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Return predictability following large price changes and information releases

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Abstract

We examine return behavior following large price change events. Unconditional post-event abnormal returns are found to be unimportant. As we condition on other criteria related to the quality of information like volume and public announcements, the abnormal returns become large. The type of news provides further refinement. If the news relates to earnings or analyst recommendations then the 20-day abnormal returns become much larger ranging from 3% to 4% for positive events and about −2.25% for negative events. Finally, an out-of-sample trading strategy confirms investor under-reaction and generates significant abnormal annualized returns of the order of 12–18%. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

There is an extensive literature examining short-run stock return predictability following release of new information proxied by large volume increases,

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large price changes, or public announcements. We do not believe the existing studies capture the multidimensional nature of information signals. Magnitude, precision, and dissemination are a signal's major characteristics. Large price changes capture the magnitude, volume changes capture the precision, and public announcements capture the level of dissemination of information signals. However, any one of the proxies used captures only one of the three dimensions. In this paper, we use all three signal-identifying proxies simultaneously and examine whether there is an improvement in return predictability.

We begin with a sample of abnormally large price changes. Carefully avoiding the pitfalls related to market microstructure issues, we find that unconditional post-event abnormal returns are economically insignificant, though sometimes statistically significant. The results become more interesting when other screens are imposed. Conditional on a public announcement, investors earn an average 20-day abnormal return of +1.25% following positive events and −1.62% following negative events. For the "no public announcement" categories, there is no significant under-reaction. If large price changes are accompanied by a public announcement and an increase in volume then the 20-day abnormal return is about 2% for the positive events sample and −1.68% for the negative events sample.

Finally, we consider the type of announcement. If earnings announcements, earnings forecasts, and analyst recommendations are accompanied by a large increase in volume and a large price change, then the under-reaction is large: about 3.50% over a 20-day period for the positive events and −2.25% for negative events. The extent of under-reaction is more severe than that reported in previous papers.

An out of sample test of a trading strategy of buying (selling) positive (negative) price event firms accompanied by an increase in volume and news relating to earnings or analyst recommendations earn a statistically significant 20-day abnormal return of 1–1.5% after transaction costs (excluding commission costs).

The rest of the paper is organized as follows. Section 2 reviews the related literature, and Section 3 describes the data and sample selection procedure. Section 4 discusses the methodology to calculate abnormal returns and presents the results for events with and without public announcements and volume changes. Section 5 relates the price discovery process to the type of announcement. Section 6 presents the results of an out of sample implementation of our trading strategy, while section 7 concludes the paper.

2. Prior work

In this section, we discuss the three major characteristics of information signals and the related theoretical models and empirical evidence. The first

property of a signal, its magnitude, measures the signal's importance. Blume et al. (1994) note that price change is a good proxy for a signal's magnitude. Many authors have studied returns following large price changes. Bremer and Sweeney (1991) and Atkins and Dyl (1990) find that price declines of at least 10% are followed by reversals. The 2-day abnormal return in Bremer and Sweeney (1991) is 2.20% following the event. Cox and Peterson (1994) find that the degree of reversals following large price declines of at least 10% wanes through time, and these events experience negative cumulative abnormal returns over 4–20 days following the event. On the other hand, Brown et al. (1988) find evidence of small but statistically significant positive abnormal returns following positive and negative price events. Using the mid-point of bid–ask prices, however, Park (1995) shows that predictable variation in stock returns following large price changes is in part driven by the bid–ask bounce. Controlling for this effect, he finds that the short-run price reversals are not tradable.

The second distinguishing characteristic of a signal is its precision. An imprecise signal is a signal of low quality or high noise. Several heterogeneous agent models of trading show that volume captures the level of precision of a signal (see Harris and Raviv, 1993; Blume et al., 1994; Kim and Verrecchia, 1994). The intuition underlying these models is that as the precision of a signal increases, it will lead investors to have more confidence in their private valuations of the risky asset and so they will be willing to take large speculative positions. However, it will also lead to a convergence in prices, as investors are likely to share the same beliefs. This in turn will lower trading volume, as the potential benefits from speculative positions are likely to be lower than trading costs. On the other hand, if a signal is highly imprecise, it will again lead to low trading volume, because though investors have diverse beliefs they place little confidence in their private valuations and so are not willing to take large speculative positions. Therefore, volume is likely to be high at moderate levels of signal precision where investors hold diverse beliefs as well as have enough confidence in their individual valuations to undertake large speculative positions.

Surprisingly, few empirical studies have examined whether volume can help predict future returns. Over weekly horizons, Conrad et al. (1994) find evidence of price reversals following increases in volume and price continuations following low volume. Over intermediate horizons of 3–12 months, Lee and Swaminathan (1998) find that a strategy of buying past high-volume winners and selling past high-volume losers outperforms the traditional momentum strategy of buying past winners and selling past losers by 2–7% per year.

The last characteristic of a signal is its dissemination. Dissemination refers to the fraction of traders that receive the signal. For signals of the same precision, the greater the level of dissemination, the smaller will be the volume because with greater dissemination there will be a smaller divergence of

opinion. Since public announcements generate the greatest amount of dissemination, a volume increase around a public announcement is less likely due to a low level of dissemination and more likely due to the imprecise nature of the signal. Thus, public announcements release new information while achieving a high level of dissemination.

