq over the NYSE as a result of block trades. The authors calculate that this translates into an extra cost to block traders of $157 million per Nasdaq firm.

Separating out permanent effects (whether due to liquidity changes or demand shifts) and

temporary effects (due to price pressure) is more straightforward after October 1989, when S&P started pre-announcing Index changes. Permanent price increases associated with liquidity or demand shift explanations should be incorporated by rational traders as soon as this information becomes public (i.e., at the announcement date). Furthermore, Beneish and Whaley (1996) show that trading volume is very large between announcement and listing dates, evidence that the liquidity improvement has already occurred.

Our study uses additions after October 1st, 1989. Doing so allows us to isolate price pressure effects from the other, possibly information-driven effects, that largely occur around the announcement day.

B. Market Design

Many papers examine the relative performance of the NYSE and Nasdaq systems, and the performance of dealer compared to auction markets, for example, Goldstein (1993), Christie and Schultz (1994), Huang and Stoll (1996), and Bessembinder and Kaufman (1997). These papers generally find there are larger spreads and trading costs on the Nasdaq than on the NYSE. However, although most of the comparisons of the Nasdaq and NYSE focus on market microstructure measures, such as spread and components of the spread, our paper focuses on overall return and volume measures.

In broad terms, the degree to which market fragmentation (i.e., decentralized [Nasdaq] compared to centralized [NYSE]) is beneficial to investors relates to our study. Hamilton (1979) and Battalio, Greene, and Jennings (1997) examine the effect of fragmentation for NYSE stocks that are also listed on regional exchanges. Hamilton argues that fragmentation can provide both benefits (greater competition) and costs (lower economies of scale and less efficiency). By looking at spreads and return variances, Hamilton concludes that the competitive effect outweighs the fragmentation effect.

Madhavan (1995) models fragmented markets as being characterized by higher price volatility than are centralized markets. Davis and Lightfoot (1998) find that the implementation of SEC rule 19c-3, which promotes more fragmented trading, may have increased spreads but has had little effect on return variance. The impact of additions to the S&P 500 represents a different test of the fragmentation issue by examining whether more fragmented markets such as the Nasdaq are better able to absorb demand shocks than consolidated markets such as the NYSE.

II. Data and Method

There were 304 firms added to the S&P 500 Index between from October 1989 and December 2000. To obtain a sample of listing days that are uncontaminated by announcement-day returns, we exclude additions where there is not at least one clear day between the announcement day and the listing day. Therefore, if the announcement is made after the close on day t-1, the announcement effect occurs on day t. We include in our sample only those firms where the listing is on day t+2 or later. We could include stocks listed on day t+1, but examination of the returns on the days between the announcement and listing days indicates significant abnormal returns and trading activity during this period. To separate out these effects, which might be due to arbitrageurs front-running index funds, we impose the one-clear-day requirement. Our results are similar if we use zero clear days between the announcement and listing days. We also experiment with windows of two and three days between the announcement and listing days and obtain similar results. This screen results in

the loss of 74 firms. We drop an additional 37 firms due to lack of data, and six AMEX firms are dropped.[2] Our final sample is 187 firms of which 131 are NYSE additions and 56 are Nasdaq additions.

We obtain market-related and distribution data from the Center for Research in Securities Prices (CRSP) database and firm-related data from the Compustat database. We require that volume and return data be available on CRSP for 90 trading days prior to the addition and for 30 days following the addition. We do not impose any screens based on confounding events, such as mergers. Although such events may add noise to our analysis, we do not expect them to bias our results.

We focus on the effective or listing day of S&P 500 additions and classify this date as event day 0. We compute abnormal returns as the return in excess of the value-weighted CRSP market-return index. As robustness checks we also compute abnormal returns as the error term from the market model, using the Scholes and Williams (1977) correction for infrequent trading, and the excess return over size-decile return portfolios. Our results are not significantly affected by the method of abnormal return computation. To adjust for changes in overall market volume on any given day, we use the Harris and Gurel (1986) metric (HGVOL) as a measure of abnormal volume. The Harris-Gurel measure incorporates the ratio of the market volume in addition to the ratio of the individual security volume.

$$HGVOL_{it} = \frac{V_{it}}{V_{mt}} \cdot \frac{V_m}{V_i} \tag{1}$$

where V_{it} and V_{mt} are the trading volumes of security i and the market during day t, respectively, and V_i and V_m are the average volumes of the security and the market over the period from 90 to 31 days before the event day. It is impossible to discern whether the metric is capturing an abnormal volume for the market overall or the individual security (if the volume in the security is not highly correlated with volume in the market). However, when only the ratio of the individual security volume is used in the regressions, the results are qualitatively similar.

