Evidence that Trading Volume Sustains Stock Price Changes

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A conventional wisdom on Wall Street is that "volume is the fuel for stock prices." The question is how *trading volume influences subsequent price change. The hypothesis presented here is that price changes are more likely to reverse following weak volume support than strong volume support, because price changes reflect demand for a stock and higher volume reflects a greater likelihood that the demand originates from informed rather than uninformed trade. Consequently, as volume increases, the probability that the price change is information driven increases. The evidence indicates that large price changes on days with weak volume support tend to reverse, at least partially, the next day. This volume effect is reinforced by, but is independent of, a bid–ask bounce effect. Returns do not reverse following days of strong volume support. In fact, large price increases with strong volume support tend to be followed by another price increase the next day.*

An article in *Investor's Business Daily* offered the following explanation for the temporary drop in stock prices on January 27, 1993:[1]

> The first tip-off of how innocuous the sell-off was would have been evident in the volume figures for the three major markets. Turnover on the New York Stock Exchange, the Nasdaq and the American Stock Exchange actually declined during Wednesday's sell-off and continued easing for the rest of the week. Stock market analysts would read the low volume as a positive sign following a sell-off. It shows the drop was more likely an orderly correction as opposed to the beginning of a change in the overall market direction. "Volume is the fuel for stock prices," explained Andrew Addison, publisher and editor of the Franklin, Massachusetts-based investment newsletter, *The Addison Report*.

The view that price changes are more likely to reverse following weak volume support than strong volume support is not unusual on Wall Street. One possible reason may be that increased volume reflects a greater likelihood that the demand for a stock originates from informed as opposed to uninformed or liquidity-motivated trading. Consequently, investors interpret high volume as an indication that the demand underlying a price change is informed.[2] The presence of informed trading, in turn, implies that price changes are less likely to reverse. Conversely, investors interpret low volume as an indication that the demand underlying a price change is uninformed or liquidity motivated. Therefore, price changes accompanied by low volume are more likely to reverse, because they result from some transitory effect unrelated to information; that is, price changes are more likely to be temporary when volume is low. Thus, volume distinguishes price changes caused by information effects from price changes induced by liquidity effects.

METHODOLOGY

To test the hypothesis that trading volume distinguishes permanent from temporary stock price changes, we examined daily volume of trade and daily returns on the major U.S. exchanges at earnings announcements. Earnings announcements have the desirable characteristic of having information content.[3] In addition, earnings announcements are plentiful, which allows a powerful test of our hypothesis. Our results are robust to a replication on nonannouncement dates, and we concluded that volume proxies for information-driven price change regardless of the date.

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Sample Description

Data for this study included all quarterly earnings per share (EPS) announcements for firms listed on the Nasdaq National Market System (NMS) for fiscal years within the 1982–90 period for which the announcement date is available from the 1990 Compustat Quarterly Industrial or Full Coverage File and for which returns, trading volume, and bid–ask spread data are available from the 1990 Center for Research in Securities Prices (CRSP) Nasdaq NMS files.[4] An additional requirement was that at least one trade took place on each of event days −4 through +4 surrounding the earnings announcement day (Day 0). This requirement ensures that the CRSP prices are not simply the average of the bid and ask prices.[5] The final Nasdaq-based sample consisted of 24,302 quarterly earnings announcements for 2,056 firms.

The sample also included all quarterly EPS announcements for New York Stock Exchange (NYSE)/American Stock Exchange (Amex) firms for fiscal years within the 1986–90 period for which the announcement date is available from the 1990 Compustat Quarterly Files and for which returns and trading volume data are available from the 1990 CRSP files. The 2,150 firms meeting these requirements added 28,030 quarterly earnings announcements to the sample. CRSP does not provide bid or ask prices for NYSE/Amex firms.

To examine the relationship between announcement-day (Day 0) return, volume, and next-day (Day +1) return, we first segregated the Nasdaq and the NYSE/Amex samples into quintiles on the basis of announcement-day returns and on the basis of volume. Table 1 reports the following sample characteristics for each of the return/volume cells: the number of announcements per cell, mean price per share, mean market value of common stock, and for Nasdaq firms, mean percentage bid–ask spread. Because of the well-known positive correlation between volume and absolute returns, the number of earnings announcements per cell varies systematically. As expected, smaller and lower priced firms dominate the highest and lowest return quintiles.

Measuring Volume and Returns

Trading volume for a security on day t is defined as $\ln[100\,(n_t/N_t) + c]$, where (n_t/N_t) is the fraction of outstanding shares of the security traded on day t, and c is a small constant added to preclude computing the natural logarithm of zero. The constant c is set equal to 0.005 to "maximize the normality" of the distribution of daily trading volume.[6]

We measured the likelihood that announcement-day price change is information driven by abnormal volume on the announcement day, which is defined as actual volume minus expected volume. Expected volume for a given firm is the average volume for the given firm across the surrounding benchmark period of days −40 to −21 and +21 to +40.[7] The results are not sensitive to whether we used actual volume or abnormal volume.

Returns rather than price changes were used because we wanted to maintain comparability across firms. We reported daily abnormal returns, which were computed as actual return minus the mean return to the stock during the benchmark period.[8] The number of days of data in the benchmark period is a minimum of 30 and a maximum of 40. Our results are not sensitive to whether we used actual returns or abnormal returns.

As expected, volume of trade was relatively high on earnings announcement days, the mean (median) percentage traded was 0.67 percent (0.32 percent) for Nasdaq stocks and 0.37 percent (0.20 percent) for NYSE/Amex stocks. The mean (median) absolute abnormal return is also relatively high on earnings announcement days: 3.22 percent (2.06 percent) for Nasdaq stocks, and 2.45 percent (1.43 percent) for NYSE/Amex stocks.

DOES VOLUME SUSTAIN PRICE CHANGE?

Table 2 summarizes the relationship between Day 0 volume and Day +1 return for a given announcement-day return. The sample is segmented into quintiles on the basis of Day 0 returns and volume. The return/volume quintile cells 1/1 and 5/1 are where we expected the greatest next-day rebound in return, low Day 0 volume, and high Day 0 absolute return. We expected less next-day rebound for a given level of Day 0 return (for a given row) as Day 0 volume increases (i.e., moving from left to right in a given row).