Market reaction to public announcements has been researched at several levels. At an aggregate level, researchers such as Mitchell and Mulherin (1994) and Schwert (1981) have been unable to find a reliable relation between news and stock prices. At a firm level, Roll (1988) finds that stories from the financial press have little effect on the returns of large stocks. When announcements are grouped into different categories, however, some return regularities are observed. The most well-known price continuation is the post-earnings announcement drift. Bernard and Thomas (1989) find that firms with surprisingly good earnings earn 60-day post-event abnormal returns of approximately 2%, and firms with bad earnings lose about 2% in the 60 days following the announcement. In addition to the earnings drift, Ikenberry et al. (1995) find that stock prices under-react to open market share repurchase announcements to the extent of about 2% over the following year. Michaely et al. (1995) find that firms initiating (omitting) dividends earn abnormal returns of 1.8% (−4.6%) over approximately 60 days following the event.

To sum up, each of the three signal characteristics is able to predict future returns. However, most of these predictable returns are not of economic significance in the face of transaction costs, especially over short horizons. In this paper, we examine the joint ability of these three signal characteristics to predict future returns and assess the economic significance after taking into account transaction costs.

3. Data and sample

The initial sample consists of all common stocks listed on the New York Stock Exchange (NYSE) or the American Stock Exchange (AMEX) for which data is available in the 1990–1992 transactions file of the Institute for the Study of Security Markets (ISSM). [1] A daily stock return that represents a large abnormal price change is called an event. A change is said to be "large" if the abnormal return after adjusting for the value-weighted CRSP index is more than three standard deviations away from the mean, based on mean and

[1] We exclude American Depository Receipts (ADRs) and closed-end funds because public announcements regarding ADRs are more difficult to obtain and because closed-end funds are derived from individual stocks. We also exclude Berkshire Hathaway and Capital Cities because of their high stock prices and spreads.

standard deviation calculated over the preceding 250 trading days for that firm. [2] While the definition of "large" price change is different from previous work wherein researchers rely on an absolute percentage cutoff, we believe that this is more appropriate for our research since we are using price change as a proxy for a significant change in investor expectations: a 10% change for a high-volatility stock may be a non-event whereas a 5% change for a low-volatility stock may be an event of importance. As a result, our sample is less likely to biased in favor of selecting highly volatile stocks. [3]

Since previous studies have found evidence of market microstructure effects contributing to the observed predictable pattern of prices, we try to avoid such biases. In particular, a potential source for the predictable pattern in prices is the bid–ask bounce effect. Even after excluding below $10 price stocks, prior studies find that the reversals can, in part, be attributed to the bid–ask bounce effect (see Cox and Peterson, 1994; Park, 1995). Another potential source for the predictable pattern in prices is infrequent trading, which could lead the observed stock price to adjust slowly to new information resulting in under-reaction.

With these issues in mind, returns are calculated at mid-point of closing bid–ask prices. The bid–ask prices are obtained from ISSM data. Missing and erroneous ISSM prices are replaced with CRSP closing prices (these observations constitute less than 0.2% of the sample). [4]

The events are restricted to lie on or between 1 January 1990 and 2 December 1992. The last 20 days of 1992 are reserved for examining the post-event price discovery process. This criterion generates a sample of 23,459 events with large abnormal price changes, about 33 events per day. The sample looks large. However, based on the universe of about 2100 firms on ISSM, this works out to 1.5% of the universe. If returns are normally distributed, our criteria would generate 1% of the universe. Given that the returns distribution has fatter tails relative to a normal distribution, the size of the sample is reasonable.

A second screen requires the selected firms not to have a large abnormal price change over the preceding 20 trading days. We impose this criterion to ensure that we do not include multiple events in the same time period for the same firm. This reduces the sample to 13,130 events. To ensure that increases in

[2] A minimum of 240 non-missing observations is required to calculate the mean and standard deviation.

[3] However, for comparison, we redo our analysis by excluding small price changes from our final sample by using a ±5% screen and a ±10% screen. The results are similar with the ±5% screen. They are also similar with the ±10% screen as long as the sample size remains adequate. The results are available upon request from the authors.

[4] If the midpoint of the bid–ask prices differs from the CRSP closing price by more than $2, then the price is considered to be in error.

volume are not spuriously caused by a change in number of shares outstanding, we exclude events for which the firm experienced a change in shares outstanding of greater than 1% on the event day or the preceding 60 trading days. [5] This reduces our sample to 10,689 events.

Considering the market microstructure issues discussed above, we impose two additional screens. First, we exclude all events where the firm had a closing price of less than $10 on the event date. Low price stocks usually have higher transaction costs making it more difficult to incorporate all relevant information. This reduces our sample to 6127 events. [6] Second, we require the firms to be traded on each of the 60 days preceding the event date. This screen ensures that infrequently traded stocks with the attendant problem of high autocorrelation are not included in the sample. This reduces our sample to 4886 events.

Finally, we exclude firms that are in the bottom size quintile relative to the universe of NYSE/AMEX stocks. This screen is required to obtain an adequate number of size-matched control firms to bootstrap for computation of abnormal returns. In any case, there is a reduction of only 13 events to a final sample of 4873 events.

The sample is divided into positive and negative events depending on whether the event day market adjusted abnormal return is positive or negative. Table 1 provides some characteristics of the sample. Of the 4873 events, the return is significantly positive for 2919 and significantly negative for 1954 events. The positive events sample and the negative events sample are quite similar in firm size and magnitude and distribution of abnormal returns. Table 1 shows that firms in our sample are not small. The median firm's market value is almost $1 billion, the stock price is over $25, and it is in the second largest size quintile of NYSE/AMEX universe of firms. With the last screen in place, we have no stocks that lie in the bottom quintile of NYSE/AMEX stocks. Therefore, it is unlikely that small firms drive the results in this paper.