For NYSE stocks we use the total NYSE volume as the market, and for the Nasdaq stocks we use the total Nasdaq volume for the market (our results are not affected when the composite market volume is used for all firms). An HGVOL of unity indicates no abnormal volume, and an HGVOL greater than unity indicates abnormally high volume. Because we use the total NYSE volume in our construction of the Harris-Gurel metric for NYSE firms and the total Nasdaq volume for Nasdaq firms, we do not need to adjust the trading volumes of Nasdaq firms for the higher participation rate of market makers as documented by Atkins and Dyl (1997).

To control for arbitrage risk, we compute the arbitrage risk measures (ARB1 and ARB2) discussed in Wurgler and Zhuravskaya (2002). ARB1 is the variance of the error term of a regression of the added stock's excess returns on the market's excess returns for the 250 days prior to the addition. ARB2 is the variance of the error term of a regression of the added stock's excess returns on a portfolio of three substitute stocks, again for the 250 days prior to the addition.

$$\left(R_{added} - R_{rf}\right) = \beta_1\left(R_{sub1} - R_{rf}\right) + \beta_2\left(R_{sub2} - R_{rf}\right) + \beta_3\left(R_{sub3} - R_{rf}\right) + \varepsilon \tag{2}$$

where R_{added} is the daily return for the added stock, R_{rf} is the daily risk free rate, and $R_{sub1\text{-}3}$

[2]We lose four firms, because they do not have announcement days from S&P, of these, two appear to be name changes only. Two firms lack CUSIP numbers, 18 firms are missing CRSP data, and 13 are missing Compustat data.

represents the daily returns for the substitute stocks.

We draw substitute stocks from those stocks that have the same Fama and French (1997) industry classification as the added stock. We then place these stocks into quintiles according to the absolute value of the difference between their market value and that of the added stock. We select the lowest market-value-difference quintile of stocks, and of those we select the three with the lowest book-to-market difference. Selecting the stock with the smallest absolute difference in market value breaks ties.

Table I shows descriptive statistics for the sample. The market-adjusted return on the listing day for NYSE firms is 0.73%, compared to an average market-adjusted return of 3.41% for Nasdaq firms. The mean abnormal volume for both NYSE and Nasdaq firms on the listing day is closer, at 13.87 for NYSE stocks and 9.68 for Nasdaq stocks. Thirty–six percent of the Nasdaq firms are either high-tech or communications companies, compared to only 12% of the NYSE firms added to the Index. Nasdaq firms have higher market-to-book values than do the NYSE firms. The Nasdaq firms also have higher market values, possibly due to the tech market boom of the 1990s.

Arbitrage risk also differs across the exchanges. The NYSE stocks have lower arbitrage risk than the Nasdaq stocks (ARB2 for NYSE equals 0.00051, ARB2 for Nasdaq equals 0.00137).

Announcement-day returns for Nasdaq stocks are 4.74%, compared to 3.52% for NYSE stocks. We suspect that the announcement day effect is based in part on the certification effect of being included in the Index. Although being included in the Index does not indicate superior investment potential, Standard and Poor's does screen additions to ensure that the stocks are not facing imminent financial distress. To the extent that such certification may be of greater importance for Nasdaq stocks, we would expect the abnormal announcement-day returns to be higher than those for NYSE stocks.

Index fund demand, which is the ratio of the market value of index funds to the total value of the S&P 500 at the beginning of the year, represents the proportion of the added stock that will be acquired by index funds. During the 1989-2000 period, this variable averages about 8.5%.

III. Results and Analysis

We first test for a difference in the listing-day returns between NYSE- and Nasdaq-listed firms. We then analyze the post-listing-day returns for evidence of a reversal of the listing-day returns. A reversal of the listing-day returns is consistent with the price pressure theory.

Table II presents the market-adjusted returns (AR) and the cumulative adjusted returns (CAR) for the full sample and both subsamples (NYSE only and Nasdaq only) for 1989-2000. The first two rows of the table show the market-adjusted return on the announcement day and the cumulative adjusted return for the intervening days between the announcement and listing day. In all cases these returns are, on average positive and significantly greater than zero. These results confirm the significant announcement-day reaction found by other researchers. Furthermore, during the intervening days, the significant market-adjusted returns continue, possibly as a result of index arbitrage trading, or from spillover effects from the initial announcement. By allowing at least one clear day between the announcement and listing days we expect to mitigate the contaminating effects of the announcement day and to focus on the listing-day effect.