For the Nasdaq stocks, the returns rebounded following low volume support. In the lowest return/lowest volume cell (1/1), the Day 0 and Day +1 mean abnormal returns were −5.54 percent and 1.33 percent, respectively. In the highest return/lowest volume cell (5/1), the Day 0 and Day +1 mean abnormal returns were 5.34 percent and −1.73 percent, respectively. These next-day reversals are economically and statistically significant.[9]

Volume support was high in return/volume quintile cells 1/5 and 5/5. In the lowest return/highest volume cell (1/5), the Day +1 return for the Nasdaq group was 0.07 percent, which is not

Table 1. Sample Characteristics by Announcement-Day Abnormal Return and Abnormal Volume

	Day 0 Abnormal Volume Quintile				
Abnormal Return Quintile	Quintile 1[a]	Quintile 2	Quintile 3	Quintile 4	Quintile 5[b]
Nasdaq stocks					
Quintile 1 (lowest Day 0 return)					
Mean percentage bid–ask spread[c]	7.902%	5.14%	4.86%	4.51%	4.93%
Mean price per share	$7.01	$9.76	$9.84	$10.71	$11.18
Mean market value of equity ($mil)	$62	$137	$128	$158	$195
Number of announcements	706	837	966	1,067	1,276
Quintile 2					
Mean percentage bid–ask spread	3.03%	2.64%	2.61%	2.73%	2.99%
Mean price per share	$14.25	$105.65	$16.67	$16.22	$15.91
Mean market value of equity	$168	$269	$260	$238	$195
Number of announcements	1,229	1,191	1,052	833	562
Quintile 3					
Mean percentage bid–ask spread	2.07%	1.90%	1.87%	2.03%	2.43%
Mean price per share	$22.42	$22.31	$23.38	$22.56	$20.37
Mean market value of equity	$299	$354	$362	$295	$209
Number of announcements	1,466	1,192	921	748	521
Quintile 4					
Mean percentage bid–ask spread	3.23%	2.56%	2.42%	2.35%	2.82%
Mean price per share	$13.89	$17.47	$18.06	$18.00	$17.02
Mean market value of equity	$143	$313	$319	$254	$141
Number of announcements	905	1,058	1,046	1,013	849
Quintile 5 (highest Day 0 return)					
Mean percentage bid–ask spread	7.58%	5.48%	4.32%	3.89%	4.41%
Mean price per share	$6.88	$9.61	$11.99	$12.75	$11.17
Mean market value of equity	$61	$136	$204	$183	$98
Number of announcements	549	578	871	1,206	1,660
NYSE/Amex stocks					
Quintile 1 (lowest Day 0 return)					
Mean price per share	$11.57	$26.61	$18.99	$19.53	$18.24
Mean market value of equity	$460	$2,707	$1,224	$1,444	$846
Number of announcements	753	850	1,009	1,331	1,651
Quintile 2					
Mean price per share	$23.85	$35.14	$30.22	$29.86	$23.43
Mean market value of equity	$1,333	$5,346	$3,015	$1,597	$956
Number of announcements	1,489	1,387	1,204	899	634
Quintile 3					
Mean price per share	$30.00	$34.84	$34.85	$32.06	$27.64
Mean market value of equity	$2,097	$4,676	$3,781	$1,763	$898
Number of announcements	1,867	1,440	1,087	737	461
Quintile 4					
Mean price per share	$24.51	$45.65	$46.08	$36.07	$26.25
Mean market value of equity	$1,456	$4,944	$3,880	$2,345	$802
Number of announcements	1,022	1,256	1,335	1,195	801
Quintile 5 (highest Day 0 return)					
Mean price per share	$10.26	$18.39	$21.06	$21.15	$17.50
Mean market value of equity	$332	$1,704	$1,902	$1,443	$570
Number of announcements	466	670	965	1,455	2,066

[a] Lowest Day 0 volume.
[b] Highest Day 0 volume.
[c] Ask price minus bid price, scaled by the average of bid and ask.

significantly different from zero. In the highest return/highest volume cell (5/5), the day +1 return was 0.65 percent ($t = 3.99$), which indicates that high volume is associated with continued price increase.

The evidence for the NYSE/Amex stocks is

Table 2. The Relation between Volume, Return, and Next-Day Return

Abnormal Return Quintile	Day 0 Abnormal Volume Quintile				
	Quintile 1[a]	Quintile 2	Quintile 3	Quintile 4	Quintile 5[b]
Nasdaq stocks					
Quintile 1 (lowest Day 0 return)					
Day 0 mean abnormal return	−5.54%	−5.19%	−5.66%	−6.07%	−7.88%
Day +1 mean abnormal return	1.33	0.04	0.28	0.05	0.07
(*t*-statistic for Day +1)	(7.73)**	(0.23)	(1.79)	(0.27)	(0.33)
Quintile 2					
Day 0 mean abnormal return	−1.48	−1.49	−1.60	−1.55	−1.59
Day +1 mean abnormal return	−0.11	−0.28	−0.22	−0.18	0.07
(*t*-statistic for Day +1)	(−1.09)	(−2.41)*	(−2.30)*	(−1.89)	(0.45)
Quintile 3					
Day 0 mean abnormal return	−0.05	−0.04	−0.04	−0.02	−0.02
Day +1 mean abnormal return	−0.12	−0.23	−0.16	−0.05	0.02
(*t*-statistic for Day +1)	(−0.98)	(−1.71)	(−1.03)	(−0.31)	(0.10)
Quintile 4					
Day 0 mean abnormal return	1.39	1.44	1.45	1.47	1.52
Day +1 mean abnormal return	−0.69	−0.10	0.25	0.31	0.21
(*t*-statistic for Day +1)	(−4.59)**	(−1.17)	(2.06)*	(1.99)	(1.55)
Quintile 5 (highest Day 0 return)					
Day 0 mean abnormal return	5.34	5.31	5.51	6.10	7.42
Day +1 mean abnormal return	−1.73	−0.62	0.14	0.21	0.65
(*t*-statistic for Day +1)	(−6.27)**	(−2.50)	(0.98)	(1.26)	(3.99)**
NYSE/Amex stocks					
Quintile 1 (lowest Day 0 return)					
Day 0 mean abnormal return	−3.83	−3.79	−3.90	−4.37	−6.34
Day +1 mean abnormal return	0.09	−0.08	−0.34	−0.22	−0.00
(*t*-statistic for Day +1)	(0.72)	(−0.38)	(−2.65)*	(−1.65)	(−0.01)
Quintile 2					
Day 0 mean abnormal return	−1.16	−1.15	−1.16	−1.21	−1.20
Day +1 mean abnormal return	−0.38	−0.28	−0.15	−0.16	0.11
(*t*-statistic for Day+1)	(−3.55)**	(−2.36)*	(−2.31)*	(−2.72)*	(0.45)
Quintile 3					
Day 0 mean abnormal return	−0.10	−0.09	−0.10	−0.09	−0.09
Day +1 mean abnormal return	−0.22	−0.09	−0.10	−0.08	0.04
(*t*-statistic for Day +1)	(−2.83)*	(−0.93)	(−1.50)	(−0.53)	(0.19)
Quintile 4					
Day 0 mean abnormal return	0.92	1.01	1.00	1.00	1.03
Day +1 mean abnormal return	0.05	−0.02	0.12	0.15	0.18
(*t*-statistic for Day +1)	(0.55)	(−0.17)	(1.75)	(1.40)	(1.32)
Quintile 5 (highest Day 0 return)					
Day 0 mean abnormal return	4.12	3.62	3.94	4.28	6.43
Day +1 mean abnormal return	−1.00	−0.26	0.08	0.30	0.46
(*t*-statistic for Day +1)	(−3.46)**	(−1.64)	(0.62)	(2.63)*	(3.08)**