One other concern relating to the sample is the length of the period selected for analysis: only 3 years. We believe the sample is reasonable and consistent with sample selection in previous papers. Prior work that has required hand collection of data have short sample periods to reduce the human capital required for completion of research. For example, Barber and Loeffler (1993) use

[5] To guard against any misreporting in the number of shares outstanding, we exclude events where a stock split, stock dividend, or an equity issue was made over the prior 60-day period.

[6] As this criterion is imposed following the price change, it will result in a larger number of negative price changes being excluded relative to positive price changes. An alternative would be to impose this criterion before the price change. However, this would lead us to include in our sample negative price change events with a closing price on the event day of less than $10, resulting in these stocks having potentially high effective bid–ask spreads. Therefore, we believe it is appropriate to impose this criterion following the price change. Also, imposing this criterion following the price change does not introduce a bias in the post-event returns.

Table 1
Sample characteristics

	Positive events					Negative events				
Sample size:	2919					1954				
	Mean	Quartile 1	Median	Quartile 3	S.D.	Mean	Quartile 1	Median	Quartile 3	S.D.
Abnormal return (%)[a]	7.13	4.79	6.27	8.31	4.17	−7.13	−8.31	−6.12	−4.60	4.10
Price[b]	30.86	17.06	25.75	38.44	21.02	31.10	17.86	26.25	37.88	19.47
Firm size[c] (in $ billions)	2.23	0.28	0.79	2.17	5.04	3.13	0.38	0.99	2.80	7.03
Size quintile[d]	4.04	3	4	5	0.91	4.18	4	4	5	0.85

[a] Abnormal return is the market adjusted abnormal return for the sample firm (adjusted for the value weighted CRSP NYSE/AMEX index).
[b] Price is the midpoint of the closing bid–ask prices on day 0.
[c] Firm size is the size of the firm at the beginning of the year.
[d] Size quintiles are formed based on the universe of NYSE/AMEX firms at the beginning of the year. Size quintile 1 represents the smallest firms and size quintile 5 represents the largest firms.

2 years of data, Womack (1996) uses 3 years of data, and Lee et al. (1994) rely on one year of data. Furthermore, we test the results of our sample over an out-of-sample period of two years. The out-of-sample test probably lends a little more credibility to our results. However, the generality of the results in this paper is limited to the extent that there is a systematic bias in the sample period.

4. Post event abnormal returns

To measure abnormal returns, buy and hold returns for an equally weighted portfolio of sample firms are computed for up to 20 days following an event. The choice of the 20-day period has been made because previous papers have found that predictable price patterns over short horizons of up to 20 days are not of economic significance. We examine whether the price patterns become more predictable and economically more important after conditioning on the multidimensional characteristics of information signals. Nonetheless, the 20-day period is somewhat ad hoc, therefore we report results for various periods *up to* 20 days, though our discussion is limited to the 20-day period.

Post-event abnormal returns and their statistical significance are calculated using bootstrapping. The abnormal return is the buy and hold return less the average return to a control portfolio formed by bootstrapping. The return to a control portfolio is calculated as follows: For each sample firm in our portfolio, a control firm in the same size quintile is randomly selected with replacement. [7] Size quintiles are determined at the beginning of the year, and are based on market equity value relative to the universe of all NYSE/AMEX common stocks. Other relevant screens applied to the sample firm are also applied to the control firm. These include the 250-day listing requirement, a minimum \$10 price, and positive trading volume on each of the 60 days preceding the event date. [8] The control portfolio selection process is repeated 1000 times to generate an empirical distribution of control portfolio returns. [9]

We also calculate the buy and hold abnormal return for each firm and test whether the proportion of firms (PRO) in the sample portfolio that have positive abnormal returns is significantly different from 0.50. The buy and hold abnormal return for a firm is measured as the raw return less the average return

[7] Control firms are not limited to non-event firms. For example, if our sample portfolio has 4 firms, say A, B, C, and D, then firms B, C, and D can also serve as a control firm for sample firm A.

[8] After imposing these criteria, on average there are 51, 179, 315, and 397 firms that can serve as a control firm for events in size quintiles 2, 3, 4, and 5, respectively.

[9] We test whether our results are sensitive to the methodology used to calculate abnormal returns and whether the abnormal returns could be explained by potential differences in beta between the sample and control firms. We do not find evidence of such a bias.

to a control firm formed by bootstrapping. To test whether PRO is statistically significantly different from 0.50, we use a normal approximation and calculate the following z-statistic, where N is the number of observations:

$$z\text{-statistic} = \frac{\text{PRO} - 0.50}{\sqrt{0.25/N}}.$$

4.1. Large price changes

The buy and hold abnormal returns to an equally weighted portfolio of the sample of large price change events are presented in Table 2. The results indicate that the market under-reacts to the announcement as evidenced by the return for the day following the event. Over a holding period of 20 days, the abnormal return is statistically insignificant for the positive events sample. For the negative events sample, the 20-day abnormal return of −0.48% is statistically significant. For NYSE-AMEX stocks, Chalmers and Kadlec (1998) estimate the round-trip transaction cost at 0.50% for stocks with the smallest effective spread. Similarly, Knez and Ready's (1997) estimate is 0.58% for the large NYSE stocks. Based on these estimates of transaction costs, the abnormal returns for both positive and negative events are not economically

Table 2
Returns to portfolios of positive and negative events[a]

Events:	Positive			Negative		
Sample size:	2919			1954		
Trading day	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns
0	7.12***	6.91***	1.00***	−6.91***	−6.95***	0.00***
+1	0.25***	0.17***	0.48**	−0.29***	−0.34***	0.47***
[+1,+5]	−0.03***	−0.27***	0.47***	0.03	−0.05	0.52*
[+6,+10]	0.11	0.07	0.52**	−0.13	−0.12	0.50
[+11,+15]	0.15**	0.17**	0.51	−0.17**	−0.19**	0.49
[+16,+20]	0.21	0.09	0.49	−0.03	−0.08	0.49
[+1,+20]	0.47	0.08	0.50	−0.34**	−0.48**	0.49

[a] Buy and hold returns for different holding periods are presented. Day 0 is the day of the event when the large abnormal price change occurred. Positive (negative) events are where the day 0 abnormal price change is positive (negative). The abnormal return is the sample portfolio return minus the average return to a bootstrapped control portfolio.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

important. The results are similar to those found by Park (1995) who finds that predictable patterns in prices cannot be profitably exploited.