In the subsequent rows, we report the market-adjusted returns (AR) and cumulative adjusted returns (CAR) for the listing day and for the days following the listing day. As in Table I,

Table I. Characteristics of Sample Firms

The sample includes firms that were added to the S&P 500 Index between October 1989 and December 2000 and have at least one full day separating the announcement day from the listing day. We compute abnormal volume, HGVOL, following Harris and Gurel (1986). Tech/Communications dummy is a binary variable that equals one if a firm has a primary three-digit SIC code of 737, 481, or 357. We compute the variance of returns using daily returns for the 250 days prior to the listing date. Arbitrage risk measure 1 (ARB1) is the residual variance of the added stock's excess returns regressed on the market excess returns. Arbitrage risk measure 2 (ARB2) is the residual variance of the added firm stock's excess returns regressed on the excess returns of a portfolio of three close substitutes (see Wurgler and Zhuravskaya, 2002). Variance explained is the variance of the stock's excess returns explained by the portfolio of the three close substitutes used in arbitrage risk measure 2. Index fund demand is the market value of index funds divided by the total market value of the S&P 500 at the beginning of the year.

	NYSE Firms (N=131)			Nasdaq Firms (N=56)		
	Mean (Std. Dev.)	Median	(Minimum) [Maximum]	Mean (Std. Dev.)	Median	(Minimum) [Maximum]
Percent Market-Adjusted Return on Day of Listing	0.73 (3.821)	0.64	(-13.795) [13.696]	3.41 (5.199)	3.221	(-9.041) [24.327]
Percent Market-Adjusted Return on Announcement	3.521 (3.259)	3.349	(-4.511) [14.332]	4.738 (4.186)	3.878	(-5.32) [18.68]
Abnormal Volume on Day of Listing (HGVOL)	13.869 (10.566)	11.53	(0.457) [61.802]	9.675 (7.061)	6.939	(2.403) [33.088]
Abnormal Volume on Announcement	3.913 (2.927)	3.248	(0.364) [15.37]	2.874 (2.095)	2.504	(0.53) [10.137]
Tech/Communications Dummy	0.122 (0.329)	0	(0) [1]	0.357 (0.483)	0	(0) [1]
Market Value ($billions)	8.805 (9.679)	6.088	(0.607) [71.07]	11.928 (16.036)	7.722	(0.632) [91.608]

Table I. Characteristics of Sample Firms (*Continued*)

	NYSE Firms (N=131)			Nasdaq Firms (N=56)		
	Mean (Std. Dev.)	Median	(Minimum) [Maximum]	Mean (Std. Dev.)	Median	(Minimum) [Maximum]
Market-to-Book	4.882 (10.583)	3.233	(0.072) [118.896]	10.008 (11.481)	6.712	(0.689) [72.623]
Shares Outstanding (millions)	182.718 (176.786)	128.648	(11.371) [1156.18]	169.88 (128.564)	137.898	(23.326) [598.776]
Variance of Returns	0.00061 (0.00057)	0.00043	(0.00006) [0.00406]	0.00182 (0.00157)	0.00144	(0.00016) [0.00671]
Variance Explained	0.0001 (0.00015)	0.00005	(0.00001) [0.00108]	0.00045 (0.00056)	0.0002	(0.00001) [0.00239]
Arbitrage Risk Measure 1 (ARB1)	0.00051 (0.0005)	0.00036	(0.00005) [0.00394]	0.00136 (0.00109)	0.00108	(0.00015) [0.00499]
Arbitrage Risk Measure 2 (ARB2)	0.00051 (0.0005)	0.00038	(0.00006) [0.00405]	0.00137 (0.00115)	0.001	(0.00015) [0.00479]
Index Fund Demand (%)	8.45 (0.137)	8.443	(7.919) [8.884]	8.391 (0.289)	8.443	(7.118) [8.884]

Table II. Percentage Market-Adjusted and Cumulative Adjusted Returns for Additions to the S&P 500 from October 1989 to 2000

We use percentage market-adjusted daily returns throughout. Columns 1 and 2 present market-adjusted returns for the full sample of 187 firms added to the S&P 500 Index between October 1989 and December 2000 for which there is at least one clear day of trading between the announcement and listing day. Columns 3 and 4 display the market-adjusted and cumulative market-adjusted return for only NYSE firms added to the Index. Columns 5 and 6 show the same for Nasdaq firms. We compute cumulative market-adjusted returns for either the intervening days or the days following the listing day (including the listing day). The final column shows the difference in CARS for the NYSE-Nasdaq for the listing day onwards.