[a] Lowest Day 0 volume.
[b] Highest Day 0 volume.
* Significant at 5 percent level.
** Significant at 1 percent level.

weaker than for the Nasdaq stocks but confirms that returns rebound following low volume support. The lowest return/lowest volume cell (1/1) shows no evidence of rebound; the Day 0 and Day +1 mean abnormal returns were −3.83 percent and 0.09 percent (t = 0.72), respectively. The highest return/lowest volume cell (5/1) does provide evidence of rebound; the Day 0 and Day +1 mean abnormal returns were 4.12 percent and −1.00 percent (t = −3.46), respectively. More evidence that price continues to increase following strong volume support is found in the highest return/highest volume cell (5/5); the Day 0 and Day +1 mean abnormal returns were 6.43 percent and 0.46 percent ($t = 3.08$), respectively.[10]

Although Table 2 provides an interesting summary of the relationship between volume and next-day return, it cannot be used to test our hypothesis because it does not control for cross-sectional differences in bid–ask spreads and any reversal induced by a bid–ask bounce.[11] For example, for Nasdaq stocks, the low return/low volume cell (1/1) next-day abnormal return of 1.33 percent and the low return/high volume cell (1/5) next-day abnormal return of 0.07 percent, shown in Table 2, are partially explained by larger mean bid–ask spreads (see Table 1) in the lowest return/lowest volume cell (7.02 percent of the bid–ask average price) than in the lowest return/highest volume cell (4.93 percent of the bid–ask average), as well as our hypothesis that price changes are more likely to reverse following weak volume than following strong volume.

A Multivariate Analysis

A multivariate approach permits examination of the relationship between announcement day abnormal volume and next-day abnormal return while holding constant cross-sectional differences in measured bid–ask spread, as well as other proxies for the "true" bid–ask spread, including firm size, stock price level, and normal volume.[12] Specifically, we estimated the following regression:

$$\begin{aligned} ARET_{+1} = {} & \beta_0 + \beta_1(AVOL_0) + \beta_2(SPRD_0) \\ & + \beta_3(LSIZE_0) + \beta_4(LPRICE_0) \\ & + \beta_5(NVOL) + \beta_6(ARET_0) + \epsilon, \end{aligned}$$

where

- $ARET_{+1}$ = abnormal return to the stock on Day +1
- $AVOL_0$ = abnormal volume to the stock on Day 0
- $SPRD_0$ = difference between the ask and bid prices on Day 0 scaled by the average of the bid and ask prices
- $LSIZE_0$ = natural logarithm of the market value of common stock on Day 0
- $LPRICE_0$ = natural logarithm of the stock price on Day 0
- $NVOL$ = normal (expected) volume, defined as the average daily volume during the benchmark period: days −40 to −21 and +21 to +40

The regression analyses are partitioned by the quintile of the Day 0 abnormal return, $ARET_0$. $ARET_0$ is included in the partitioned regressions to control for the magnitude of Day 0 abnormal return within a partitioned regression.

For negative announcement-day abnormal returns (quintiles 1 and 2 in Table 2), our hypothesis predicts a negative β_1; conditional on negative announcement-day abnormal return ($ARET_0$), next-day abnormal returns ($ARET_{+1}$) are more positive (rebound more) with lower announcement-day volume ($AVOL_0$). The independent variables $SPRD_0$, $LSIZE_0$, and $LPRIC_0$ all proxy for cross-sectional differences in the true bid–ask spread of the stock and control for any bid–ask bounce. Stocks with wider bid–ask spreads are expected to have a larger rebound irrespective of abnormal volume. For negative Day 0 abnormal returns, the expectation is for β_2 to be positive and β_3 and β_4 to be negative; that is, next-day abnormal returns ($ARET_{+1}$) rebound more with higher bid–ask spreads ($SPRD_0$), lower market value of common stock ($LSIZE_0$), and lower stock price ($LPRICE_0$). For positive $ARET_0$ (return quintiles 4 and 5 in Table 2), the predicted signs of coefficients are the opposite of those for negative $ARET_0$.

Table 3 reports mean coefficients from calendar quarter regressions for announcement-day abnormal return quintiles 1, 2, 4, and 5.[13] The results support our hypothesis that price changes are more likely to reverse, and less likely to continue in the same direction, following a low-volume day than following a high-volume day. For Nasdaq stocks, the mean coefficient on announcement-day abnormal volume ($AVOL_0$) is significantly different from zero for all quintiles, except Quintile 2. For NYSE/Amex stocks, the mean coefficient on $AVOL_0$ is significantly different from zero for Quintile 5 (extreme positive returns), but not for Quintile 1 (extreme negative returns).