4.2. Public announcements

Public announcements signal release of new information that is disseminated broadly among investors. The literature related to price continuations or price reversals around public announcements suggests that release of news is an important determinant of return predictability (for example, see Ikenberry et al., 1995; Michaely et al., 1995). Therefore, the next categorization is by availability of a public announcement. For each event date, we search for news reports in the Wall Street Journal or the Dow Jones News Wire. [10] Approximately one-third of the events had public announcements. The non-availability of public announcements for the remaining events may be due to non reporting of news related to small firms, or the large price change may have been caused by other factors such as significant changes in macroeconomic or industry-wide factors, communication between financial analysts or advisors and their clients that is not made public, or trading by agents based on private information. Finally, the large price changes could also occur through liquidity trades.

The results reveal that positive events accompanied by a public announcement are followed by a statistically significant return of 1.25% over a 20-day period; and negative events with a public announcement are followed by a statistically significant abnormal return of −1.62%. [11] However, events not accompanied by a public announcement are not followed by abnormal returns.

It is generally expected that private information will take longer to be reflected in prices than public information as the latter is immediately available to all traders and investors. Since this has not occurred in the "no public announcements" sample, it appears that the large price changes in the "no public announcements" sample probably occurred due to liquidity trades. The difference in return predictability between the "public announcements" and "no public announcements" samples implies that release of information is a necessary condition for price continuations. Further, the evidence of price continuation following large price changes accompanied by public announcements has not been previously reported in the literature. Previous studies have considered only a few types of special announcements.

[10] The announcement is assumed to occur on the event day if it occurs any time between the stock market close of the preceding trading day and the close of the event day.

[11] Results are available from the authors upon request. The results can also be obtained by aggregating the "increased" volume and "did not increase" volume columns of Table 3.

4.3. Volume increases

Several heterogeneous agent models of trading show that volume captures the level of precision of information signals. Volume increases can occur due to actions of informed traders, liquidity traders, or both. Campbell et al. (1993) reason that volume increases due to liquidity trading without the release of new information would result in price reversals. Portfolio rebalancing around large price changes could cause price pressure leading to subsequent price reversals. On the other hand, an increase in volume due to divergence of opinion among investors can result in price continuations due to strategic trading by diversely informed traders. Kyle (1985) and Foster and Vishwanathan (1996) show that, under information asymmetry, investors trade strategically which results in information being incorporated in prices slowly over time. This could lead to price continuations. [12]

We separate volume increase events due to liquidity traders and informed traders by relying on whether a public announcement accompanied the volume increase or not. [13] An increase in volume accompanied by a public announcement is likely to lead to price continuations, while events not accompanied by public announcements could occur due to liquidity traders or informed traders.

To examine the effect of volume changes on future returns, we subdivide the samples based on whether the event was accompanied by an increase in volume on the event day. To be included in the "increased volume" subsample, the firm's volume standardized by the aggregate NYSE/AMEX market volume should be greater than the 90th percentile of the volume distribution over the preceding 60 days. [14]

As expected, Table 3 shows that volume increases are more common for events accompanied by a public release of news than for other events: nearly 75% of public announcement events experience an increase in volume compared with less than 45% for the "no public announcements" events. Conditional on volume increases and public announcements, positive events are followed by a statistically significant abnormal return of 1.98% and negative events are followed by a statistically significant abnormal return of −1.68%

[12] The findings of Chan and Lakonishok (1995) suggest that strategic trading by institutional investors could lead to price continuations.

[13] Empirical findings support the reasoning that public announcements generate information asymmetry, and that volume around public announcements is likely to be generated by the speculative trades of diversely informed investors. Krinsky and Lee (1996) find that the adverse selection component of the bid–ask spread increases significantly around earnings announcement.

[14] The results are similar if a higher cutoff is used. A lower cutoff will make the "no volume increase" sample too small. We standardize volume by the aggregate market volume, so that a significant change in volume is not observed due to a change in the market's overall trading volume.

Table 3
Portfolio returns, public announcements, and volume changes[a]

Events	Positive											
Public news:	Yes						No					
Volume:	Increased			Did not increase			Increased			Did not increase		
Sample size:	603			248			874			1194		
Trading day	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns
0	9.08***	8.96***	1.00***	6.49***	6.26***	1.00***	7.49***	7.27***	1.00***	6.00***	5.75***	1.00***
+1	0.49***	0.46***	0.53	0.12	0.01	0.47	0.34***	0.30***	0.49	0.10	−0.02	0.46***
[+1,+5]	0.59***	0.54***	0.55**	−0.30**	−0.64**	0.45*	0.00	−0.09	0.46***	−0.30***	−0.72***	0.44***
[+6,+10]	0.53***	0.47***	0.56***	0.45	0.31	0.52	0.19	0.11	0.51	−0.22*	−0.22*	0.50
[+11,+15]	0.48***	0.52***	0.51	0.19	0.02	0.56**	−0.06	0.08	0.48	0.14	0.10	0.51
[+16,+20]	0.41**	0.44**	0.50	−0.09	−0.22	0.50	0.00	−0.07	0.48	0.34	0.12	0.49
[+1,+20]	1.99***	1.98***	0.58***	0.19	−0.58	0.48	0.15	0.03	0.49	−0.01***	−0.70***	0.48*