	Full Sample N=187		NYSE Firms N=131		Nasdaq Firms N=56		NYSE–Nasdaq
	AR	CAR	AR	CAR	AR	CAR	CAR
	1	2	3	4	5	6	7
Announcement Day	3.88***	---	3.52***	---	4.73***	---	
Intervening Day(s)	---	3.25***	---	2.59***	---	4.78***	
Listing Day (0)	1.53***	1.53***	0.73***	0.73***	3.41***	3.41***	-2.68***
Listing Day +1	-0.77***	0.76***	-0.61***	0.12	-1.15**	2.26***	-2.14**
+2	-0.23	0.53	-0.35**	-0.23	0.06	2.32***	-2.55**
+3	-0.77***	-0.23	-0.76***	-0.99***	-0.81	1.51	-2.50
+4	-0.06	-0.29	-0.03	-1.02**	-0.13	1.38	-2.40
+5	0.13	-0.16	0.28	-0.74	-0.23	1.15	-1.89
+6	-0.32	-0.48	-0.01	-0.75**	-1.06**	0.09	-0.66
+7	0.09	-0.39	-0.23	-0.99**	0.84	0.93	-1.92
+8	-0.18	-0.57	-0.25	-1.24**	0.00	0.93	-2.17
+9	0.24	-0.33	-0.16	-1.40**	1.15**	2.08	-3.48
+10	-0.29	-0.62	-0.21	-1.61**	-0.47	1.61	-3.22

***Significant at the 0.01 level.
**Significant at the 0.05 level.

Table II shows that the Nasdaq firms have a listing-day return of 3.41% and the NYSE firms have a return of 0.73%.

The key question is whether these returns are temporary, reverting toward zero as in a price pressure story, or whether they persist, which would be consistent with a permanent price effect. On the day after listing (listing day +1) the full sample shows a significant and negative adjusted return of -0.77%, which indicates a partial reversal of the 1.53% listing-day return. For the NYSE, the listing day +1 return is a significant -0.61%, which is close in magnitude to the positive listing-day return. By listing day +3, the CAR for the NYSE stocks has become negative. This negative CAR persists for the following seven days. Thus, for the NYSE stocks we find evidence that the listing-day return reverses very quickly. This finding supports the price pressure hypothesis.

For Nasdaq stocks, we find a significant negative return of -1.15% on listing day +1. However, the returns in the following days seem to drift, with the exception of the listing day +6 CAR, which is 0.09%, and very close to zero. None of the listing day +3 to listing day +10 CARs are significantly different from zero, but they are consistently positive. Therefore, we cannot say affirmatively that the full listing-day effect has reverted, which would be consistent

with the price pressure story. However, the significant and negative day +1 return is consistent with a portion of the listing-day return being due to price pressure. Noise in the post-listing CARs and the relatively small sample size (56 Nasdaq stocks) prevents us from drawing any stronger conclusions. Column seven of Table II presents tests of the difference in the CARs from the listing day onwards for both the NYSE and Nasdaq samples. We find a significant difference between the two markets of 2.68% on the listing day. This difference persists until day +5, when it becomes insignificant. After day +6, the CARs appear to diverge further until day +9, when they are significantly different at the 10% level. This pattern is consistent with different rates of price reversal for the Nasdaq and NYSE coupled with noise, particularly in the Nasdaq sample.

We wish to establish whether the differential listing-day returns for Nasdaq and NYSE stocks are due to the exchange listing or other stock characteristics. To explore the different effects of exchange listing when a firm is added to the S&P 500 Index, we run several regressions.

In Table III, we examine the influence of the listing exchange, firm characteristics, arbitrage risk, and index fund demand on the market-adjusted listing-day return. In Model 1, we regress the adjusted return on the listing day on a binary variable (EXDUM) that has a value of one when the added firm is listed on the NYSE and zero when the firm is listed on Nasdaq. Firm-specific variables included in the regression are the log of the Harris and Gurel (1986) measure of abnormal volume (HGVOL), the log of market value, the log of the market-to-book ratio (we drop firms with negative book values), and the log of shares outstanding. We note that shares outstanding do not perfectly represent a measure of a stock's liquidity. However, the S&P Index Committee requires that any NYSE firm and any Nasdaq firm in the Index must have a minimum of 0.3 and 0.6 turnover during an average month, respectively (0.6 for the Nasdaq because of the double counting of trading volume on the Nasdaq). They also require that "… multiple entities may not hold more than 60% of the outstanding shares".