The results also suggest that price rebounds are more pronounced for stocks with wider bid–ask spreads. For Nasdaq stocks, the mean coefficients on percentage bid–ask spread ($SPRD_0$) are significant in the predicted direction for Quintiles 1 and 5, the extreme Day 0 returns. The mean coefficient for Quintile 2, however, is unexpectedly negative and significant.

The mean coefficients on market value of common stock ($LSIZE_0$) and price per share ($LPRICE_0$) for the Nasdaq group provide mixed evidence. For NYSE/Amex firms, CRSP does not supply bid and ask prices; thus, we rely on the other proxies. The mean coefficients on $LSIZE_0$ and $LPRICE_0$ also provide mixed evidence. The coefficients on $LPRICE_0$ suggest that price rebounds are

Table 3. Coefficients of Regressions of Next-Day Abnormal Return ($ARET_{+1}$) on Announcement-Day Variables

Abnormal Return Quintile	Independent Variables[a]							Mean Adjusted R^2
	Intercept	$AVOL_0$	$SPRD_0$	$LSIZE_0$	$LPRICE_0$	$NVOL$	$ARET_0$	
Nasdaq stocks								
Quintile 1 (lowest Day 0 return)								
Predicted sign	?	(−)	(+)	(−)	(−)	(−)	(−)	
Mean coefficient	−0.0024	−0.0030	0.1254	−0.0005	−0.0027	−0.0036	−0.0608	0.07
(t-statistic)	(−0.52)	(−3.12)**	(2.62)*	(−0.49)	(−1.24)	(−3.44)**	(−1.22)	
Quintile 2								
Predicted sign	(?)	(−)	(+)	(−)	(−)	(−)	(−)	
Mean coefficient	0.0069	0.0003	−0.1223	−0.0013	−0.0018	−0.0020	−0.1777	0.03
(t-statistic)	(1.35)	(0.77)	(−2.35)*	(−1.73)	(−1.30)	(−3.89)**	(−1.91)	
Quintile 4								
Predicted sign	(?)	(+)	(−)	(+)	(+)	(+)	(+)	
Mean coefficient	0.0084	0.0034	−0.1315	0.0015	−0.0041	0.0011	−0.0573	0.02
(t-statistic)	(1.73)	(4.99)**	(−1.90)	(1.81)	(−2.98)**	(1.42)	(−0.94)	
Quintile 5 (highest Day 0 return)								
Predicted sign	(?)	(+)	(−)	(+)	(+)	(+)	(+)	
Mean coefficient	0.0082	0.0078	−0.1596	0.0026	−0.0044	0.0041	−0.0447	0.10
(t-statistic)	(1.25)	(9.25)**	(−3.02)**	(2.66)*	(−2.02)	(3.49)**	(−1.94)	
NYSE/Amex stocks								
Quintile 1 (lowest Day 0 return)								
Predicted sign	(?)	(−)	—	(−)	(−)	(−)	(−)	
Mean coefficient	−0.0143	−0.0020	—	0.0022	−0.0056	−0.0026	−0.2714	0.05
(t-statistic)	(−2.08)	(−1.71)	—	(2.81)*	(−2.35)*	(−2.92)**	(−2.61)*	
Quintile 2								
Predicted sign	(?)	(−)	—	(−)	(−)	(−)	(−)	
Mean coefficient	−0.0010	0.0015	—	0.0009	−0.0025	−0.0004	−0.0138	0.01
(t-statistic)	(−0.21)	(2.44)*	—	(2.22)*	(−1.53)	(−0.62)	(−0.13)	
Quintile 4								
Predicted sign	(?)	(+)	—	(+)	(+)	(+)	(+)	
Mean coefficient	−0.0036	0.0007	—	0.0004	−0.0003	−0.0012	−0.0134	0.00
(t-statistic)	(−0.87)	(1.43)	—	(1.22)	(−0.20)	(−1.77)	(−0.10)	
Quintile 5 (highest Day 0 return)								
Predicted sign	(?)	(+)	—	(+)	(+)	(+)	(+)	
Mean coefficient	−0.0080	0.0044	—	−0.0008	0.0046	0.0007	−0.0079	0.04
(t-statistic)	(−1.94)	(5.61)**	—	(−1.73)	(3.33)**	(0.62)	(−0.23)	

[a] See text for definitions of variables.
* Statistically significant at 5 percent level.
** Statistically significant at 1 percent level.

more pronounced for stocks with lower prices and, presumably, wider bid–ask spreads. The coefficients on $LSIZE_0$ generally indicate that, holding all other variables constant, larger firms have greater return rebounds. These results for $LSIZE_0$ are surprising and left unexplained.

The mean coefficient on *NVOL*, mean volume in a nonannouncement period, is significantly different from zero for all quintiles of the Nasdaq sample, except Quintile 4. To the extent that *NVOL* proxies for cross-sectional differences in true bid–ask spreads, this result is similar to the result for percentage bid–ask spread ($SPRD_0$): Stocks with higher normal volume have lower bid–ask spreads and rebound less. An alternative explanation is that *NVOL* proxies for the presence of information in nonannouncement periods and that subtracting *NVOL* from actual volume on the announcement date eliminates some of the information we are attempting to measure; that is, perhaps a better proxy for information-driven price changes is actual volume, not mean-adjusted volume. Because $SPRD_0$, $LSIZE_0$, and $LPRICE_0$ all proxy for cross-sectional differences in true bid–ask spreads, it is possible that *NVOL* proxies for the presence of information and that the results for *NVOL*, like the results for $AVOL_0$, are consistent with our hypothesis that price changes are more likely to reverse following low volume than following high volume. For NYSE/Amex firms, the results for *NVOL* are less convincing. The coefficient on *NVOL* is significant in the predicted direction for Quintile 1 stocks (extreme negative Day 0 returns) but insignificant for the other quintiles.