Events	Negative											
Public news:	Yes						No					
Volume:	Increased			Did not increase			Increased			Did not increase		
Sample size:	653			163			489			649		
Trading day	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold raw return (%)	Buy and hold abnormal return (%)	Proportion of positive abnormal returns
0	−9.48***	−9.47***	0.00***	−5.97***	−6.18***	0.00***	−6.29	−6.28***	0.00***	−5.02***	−5.11***	0.01***
+1	−0.87***	−0.87***	0.43***	−0.82***	−0.84***	0.41***	0.14	0.13*	0.54**	0.12	−0.03	0.48
[+1,+5]	−1.22***	−1.26***	0.43***	−0.71**	−0.77**	0.51	0.59	0.63***	0.59***	1.05***	0.81***	0.55***
[+6,+10]	0.24	−0.05	0.51	−0.38	−0.36	0.49	0.01	0.12	0.51	−0.55*	−0.29*	0.47*
[+11,+15]	−0.22**	−0.36**	0.46**	0.12	−0.07	0.49	0.01	−0.06	0.53*	−0.33	−0.14	0.50
[+16,+20]	0.17	0.04	0.51	−0.42	−0.02	0.47	−0.13	−0.23	0.47*	−0.06	−0.11	0.48
[+1,+20]	−1.05***	−1.68***	0.42***	−1.44**	−1.34**	0.44*	0.53	0.52	0.54**	0.00	0.17	0.55**

[a] Buy and hold returns for different holding periods are presented. Day 0 is the day of the event when the large abnormal price change occurred. Positive (Negative) events are where the day 0 abnormal price change is positive (negative). The abnormal return is the sample portfolio return minus the average return to a bootstrapped control portfolio. The events are subdivided based on whether a public announcement regarding the firm was reported in the Dow Jones News Wire or Wall Street Journal. Firms are classified into the ''volume increased'' sample if the event day volume is at or above the 90th percentile of the volume for the past 60 days.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

over a 20-day period. The percent of firms with positive abnormal returns confirms this observation: 58% of the positive events have positive abnormal returns and 58% of the negative events have negative abnormal returns. This evidence is consistent with information asymmetry models such as Kyle (1985) and Foster and Vishwanathan (1996) that suggest strategic trading by informed investors.

Volume increase events unaccompanied by a public announcement do not have significant abnormal returns over a 20-day period. Evidence relating to events where the volume did not increase is mixed: the negative events accompanied by a public announcement show price continuations but positive events do not. One reason for the under-reaction in negative events unaccompanied by a volume increase could be that informed traders are more willing to take long positions rather than short positions in stocks. Also, short selling is possible only in very liquid stocks. Therefore, while a volume increase can take place for all positive events, it may not occur for all negative events. Accordingly, the "no volume increase" sample of negative events may include many events where there was a significant increase in information asymmetry without a corresponding increase in volume.

5. Abnormal returns and the type of announcement

In the previous section, we noted that return predictability is greater in the presence of a public announcement and with an increase in volume. Prior work has found evidence of price continuation for certain kinds of events: earnings announcements, dividend omissions and initiations, stock repurchases, and analyst recommendations. Taking cognizance of this evidence, we divide the public announcement sample into several subsamples based on the type of news. Construction of subsamples is dictated by similarity of news and the resulting size of each subsample. Seven distinct types of announcements are listed in Table 4. [15] The sizes of the positive and negative event subsamples are similar except for types 2 and 5 (see Tables 5 and 6). There are only 27 type 2 positive events compared to 132 type 2 negative events. The difference seems to suggest that managements pre-announce under-performance more frequently than over-performance. For type 5, there are 177 positive events but only 73

[15] Whenever a news could fall into several categories, precedence is given in the following order: mergers and acquisitions, earnings announcement, earnings forecasts, other restructuring related information, capital structure related information, analyst recommendations, and general business related information, respectively. For example, analysts frequently upgrade or downgrade stocks immediately following an earnings announcement. In such cases, the event is characterized by a type 1 announcement (earnings).

Table 4
Types of public announcements

Type 1	Actual earnings announcement by management
Type 2	Forecast of earnings by management
Type 3	Analyst recommendations: recommendations by security analysts, and information regarding credit ratings by rating agencies
Type 4	Capital structure related information: dividends, stock repurchases, stock/debt issues, and preferred stock/debt redemption
Type 5	Restructuring related information: mergers, acquisitions, asset sales, hiring and firing of top management
Type 6	General business related information: sales, product related information, business contracts, and joint ventures
Type 7	Miscellaneous information: legal and legislative announcements, labor disputes

negative events reflecting the fact that restructuring announcements are usually big positive events for target firms.

Among the different categories, news of types 1, 2, 3, and 5 are generally more substantive in content than other news types. While there is much ambiguity about how current earnings are likely to be related to future earnings, there is comparatively little ambiguity regarding valuation in the case of mergers and acquisitions. Therefore, strategic trading would lead to price continuation more for earnings related announcements and analyst expectations, i.e., announcements of types 1, 2, and 3 than for other announcements. [16]

Table 5 contains results for positive events based on the type of announcement. [17] Over a 20-day post-event period, there is a strong and systematic under-reaction for announcements of types 1, 2, and 3 earning statistically significant abnormal returns of 3.44%, 4.16% and 3.59%, respectively. For other types of announcements accompanied by an increase in volume, the market reaction is unbiased in that these events do not earn statistically significant abnormal returns over a 20-day period. For the subsamples with no increase in volume, there is no significant under-reaction, except for a significant overreaction to announcements of type 4.