We also include a binary variable that takes a value of one if the firm's three-digit SIC code is 737, 481, or 357. This variable controls for high-tech and communication companies, which predominate on the Nasdaq.

Finally, to control for firm-specific risk, we include the historical variance of daily returns for the added firms, which we compute over the 250 trading days prior to the addition. This variable controls for the greater idiosyncratic risk that speculators face by trying to profit on Index additions.

In all our regressions, we deduct the variable means from all the independent variables, except EXDUM, to allow for a more straightforward interpretation of the intercepts. Therefore, the intercept alone represents the market-adjusted return on the listing day for the average Nasdaq stock (i.e., EXDUM equals zero) and the intercept plus the EXDUM coefficient represents the market-adjusted return for the average NYSE stock (i.e., EXDUM equals one). Therefore, EXDUM can be interpreted as the difference between market-adjusted return for the average Nasdaq and NYSE stocks.

In Model 1, the coefficient on EXDUM is a significant –2.223% (p-value equals 0.01), indicating that, ceteris paribus, Nasdaq stocks experience about 2.2% greater listing-day return than NYSE stocks. Further, the intercept indicates a significant 3.089% adjusted return for the Nasdaq sample, compared with a significant 0.866% (intercept plus EXDUM) for the NYSE sample. Abnormal volume is not significantly related to listing-day returns, which may at first appear to be counterintuitive. However, increased trading alone will not necessarily result in price pressure and subsequent price reaction. The price pressure effect arises from an imbalance between buyers and sellers and a downward sloping demand curve for the stock. For stocks added to the Index, the amount demanded by index funds is fixed and

Table III. Relation Between the Market-Adjusted Return and Listing Exchange for Additions to the S&P 500 from October 1989 to 2000

The dependent variable is the market-adjusted listing-day return. EXDUM takes on a value of one if the firm is NYSE listed and zero if the firm is traded on Nasdaq. The control variables include the log of abnormal volume; a Tech/Communications Dummy that equals one if the firms three-digit SIC code is 481, 737, or 357; the log of market value; the log of market-to-book ratio at year-end; the log of shares outstanding; the variance of returns, computed using daily returns for the 250 days prior to the listing date; arbitrage risk measure 1 (ARB1), which is the log of the residual variance of the added stock's excess returns regressed on the market excess returns; arbitrage measure 2 (ARB2), which is the log of the residual variance of the added firm stock's excess returns regressed on the excess returns of a portfolio of three close substitutes (see Wurgler and Zhuravskaya 2001); index fund demand is the market value of index funds divided by the total market value of the S&P 500 at the beginning of the year. We have subtracted the means from all independent variables (excluding EXDUM). We compute p-values for test statistics computed using White's hetereoskedastic-consistent covariance matrix. The p-values are shown in parentheses.

	Model 1	Model 2	Model 3	Model 4
Intercept	3.089*** (<0.01)	3.051*** (<0.01)	3.020*** (<0.01)	3.313*** (<0.01)
EXDUM	-2.223*** (<0.01)	-2.169*** (<0.01)	-2.125*** (0.01)	-2.543*** (<0.01)
Ln(Abnormal Volume) (HGVOL)	-0.227 (0.44)	-0.240 (0.42)	-0.245 (0.41)	-0.132 (0.63)
Tech/Communications Dummy	0.981 (0.34)	0.984 (0.34)	0.973 (0.35)	0.864 (0.39)
Ln(Market Value)	1.442 (0.07)	1.325 (0.11)	1.331 (0.10)	1.767 (0.04)
Ln(Market-to-Book)	0.293 (0.46)	0.291 (0.47)	0.271 (0.51)	0.372 (0.37)
Ln(Shares Outstanding)	-1.195 (0.12)	-1.236 (0.11)	-1.251 (0.10)	-1.471 (0.06)
Variance of Returns	-0.298 (0.49)	--	--	--
Arbitrage Risk Measure 1 (ARB1)	--	-0.177 (0.69)	--	--
Arbitrage Risk Measure 2 (ARB2)	--	--	-0.119 (0.79)	0.600 (0.23)
Explained Variance of ARB2 Regression	--	--	--	-0.824*** (<0.01)
Ln(Index Fund Demand)	--	9.735 (0.31)	9.668 (0.31)	9.967 (0.27)
Intercept + EXDUM	0.866** (0.03)	0.882** (0.03)	0.895** (0.03)	0.770** (0.05)
Adjusted R^2	0.0981	0.0936	0.0930	0.1216
F-Test	3.89	3.40	3.38	3.86
N	187	187	187	187

***Significant at the 0.01 level.
**Significant at the 0.05 level.

essentially known beforehand. Although this index-fund-induced volume is essentially the same for all stocks, there is a significant relation between abnormal volume and returns on the announcement day. This finding is consistent with an information story. However, there is no reason why abnormal volume should be directly correlated with returns on the listing day, since no new information is released to the market on that day.