Our results are robust to replication on nonannouncement dates. We repeated our tests using abnormal returns and abnormal volume on Day +2. We examined the relationship between volume on Day +2 and return on Day +3, conditional on Day +2 return and holding constant liquidity as proxied by $SPRD_{+2}$, $LSIZE_{+2}$, $LPRICE_{+2}$, and *NVOL*. The results (not reported here) were similar to the results using earnings announcement dates. We concluded that volume proxies for the presence of information in a given price change regardless of the date.

A Graphical Analysis

Figures 1 and 2 plot mean bid, ask, and transaction prices from Day −4 to Day +4 for Nasdaq observations in each of four return/volume cells: Figure 1 contains observations from the Nasdaq lowest return/lowest volume and lowest return/highest volume cells, and Figure 2 contains observations from the Nasdaq highest return/lowest volume and the highest return/highest volume cells. These plots combine the separate effects of volume support and the bid–ask bounce documented in Table 3. In each figure, return is held constant in order to contrast the effects of weak volume support and strong volume support.

The left-hand panel of Figure 1 illustrates stocks that tend to trade near the ask on Day −1 and near the bid on Day 0. The bid and ask prices decrease on Day 0, but not by as much as the decrease in transaction price. In contrast, in the plot on the right of Figure 1, the movement in average bid, ask, and transaction prices are synchronous. Thus, although the change in transaction prices from Day −1 to Day 0 are comparable, the information in the price changes, as proxied by the change in bid and ask prices, is quite different. The large negative return on Day 0 in the low-volume plot is attributable to a combination of information and liquidity shocks, whereas the large negative return on Day 0 in the high-volume plot is largely information. These price behavior patterns are consistent with our hypothesis. A large downward price movement on low volume is followed the next day by a price rebound, indicat-

Figure 1. Nasdaq Stocks with Large Negative Returns, Low and High Volume Support, Day −4 to Day +4

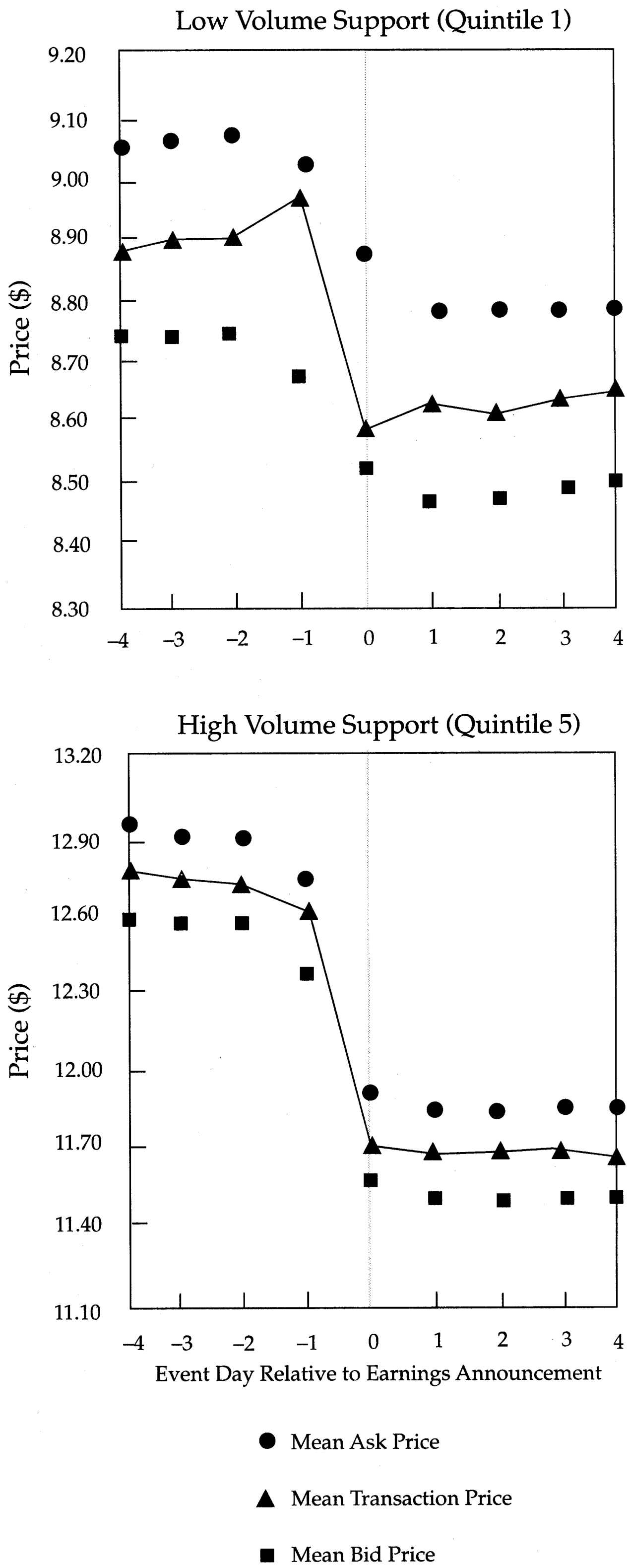
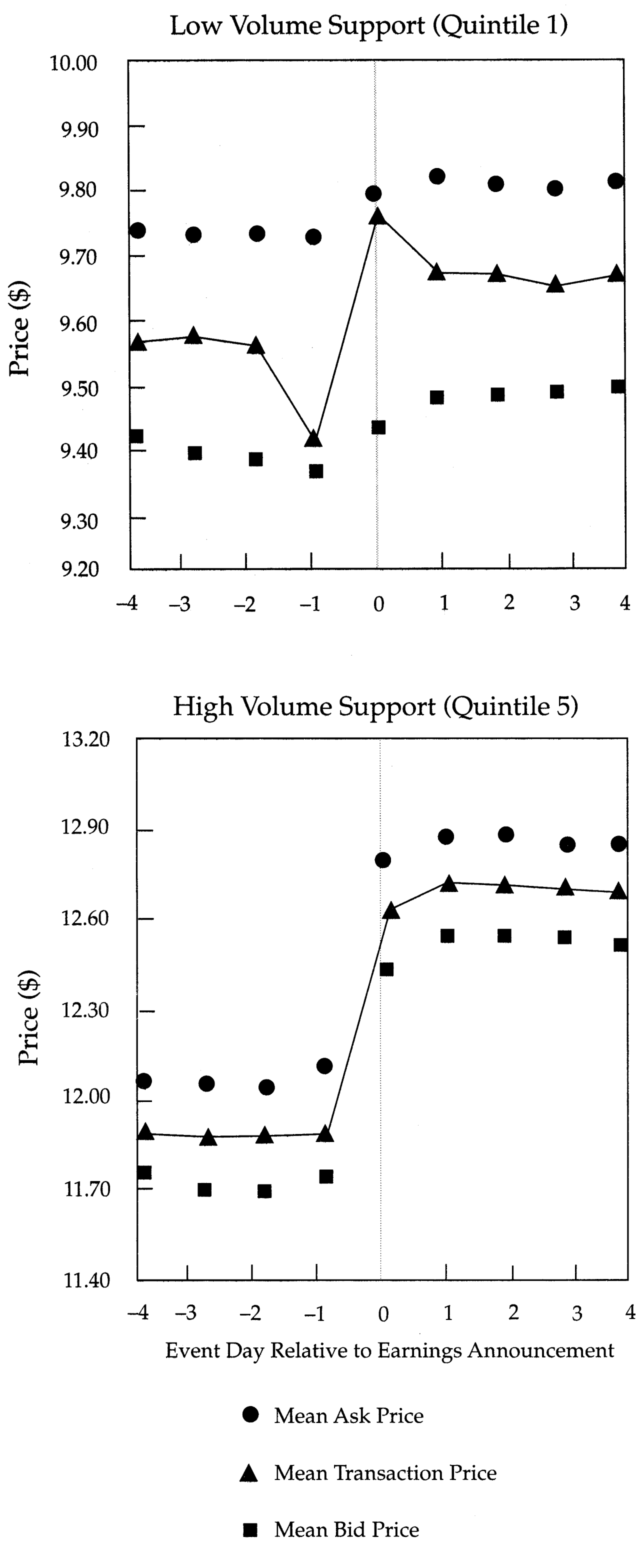