Table 6 presents the results for negative events based on the type of announcement. Similar to the positive events sample, we find that the market

[16] Barberis et al. (1998) propose a competing hypothesis. According to their investor sentiment hypothesis, investors are slow to revise their beliefs. Any new information has a temporary and permanent component. When the information is not consistent with their priors, investors overestimate the random component of information and underestimate the permanent component. With passage of time and with more information, they gradually alter their beliefs implying that prices take longer to react because of investor resistance to new information.

[17] As the raw returns do not provide much additional information, we exclude raw returns from subsequent tables. Instead we report whether the abnormal returns for the samples are significantly different from one another.

Table 5
Portfolio returns to positive events by type of public announcement[a]

Events:	Positive									
Public announcement:	Type 1					Type 2				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	208		73			18		9		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	8.03***	1.00***	6.75***	1.00***	1.28***	8.65***	1.00***	7.41***	1.00***	1.24
+1	0.53***	0.59***	0.34*	0.47	0.19	1.06**	0.56	−0.76	0.44	1.82**
[+1,+5]	1.03***	0.59***	0.27	0.52	0.76	0.95	0.61	−2.06*	0.22**	3.01*
[+6,+10]	1.16***	0.64***	0.66	0.49	0.50	1.76*	0.61	−1.33	0.33	3.09**
[+11,+15]	0.79***	0.56**	0.37	0.60**	0.42	−0.46	0.39	1.34	0.44	−1.80
[+16,+20]	0.47*	0.51	−0.37	0.47	0.84	1.92**	0.78***	1.37	0.56	0.55
[+1,+20]	3.44***	0.67***	0.89	0.53	2.55**	4.16**	0.83***	−0.70	0.44	4.86

Events:	Positive									
Public announcement:	Type 3					Type 4				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	102		33			37		38		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	8.32***	1.00***	6.59***	1.00***	1.73***	6.69***	1.00***	5.41***	1.00***	1.28***
+1	0.94***	0.58*	0.34	0.64*	0.60*	0.49*	0.57	−0.06	0.50	0.55

[+1,+5]	0.80*	0.53	−0.98*	0.42	1.78**	1.01*	0.57	−0.53	0.58	1.54
[+6,+10]	−0.03	0.50	−0.16	0.55	0.13	0.83	0.57	−0.11	0.50	0.94
[+11,+15]	1.33***	0.59**	0.53	0.58	0.80	0.35	0.46	−1.66**	0.50	2.01**
[+16,+20]	1.40***	0.52	0.18	0.52	1.22	−1.77**	0.41	−1.28*	0.53	−0.49
[+1,+20]	3.59***	0.60**	−0.64	0.42	4.23**	0.27	0.51	−3.74**	0.40*	4.01**

Events:	Positive									
Public announcement:	Type 5					Type 6				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	136		41			70		41		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	12.76***	1.00***	6.05***	1.00***	6.71***	7.10***	1.00***	6.47***	1.00***	0.63*
+1	0.31**	0.49	0.21	0.49	0.10	0.07	0.44	−0.65**	0.32**	0.72**
[+1,+5]	0.12	0.53	−0.47	0.39*	0.59	0.11	0.56	−1.55**	0.39*	1.66**
[+6,+10]	−0.59*	0.46	0.31	0.59	−0.90	0.41	0.60**	1.15*	0.56	−0.74
[+11,+15]	0.27	0.49	0.36	0.59	−0.09	−0.27	0.43	−0.15	0.51	−0.12
[+16,+20]	−0.23	0.42**	0.03	0.51	−0.26	0.87*	0.54	0.27	0.56	0.60
[+1,+20]	−0.45	0.50	0.27	0.44	−0.72	1.17	0.53	−0.51	0.56	1.68

Table 5 (Continued)

Events:	Positive				
Public announcement:	Type 7				
Volume:	Increased		Did not increase		
Sample size:	32		13		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	7.77***	1.00***	4.43***	1.00***	3.34***
+1	−0.52**	0.25***	−0.36	0.39	−0.16
[+1,+5]	−1.57*	0.28***	−2.06**	0.31*	0.49
[+6,+10]	0.90	0.63*	−0.40	0.46	1.30
[+11,+15]	−0.21	0.38*	0.46	0.54	−0.67
[+16,+20]	0.78	0.59	−0.32	0.39	1.10
[+1,+20]	−0.26	0.38*	−2.25	0.46	1.99

[a] Buy and hold returns for different holding periods are presented. Day 0 is the day of the event when the large abnormal price change occurred. Positive (Negative) events are where the day 0 abnormal price change is positive (negative). The abnormal return is the sample portfolio return minus the average return to a bootstrapped control portfolio. The events are subdivided based on whether a public announcement regarding the firm was reported in the Dow Jones News Wire or Wall Street Journal. Firms are classified into the "volume increased" sample if the event day volume is at or above the 90th percentile of the volume for the past 60 days. Types of announcements are defined in Table 4.