In the remaining models in Table III, we examine whether an alternative explanation for our results may lie in the arbitrage risk argument proposed by Wurgler and Zhuravskaya (2002). Wurgler and Zhuravskaya find that the combined announcement- and listing-day abnormal returns are directly related to the availability of good substitutes for the added stocks. They also find that the increase in the overall demand of index funds is an additional determinant of abnormal returns.

Model 2 adds the log of the arbitrage risk measure ARB1 (using the market portfolio as a substitute). Because this arbitrage risk measure is very highly correlated with the variance of returns, we remove the variance measure. We also add the log of the index-fund demand. Both new variables are insignificant, but do slightly reduce the magnitude of the EXDUM coefficient to –2.169%. Other researchers, for example, Edmister, Graham, and Pirie (1994), also find that excess returns for S&P 500 additions are unrelated to total index fund demand. In Model 3, we replace ARB1 with ARB2, which uses three industry-, size-, and book-to-market-matched firms as substitutes for the added stock. Again, the arbitrage risk measure is insignificant.

In Model 4, we add a measure of how well the added stock's returns are explained by the arbitrage portfolio. This measure is the explained variance of the arbitrage risk regression equation. When combined, ARB2 and the explained variance variable are a measure of the total variance of the returns of the added stock. This measure is significant[3] and changes the coefficient on EXDUM to -2.125%.

Unlike Wurgler and Zhuravskaya (2002), we find no relation between listing effects and arbitrage risk. However, in unreported regressions, when we exclude the exchange dummy, arbitrage risk becomes a significant determinant of listing returns. The difference between our results and theirs may also be due to the different sample periods. Wurgler and Zhuravskaya use only pre–October 1989 data, when additions were not preannounced, and are therefore capturing the announcement day effect.

The primary result from Table III is that the listing-day market-adjusted return is significantly higher for Nasdaq stocks. This result is robust to various firm characteristics and measures of arbitrage risk. In unreported analysis we run rank regressions where the continuous variables are replaced by their ordinal ranks in the data set. The coefficient on EXDUM remains negative and significant. Adding control variables has little impact on the basic findings in Table II.

The price pressure story has two components: an abnormal listing-day return, which is different for Nasdaq stocks compared to NYSE stocks, and a reversal of this listing-day return in the days following the listing. Tables II and III provide evidence of the abnormal listing-day effect. Table IV focuses on the post-listing CARs from listing day +1 onwards, and provides evidence of post-listing day price reversals. By examining the post-listing CARs we affirmatively test the hypothesis that the post-listing returns are significantly less than zero, which is consistent with a price reversal.

For the full sample we find a negative and significant return of -0.77% on the first day

[3]The sign and significance of the explained variance measure puzzles us. One possible explanation is that it is a proxy for the overall volatility of the added stock's industry. If the market maker responds to greater industry volatility by holding greater inventory levels of stocks in that industry, then this response might lessen price pressure effects on the listing day. In unreported rank regressions, this result persists.

Table IV. Listing Day + 1 to Listing Day +10 Market-Adjusted and Cumulative Adjusted Returns for Additions to the S&P 500 from October 1989 to 2000

We use Daily returns in excess of the market return throughout. Columns 1 and 2 present adjusted returns for the full sample of 187 firms added to the S&P 500 Index between October 1989 and December 2000 for which there is at least one clear day of trading between the announcement and listing day. Columns 3 and 4 display the adjusted and cumulative adjusted returns for only those firms added to the Index that are listed on the NYSE. Columns 5 and 6 show the same for Nasdaq firms.