Figure 2. Nasdaq Stocks with Large Positive Returns, Low and High Volume Support, Day −4 to Day +4



ing that a portion of the original price change is liquidity motivated. With high volume, no next-day price rebound occurs, indicating that the original price change is information motivated.[14]

Figure 1 illustrates the Table 3 result that next-day price rebound is influenced by both volume support and the bid–ask spread. The mean next-day price rebound and bid–ask spread were larger for the low-volume than for the high-volume situation, which illustrates that larger price rebounds occur with larger spreads. The plot on the right illustrates that volume support eliminates next-day price rebound regardless of the bid–ask spread. If volume has no influence, then we would expect a next-day price rebound in the high-volume situation that is proportionate to the bid–ask spread, as happens in the low-volume example. The absence of a proportionate next-day price rebound in the right-hand panel is evidence that volume helps explain next-day return and confirms the parametric result that volume support has an influence that is independent of the bid–ask spread.

Figure 2 contains observations from the highest return/lowest volume and the highest return/highest volume cells. The low-volume plot illustrates the next-day rebound in transaction prices. The next-day rebound in transaction prices is absent in the high-volume plot, providing evidence that the positive price change on the announcement day continues into the next day.

Figures 3 and 4 replicate Figures 1 and 2 but are based on the NYSE/Amex stocks. In the absence of CRSP bid or ask prices for NYSE/Amex stocks, only the mean closing transaction prices are plotted. In comparison with the plots of Nasdaq prices, these figures show less evidence of next-day return reversal following low volume support and price changes continuing into the next day following high volume support.[15] Thus, although the regression analyses reported in Table 3 provide evidence of statistical significance, the next-day return reversals and return continuations into the next day for NYSE/Amex stocks appear to be of lesser economic significance.

CONCLUSIONS

Large stock price changes on days with weak trading volume tend to partially reverse the next day. As expected, this next-day reversal is larger for stocks with larger bid–ask spreads. Even holding bid–ask spread constant, however, the magnitude of the next-day reversal increases as volume

Figure 3. NYSE/Amex Stocks with Large Negative Returns, Low and High Volume Support, Day −4 to Day +4