* Significant at the 10 % level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 6
Portfolio returns to negative events by type of public announcement[a]

Events:	Negative									
Public announcement:	Type 1					Type 2				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	217		61			120		12		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	−9.79***	0.00***	−6.32***	0.00***	−3.47***	−11.20***	0.00***	−6.59***	0.00***	−4.61***
+1	−1.30***	0.39***	−0.80***	0.43	−0.50*	−0.49**	0.48	−0.63	0.42	0.14
[+1,+5]	−1.84***	0.43**	−0.88*	0.48	−0.96*	−1.12**	0.43*	−0.48	0.42	−0.64
[+6,+10]	−0.47*	0.46*	−0.77	0.41*	0.30	−0.16	0.45	1.78	0.75**	−1.94*
[+11,+15]	−0.74**	0.43**	0.22	0.49	−0.96*	−0.63*	0.43*	0.92	0.67	−1.55
[+16,+20]	0.41*	0.51	−0.35	0.46	0.76	−0.07	0.49	−1.13	0.33	1.06
[+1,+20]	−2.60***	0.38***	−1.93**	0.36**	−0.67	−1.96**	0.36**	0.95	0.75**	−2.91

Events:	Negative									
Public announcement:	Type 3					Type 4				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	217		61			120		12		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	−7.76***	0.01***	−5.65***	0.00***	−2.11***	−8.21***	0.00***	−5.98***	0.00***	−2.23***
+1	−1.12***	0.40**	−2.26***	0.24**	1.14**	0.13	0.49	−0.43	0.48	0.56
[+1,+5]	−1.11***	0.42**	−2.41**	0.47	1.30	−1.09*	0.44	−3.47***	0.44	2.38**
[+6,+10]	−0.76**	0.54	−0.19	0.59	−0.57	0.57	0.63**	−0.20	0.52	0.77

Table 6 (Continued)

Events:	Negative									
Public announcement:	Type 3					Type 4				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	217		61			120		12		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
[+11,+15]	−0.18	0.44*	−1.28	0.47	1.10	−1.05*	0.44	0.38	0.57	−1.43
[+16,+20]	−0.27	0.48	1.15	0.53	−1.42	1.00*	0.56	1.17*	0.61	−0.17
[+1,+20]	−2.39***	0.45	−3.01*	0.35	0.62	−0.40	0.47	−2.27	0.57	1.87
Events:	Negative									
Public announcement:	Type 5					Type 6				
Volume:	Increased		Did not increase			Increased		Did not increase		
Sample size:	132		17			43		23		
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	−10.02***	0.00***	−5.76***	0.00***	−4.26***	−9.67***	0.00***	−5.78***	0.00***	−3.89***
+1	−1.30***	0.39**	−0.19	0.38	−1.11**	−0.32*	0.49	−0.53*	0.40	0.21
[+1,+5]	−1.44**	0.37**	0.32	0.62	−1.76*	−0.09	0.46	1.11	0.60	−1.20
[+6,+10]	0.05	0.54	−0.83	0.48	0.88	2.51***	0.56	−0.46	0.50	2.97**
[+11,+15]	0.55	0.48	1.00	0.52	−0.45	0.61	0.58	−1.28*	0.40	1.89**
[+16,+20]	−0.29	0.44	0.06	0.52	−0.35	−0.91*	0.58	−0.36	0.35*	−0.55
[+1,+20]	−1.16	0.40*	0.46	0.48	−1.62	1.98**	0.56	−0.77	0.30**	2.75

Events:	Negative									
Public announcement:	Type 7									
Volume:	Increased		Did not increase							
Sample size:	23		9							
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Difference in abnormal returns
0	−7.45***	0.00***	−8.05***	0.00***	0.60					
+1	−0.03	0.48	−2.02***	0.44	1.99**					
[+1,+5]	−0.77	0.48	2.98**	0.67	−3.75**					
[+6,+10]	−0.61	0.61	0.08	0.33	−0.69					
[+11,+15]	−0.26	0.48	−2.15	0.22**	1.89					
[+16,+20]	0.59	0.65*	−1.04	0.44	1.63					
[+1,+20]	−1.08	0.48	−0.26	0.56	−0.82					

[a] Buy and hold returns for different holding periods are presented. Day 0 is the day of the event when the large abnormal price change occurred. Positive (Negative) events are where the day 0 abnormal price change is positive (negative). The abnormal return is the sample portfolio return minus the average return to a bootstrapped control portfolio. The events are subdivided based on whether a public announcement regarding the firm was reported in the Dow Jones News Wire or Wall Street Journal. Firms are classified into the ''volume increased'' sample if the event day volume is at or above the 90th percentile of the volume for the past 60 days. Types of announcements are defined in Table 4.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

under-reaction to public announcements accompanied by an increase in volume is limited to announcements of type 1, 2 and 3. Negative events accompanied by an increase in volume and announcements of types 1, 2 and 3 earn statistically significant abnormal returns of −2.60%, −1.96% and −2.39%, respectively over a 20-day period. For other types of announcements accompanied by an increase in volume, the market reaction is unbiased except for an overreaction to type 6 announcements: general business related information events earn statistically significant abnormal returns of 1.98% over a 20-day period.

Overall, both Tables 5 and 6 reveal evidence of under-reaction. For types 1, 2, and 3, the annualized abnormal returns are of the order of 40% for positive events and −25% for negative events. The extent of under-reaction is large, much greater than previously documented, and potentially tradable. In addition, Table 3 reveals that large abnormal price changes not accompanied by a public release of information do not experience any systematic follow through action. Finally, no significant under-reaction occurs for information releases related to mergers, business contracts, etc.

The evidence presented is somewhat consistent with both strategic trading under information asymmetry models and the investor sentiment hypothesis. A direct test of information asymmetry based on Kyle's lambda as an explanatory variable for post-event abnormal returns and a direct test of the investor sentiment hypothesis based on pre-event abnormal returns as an explanatory variable for under-reaction provides only weak support for these hypotheses. [18]

6. Out-of-sample trading strategy

The above results provide strong evidence of under-reaction under certain circumstances. However, to test that the results are not sample-specific, we design an out-of-sample trading strategy and examine whether abnormal profits can be earned. Based on the previous sections, we should buy (sell) positive (negative) event firms accompanied by an increase in volume and news relating to earnings or analyst recommendations and sell (buy) them after 20 days to earn abnormal returns.