	Full Sample N=187		NYSE Firms N=131		Nasdaq Firms N=56	
	AR	CAR	AR	CAR	AR	CAR
	1	2	3	4	5	6
Day +1	-0.77***	-0.77***	-0.61***	-0.61***	-1.15***	-1.15***
+2	-0.23**	-1.00***	-0.35**	-0.96***	0.06	-1.09***
+3	-0.77***	-1.77***	-0.76***	-1.72***	-0.81	-1.90***
+4	-0.06	-1.83***	-0.03	-1.75***	-0.13	-2.03***
+5	0.13	-1.70***	0.28	-1.47***	-0.23	-2.26***
+6	-0.32**	-2.02***	-0.01	-1.48***	-1.06***	-3.32***
+7	0.09	-1.93***	-0.23	-1.71***	0.84	-2.48***
+8	-0.18	-2.11***	-0.25	-1.96***	0.00	-2.48***
+9	0.24	-1.87***	-0.16	-2.12***	1.15**	-1.33
+10	-0.29	-2.16***	-0.21	-2.33***	-0.47	-1.80**

***Significant at the 0.01 level.
**Significant at the 0.05 level.

following the listing. This finding can be broken down into a -0.61% return for NYSE stocks and a -1.15% return for Nasdaq stocks. Compared with the listing-day return in Table II of 0.73% for NYSE stocks and 3.41% for Nasdaq stocks, we see evidence that there is almost a complete reversal for NYSE stocks. For Nasdaq stocks, only a partial reversal occurs on the first post-listing day. The reversal reaches its most negative CAR by day +6. We are confident that the t+1 CARs are consistent with a price reversal due to the listing day, but we cannot be so sure that longer-term CARs are continued evidence of the price reversal. They could instead, be due to some other factor such as risk mis-measurement, news, or noise.

In unreported regressions, we repeat the set up of Table III, but use the post listing CARs as the dependent variable to establish whether these CARs are robust to the various control variables. For days +1 to +10 only the intercept and the EXDUM variables in these regressions are significant and the regressions have negative adjusted R^2s.

That the NYSE CARs are lower than the initial listing-day return is another puzzle. It is possible that some of the run-up before the listing day causes a reversion after the listing day. If this is true, then we cannot be sure that the reversion found in Nasdaq stocks by day t+6 is entirely due to the listing-day abnormal return. However, there is evidence of statistically significant negative post-listing returns for both the NYSE and Nasdaq stocks. This result, although it does not represent a complete reversal of the listing-day return for the Nasdaq stocks, is nonetheless consistent with a price pressure story. However, the magnitude of the price pressure effect does depend heavily on the post-listing time period over which we compute the reversal.

IV. Conclusion

We examine the relative ability of the Nasdaq and NYSE markets to absorb large demand

shocks and compare the listing-day market-adjusted returns for additions to the S&P 500. Our analysis indicates that Nasdaq stocks suffer greater abnormal price reactions on the listing day than do NYSE stocks. These results appear robust to firm characteristics, including measures of size, growth options, and industry. Furthermore, the listing-exchange effect persists even after we control for arbitrage risk and the growth in index funds.

Our examination of the cumulative market-adjusted returns following the listing date indicates that the shock for both exchanges is partly absorbed within one to six days. We interpret these results as evidence that the NYSE specialist system is better able to evaluate and manage demand shocks than is the more fragmented Nasdaq dealer system. We can hypothesize that the difference in the Nasdaq and NYSE performance is due to the fragmented nature of the Nasdaq, but we cannot be sure that other institutional differences are not driving our result. Furthermore, recent market reforms to Nasdaq may reduce the magnitude of the listing-day effect. Since 1997, limit orders have been permitted to compete directly with market-maker orders, and market-maker quotes on ECNs are available to the public. Weston (2000) finds evidence that the Nasdaq market has become significantly more competitive since these rule changes. Furthermore, the limit-order handling rule may have an impact on the ability of the Nasdaq to absorb the demand shocks examined in this paper.

As we discussed, one advantage the NYSE had over the Nasdaq, was the additional depth provided by the limit-order book. This advantage has been lessened following the rule changes. At this stage it is too early to tell whether these rule changes will affect the ability of the Nasdaq to absorb large demand shocks, but it is an interesting area for future research.■

References

Amihud, Y. and H. Mendelson, 1986, "Asset Pricing and the Bid-Asked Spread," *Journal of Financial Economics* 17, 223-49

Atkins, A.B. and E.A. Dyl., 1997, "Market Structure and Reported Trading Volume: NASDAQ versus the NYSE," *Journal of Financial Research* 203, 291-304.

Battalio, R., J. Greene, and R. Jennings, 1997, "Do Competing Specialists and Preferencing Dealers Affect Market Quality?" *Review of Financial Studies* 104, 969-993.

Beneish, M.D. and R.E. Whaley, 1996, "An Anatomy of the 'S&P Game': The Effects of Changing the Rules," *Journal of Finance* 51, 1909-1930.