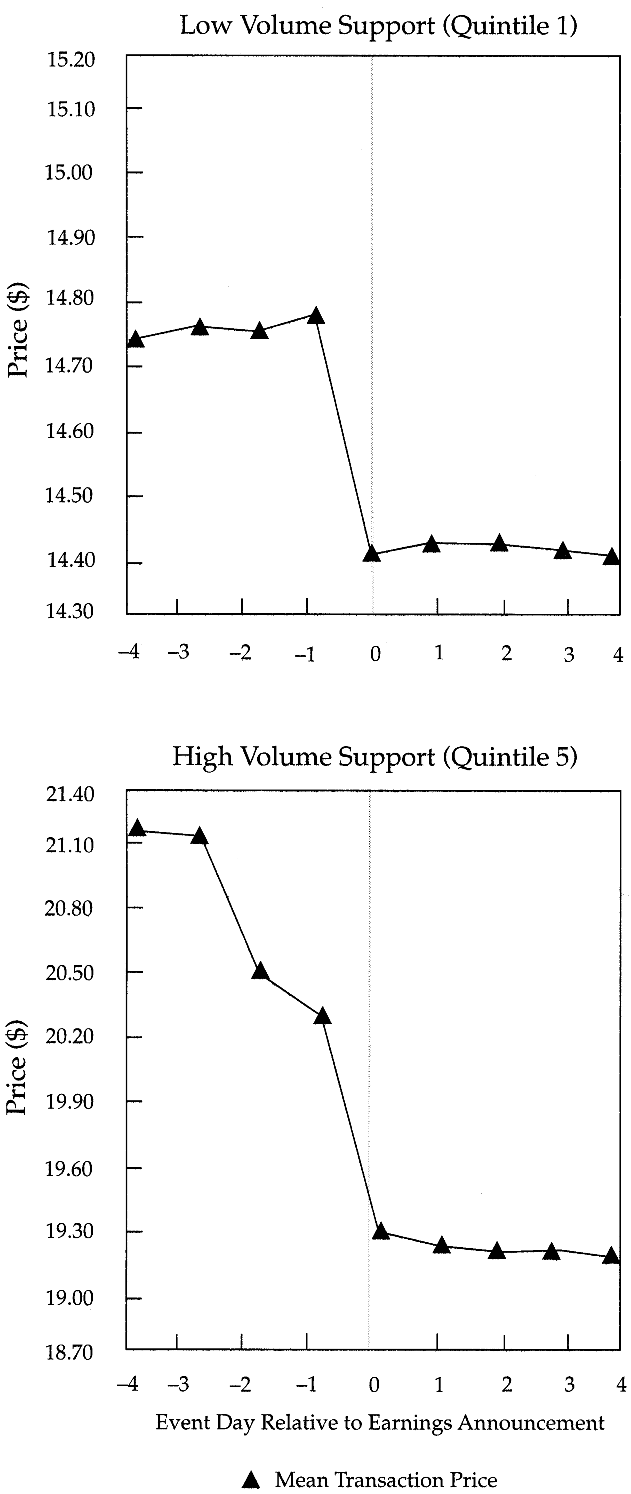
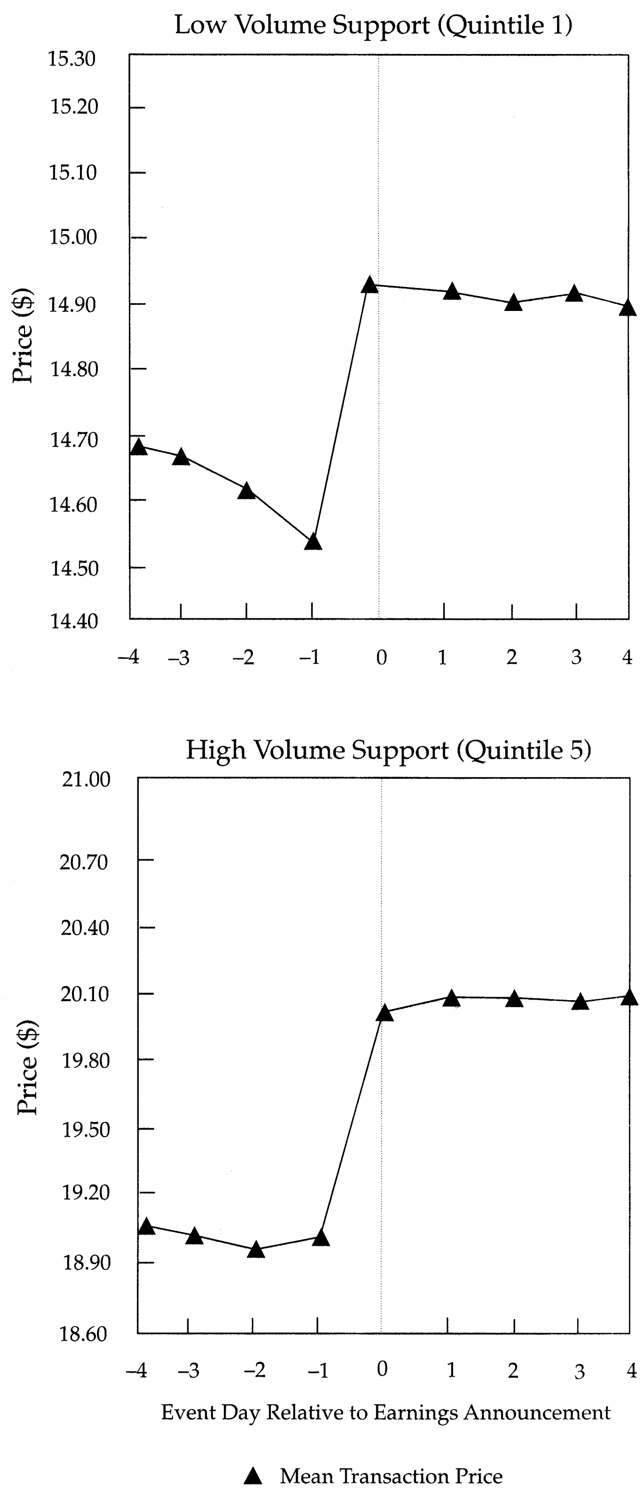


Figure 4. NYSE/Amex Stocks with Large Positive Returns, Low and High Volume Support, Day −4 to Day +4



support weakens. When volume support is strong, the next-day return reversal is absent. In fact, a large price increase with strong volume support tends to be followed by another price increase the next day.

This result suggests that investors should be cautious in interpreting large, daily stock price changes with weak volume support. Without volume support, large price changes are a misleading indicator of change in value. When volume is low, the change in bid–ask average price may better reflect change in value. Bid and ask prices are not always available, however. In such circumstances, volume of trade can be used in conjunction with price change to measure change in true value.

Our ability to predict next-day returns from volume of trade does not confirm or deny a profitable arbitrage opportunity. For Nasdaq stocks, the average next-day price rebound is much less than the average bid–ask spread. This finding reduces our expectations of profitable arbitrage. Although machine-readable bid–ask spread data are not available for NYSE/Amex stocks, the economic significance of our evidence appears to be greater for Nasdaq stocks than for NYSE/Amex stocks. Thus, we expect no profitable arbitrage opportunities in NYSE/Amex stocks.

The conclusions presented in this article are based on our results using daily data. An interesting extension of this study would be to examine whether intraday volume can predict subsequent intraday price change and yield profitable arbitrage opportunities.[16]