Our sample comes from the universe of NYSE/AMEX common stocks during 1993 and 1994. The events are restricted to lie on or between 1 January 1993 and 1 December 1994. The last 20 days of 1994 are reserved for examining the post-event returns. Closing bid and ask prices are obtained from the Trade and Quote (TAQ) database. We follow the same methodology as before, beginning with a sample of 12,810 large price change events. Excluding events

[18] Results are available from the authors upon request.

Table 7
Out of sample test: Returns to positive and negative event firms[a]

Events:	Positive		Negative	
Public announcement:	Type 1, 2, or 3		Type 1, 2, or 3	
Volume:	Increased		Increased	
Sample size:	394		368	
Trading day	Buy and hold abnormal return (%)	Proportion of positive abnormal returns	Buy and hold abnormal return (%)	Proportion of positive abnormal returns
0	7.53***	1.00***	−9.24***	0.00***
+1	0.46***	0.52	−0.55***	0.41***
[+1,+5]	0.61***	0.52	−1.07***	0.42***
[+6,+10]	0.76***	0.56**	−0.69***	0.38***
[+11,+15]	0.36**	0.53	−0.55***	0.43***
[+16,+20]	0.43**	0.50	−0.11	0.51
[+1,+20]	2.18***	0.59***	−2.40***	0.38***
[+1,+20 (after transaction costs)]	1.04***		−1.51***	

[a] Buy and hold returns are presented for event firms with an increase in volume and a public announcement of type 1, type 2, or type 3. Day 0 is the day of the event when the large abnormal price change occurred. Positive (Negative) events are where the day 0 abnormal price change is positive (negative). The abnormal return is the sample portfolio return minus the average return to a bootstrapped control portfolio. The public announcement regarding the firm was reported in the Dow Jones News Wire or Wall Street Journal. Firms are classified into the "volume increased" sample if the event day volume is at or above the 90th percentile of the volume for the past 60 days. Types of announcements are defined in Table 4.
** Significant at the 5% level.
*** Significant at the 1% level.

with no large price change over the preceding 20 days reduces the sample to 8559 events, and to 6750 events after deleting events where the number of outstanding shares changed by more than 1% over the preceding 60 trading days. The final sample consists of 3649 events after the remaining three screens are applied, viz. closing price of not less than $10 on event day, non-zero trading volume for the prior 60 day period, and not belonging to the bottom quintile of NYSE/AMEX stocks. [19]

We now focus on events that generated high abnormal returns in the within sample analysis – those events that are accompanied by a significant increase in volume and a public announcement of types 1, 2, or 3. The results are summarized in Table 7 for the 394 positive events and the 368 negative events. Positive event firms continue to earn positive abnormal returns following the

[19] Characteristics of firms in the out-of-sample sample are similar to those in Table 1. Details are available from the authors.

event accumulating a significant 2.18% by the end of 20 days. Similarly, negative event firms continue to lose ending up with an abnormal return of −2.40% by the end of the 20-day period. A negative abnormal return for the negative events indicates the profits that can be earned with a short position in the stock. The returns for positive events and negative events are economically significant at an annualized rate of about 25%, and are much larger than previously documented in the literature.

The returns in Table 7 are based on the mid-point of bid and ask prices and do not take into account the bid–ask spread. Also, given the significant abnormal return on day 0, it is possible that the stocks in our sample cannot be bought at the closing price on day 0. Therefore, we compute 20-day post-event returns for positive events based on purchases at the ask price at 10 am on day 1 and sales at the bid price at 3:50 pm on day 20 for positive events. For negative events, we short sell at the bid price at 10 a.m. on day 1 and cover the short sales at the ask price at 3:50 pm on day 20. We believe it is easier to trade at the 10 am and 3:50 pm prices than at the opening or closing prices. The use of bid and ask prices should result in a conservative estimate of the transaction costs as many market orders can be executed at a better price than the prevailing bid and ask quotes. After taking into account transaction costs, the 20-day post event abnormal returns are a statistically significant 1.04% for positive events and −1.51% for negative events, or annualized rates of 12% and 18% respectively. Thus, an out-of-sample trading strategy confirms the return predictability observed in the sample.

7. Concluding remarks

We begin our inquiry into predictable price patterns by selecting large price change events. Consistent with previous studies, we find no evidence of tradable price regularities following large price events. Conditioned on other characteristics of new information, we find that the total sample consists of subsamples that do exhibit post-event return regularities. Large price changes accompanied by a public announcement display price continuations, whereas large price changes without any accompanying news do not. Depending on volume increases, large price change events with accompanying public announcements show even stronger evidence of price continuation. At the other extreme, large price events without an accompanying public announcement or an increase in volume reveal a tendency towards price reversals. [20] Evidence of

[20] We note that our sample contains few small firms and none from the bottom quintile of NYSE/AMEX firms. Therefore, it is unlikely that the results are substantially influenced by small firms.

price continuation becomes more important for news relating to earnings and analyst recommendations where the post-event drift is +3.50% for positive events and −2.25% for negative events. While evidence of earnings related drift is not new, the role of volume and price changes in contributing to the price continuation is new. As a consequence, annualized abnormal returns of 40% and 25% are much larger than those documented in the past.

An out of sample test of a trading strategy of buying (selling) positive (negative) event firms accompanied by an increase in volume and selected news releases reaffirms the above results. After transaction costs, investors can earn 20-day abnormal returns of 1–1.5%, equivalent to annualized abnormal returns of 12–18%.

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