Bessembinder, H. and H. Kaufman, 1997, "A Comparison of Trade Execution Costs for NYSE and Nasdaq-listed Stocks," *Journal of Financial and Quantitative Analysis* 32, 287-310.

Blume, M.E. and R.M. Edelen, 2001, "On S&P 500 Index Replication Strategies," University of Pennsylvania Working Paper.

Chen, H., G. Noronha, and V. Singal, 2002, "S&P 500 Index Changes and Investor Awareness," Virginia Tech University Working Paper.

Christie, W. and P. Schultz, 1994, "Why Do Nasdaq Market Makers Avoid Odd-Eighth Quotes?" *Journal of Finance* 49, 1823-1840.

Cochrane, J.L., 1993, "The Changing Structure of Markets – The NYSE," *Sherrerd, K.F. Ed, Execution Techniques, True Trading Costs and the Microstructure of Market, Association of Investment Management and Research*, Charlottesville, VA.

Davis, J.L. and L.E. Lightfoot, 1998, "Fragmentation versus Consolidation of Securities Trading: Evidence from the Operation of Rule 19c-3," *Journal of Law and Economics* 411, 209-238.

Edmister, R.O., A.S. Graham, and W.L. Pirie, 1994, "Excess Returns of Index Replacement Stocks: Evidence of Liquidity and Substitutability," *The Journal of Financial Research* 17, 333-346.

Erwin, G.R. and J.M. Miller, 1998, "The Liquidity Effects Associated with the Addition of a Stock to the S&P 500 Index: Evidence from the Bid/Ask Spread," *Financial Review* 33, 131-146.

Fama, E.F. and K.R. French, 1997, "Industry Costs of Equity," *Journal of Financial Economics* 43, 153-194.

Goldstein, M., 1993, "Specialist vs. Dealer Market: A Comparison of Displayed Bid-Ask Spread on Nasdaq and the NYSE," University of Pennsylvania Working Paper.

Gosnell, T.F. and T.K. Krehbiel, 2000, "Market Liquidity and Changes in the Roster of the Standard and Poor's 500 Index," Oklahoma State University Working Paper.

Groth, J. and D. Dubofsky, 1987, "The Liquidity Factor," *The Nasdaq Handbook: The Stock Market of Tomorrow – Today*, Chicago, IL, Probus Publishing.

Hamilton, J.L., 1979, "Marketplace Fragmentation, Competition, And The Efficiency Of The Stock Exchange," *Journal of Finance* 34, 171-187.

Harris, L. and E. Gurel, 1986, "Price and Volume Effects Associated with Changes in the S&P 500 List: New Evidence for the Existence of Price Pressures," *Journal of Finance* 41, 815 – 829.

Hegde, S.P. and J.B. McDermott, 2003, "The Liquidity Effects of Additions to the S&P 500 Index: An Empirical Analysis," *Journal of Financial Markets* 6, 413-459.

Huang, R. and H. Stoll, 1996, "Dealer versus Auction Markets: A Paired Comparison of Execution Costs on Nasdaq and the NYSE," *Journal of Financial Economics* 41, 313-357.

LaPlante, M. and C.J. Muscarella, 1997, "Do Institutions Receive Comparable Execution In The NYSE And Nasdaq Markets? A Transaction Study of Block Trades," *Journal of Financial Economics* 45, 97-134.

Lynch, A.W. and R.R. Mendenhall, 1997, "New Evidence on Stock Price Effects Associated with Changes in the S&P 500 Index," *Journal of Business* 70, 351–383.

Madhavan, A., 1995, "Consolidation, Fragmentation and the Disclosure of Trading Information," *The Review of Financial Studies* 8, 579-603

Merton, R., 1987, "Presidential Address: A Simple Model of Capital Market Equilibrium," *Journal of Finance* 42, 483-510.

Pruitt, S.W. and K.C. Wei, 1989, "Institutional Ownership and Changes in the S&P 500," *Journal of Finance* 44, 2, 509 – 513.

Scholes, M. and J.T. Williams, 1977, "Estimating Betas from Nonsynchronous Data," *Journal of Financial Economics* 5, 309-327.

Wall Street Journal, 2000, "Index Changes Can Drive Stocks (and Investors) Wild," (July 26) C1.

Weston, J., 2000, "Competition on the Nasdaq and the Impact of Recent Market Reforms," *Journal of Finance* 55, 2565-2598.

Wurgler, J. and E. Zhuravskaya, 2002, "Does Arbitrage Flatten Demand Curves for Stocks?" *Journal of Business* 75, 583-608.