FOOTNOTES

1. Lisa Lee Freeman, "Look Before You Leap Out of the Market," *Investor's Business Daily* (February 3, 1993).
2. See, for example, R. Verrecchia, "Market Inferences from Demand and Volume," working paper (Philadelphia: Wharton School, 1994), for a discussion of why markets interpret increased volume as an indication of informed trade in the context of a model of rational trade.
3. See, for example, R. Ball and P. Brown, "An Empirical Evaluation of Acounting Income Numbers," *Journal of Accounting Research*, vol. 6, no. 2 (Autumn 1968):159–78; and W.H. Beaver, "The Information Content of Annual Earn ings Announcements," *Journal of Accounting Research*. vol. 6 (Supplement 1968):67–92.
4. Approximately 1 percent of the daily bid and ask prices on the 1990 Nasdaq NMS tape are coincidentally zero, even though there is a positive transaction price on the same date. In these cases, the bid and ask prices were assumed to be errors and excluded from the analysis.
5. The daily trade requirement is important because CRSP will use the bid–ask average price if no trade takes place. Ours is a prediction of the behavior of transaction prices, not bid–ask average prices. This requirement, however, does result in a small positive bias in measured abnormal volume. As a check on robustness, we performed all of our analyses without the daily trade requirement. Our conclusions remained unaltered.
6. See G. Richardson, S. Sefcik, and R. Thompson, "A Test of Dividend Irrelevance Using Volume Reactions to a Change in Dividend Policy," *Journal of Financial Economics*, vol. 17, no. 2 (December 1986):313–33.
7. We also considered two other measures of investors' expectation of trading volume on Day 0: volume on the earnings announcement date four quarters ago, and volume on the earnings announcement date four quarters ago multiplied by the ratio of return this quarter to return four quarters ago. These measures are less accurate measures of expected volume than the benchmark adopted, as judged by mean absolute forecast error. As expected, the statistical significance of the results using these alternative measures deteriorated with the less accurate measures of expectations.
8. For a discussion and example of the use of mean-adjusted returns, see R. Masulis, "The Effects of Capital Structure Change on Security Prices: A Study of Exchange Offers," *Journal of Financial Economics*, vol. 8, no. 2 (June 1980):139–77.
9. The sample was segregated into subsamples on the basis of the calendar quarter in which the earnings announcement occurred, and mean results were determined by subsample. The significance of mean results from these subsamples was determined by dividing the mean of the subsample means by its standard error, which is the estimated standard deviation of the subsample means divided by the square root of the number of subsamples. These procedures appeal to the Central Limit Theorem.
10. N. Jegadeesh and S. Titman, in "Short Horizon Return Reversals and the Bid–Ask Spread," working paper, University of California at Los Angeles (1993), examined short-horizon (1-, 3-, 5-, 7-, and 10-day) serial correlations in stock returns and the relationship to inventory-based market microstructure models. They found that serial correlation for consecutive (one-day lag) returns is positively associated with volume of trade (less frequently traded securities have more negative serial correlation). The authors noted that this finding is inconsistent with inventory models, which suggest that the negative correlation should be more pronounced at higher, not lower, volume because price is rebounding from greater price pressure when volume is high. In contrast, their results are consistent with ours and consistent with our information-based model of price behavior.
11. The expresssion bid–ask bounce is used to describe the behavior of prices in a sequence of transactions in which no new information is introduced. See, for example, R. Roll, "A Simple Implicit Measure of the Bid–Ask Spread in an Efficient Market," *Journal of Finance*, vol. 39, no. 4 (September 1984):1127–39.

12. For evidence that transactions occur within quoted bid–ask spreads, see C.M.C. Lee and M.J. Ready, "Inferring Trade Direction from Intraday Data," *Journal of Finance*, vol. 46, no. 2 (June 1991):733–46. Thus, measured bid–ask spreads may not equal the true bid–ask spreads. Consequently, in addition to using the measured bid–ask spread, we used firm size, stock price, and normal volume to proxy for the true bid–ask spread. For the logic underlying these proxies and an example of their use see S. Stickel, "The Ex-Dividend Behavior of Nonconvertible Preferred Stock Returns and Trading Volume," *Journal of Financial and Quantitative Analysis*, vol. 26, no. 1 (March 1991):45–61.
13. The calendar quarter regressions were calculated as follows: The sample was first segregated into quintiles on the basis of the Day 0 abnormal return. Next, each quintile was segregated by the calendar quarter within which Day 0 fell. A regression was performed for each calendar quarter subsample within each quintile, and mean coefficients were calculated by quintile. The significance of these mean coefficients was determined by dividing the mean coefficient by its standard error, which is the estimated standard deviation of the coefficients divided by the square root of the number of calendar quarters. This design subsumes any cross-sectional temporal dependence within subsamples and reduces any cross-sectional temporal dependence between subsamples. There were 28 Nasdaq subsamples (seven years times four quarters a year) and 20 NYSE/Amex subsamples (five years). For the Nasdaq sample, 642 announcements prior to 1984 were grouped with announcements in the first calendar quarter of 1984, resulting in 28 calendar quarters (the first quarter of 1984 through the last quarter of 1990). The number of Nasdaq announcements per calendar quarter ranged from 383 in the first quarter of 1986 to 1,135 in the fourth calendar quarter of 1987. The number of NYSE/Amex announcements per calendar quarter ranged from 555 in the first quarter of 1986 to 1,611 in the second calendar quarter of 1990.
14. Do not infer from Figure 1 that in a low-volume situation, most stocks increase in value on Day −1 before the Day 0 price decrease. We interpret the upward transaction price movement on Day −1 as a liquidity premium paid by a buyer, rather than good information, because of the absence of an increase in bid and ask prices on Day −1. This upward liquidity shock on Day −1 allows a large downward price movement on Day 0, a price movement that may also contain a liquidity premium paid by a seller, as well as bad information. Our experimental design *ex post* segregates observations on the basis of Day 0 returns and volume. *Ex post*, a large, negative Day 0 return is more likely to contain a negative liquidity shock than a positive liquidity shock, and the potential for a large negative liquidity shock increases with a positive liquidity shock on Day −1.
15. The implied returns from Figures 1 through 4 do not exactly equal the abnormal returns reported in Table 2. One reason is that, in Table 2, actual returns are adjusted for expected returns, whereas returns are not adjusted in the figures. A second reason is that the returns reported in Table 2 are equally weighted, but the figures are based on mean prices, which equally weights price changes, giving more weight to higher priced stocks. The equal weighting dampens next-day reversals and is consistent with Table 3, which indicates that return reversals are stronger for lower priced stocks. This dampening effect is most evident on the low-volume side of Figure 4, which shows a small Day +1 reversal; in contrast, Table 2 reports a relatively large Day +1 reversal of −1.00 percent.
16. We received helpful comments from workshop participants at Emory University, La Salle University, the University of Pennsylvania, the University of Rochester, and Temple University. A preliminary version of this study was presented at the Third Conference on Financial Economics and Accounting at New York University in November 1992.