Informed trading before stock price shocks: An empirical analysis using stock option trading volume

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Abstract

This paper offers original evidence on informed trading in stock option contracts for the period preceding price shocks in the underlying stocks. The sample stocks are all S&P100 constituent stocks for the recent period. We find that option trading volume tends to increase before positive and negative price shocks and that for up to 65% of price shocks (depending on test periods and significance levels) the hypothesis of abnormal option trading volume cannot be rejected. Furthermore, pre-event option trading volume seems related to post-event abnormal returns especially for High B/M and High Market Value stocks.

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1. Introduction

In markets that are efficient with respect to information stock prices will change due to the arrival of unexpected related fundamental information. Extreme price movements, thus, suggest the arrival of significant unanticipated related information. With respect to extreme price movements two important questions arise: (i) how do investors react following the arrival of significant information, and (ii) to what extend are price shocks unanticipated by investors? Previous studies concentrate on the first question and find results mainly consistent with price reversals after extreme stock price movements (Chan, 2003; Benou and Richie, 2003; Atkins & Dyl, 1990; Bremer & Sweeney, 1991; Schnusenberg and Madura, 2001; among others).

There is a gap in the empirical literature, however, regarding the second question and this paper aims to address this issue. If investors do anticipate price shocks, a logical assumption would be that they take positions in the market that reflect their expectations. Since the results of previous studies suggest that options markets facilitate price discovery, due to leverage and downside protection, it can be argued that these positions are more likely to take place in the options market. For instance, Lee and Cheong (2001) report evidence consistent with the notion that the options market is a venue for information-motivated trading, while Pan and Poteshman (2006) report evidence that trading volume in option contracts contains information about future stock price movements, (see also Chakravarty, Gulen, and Mayhew, 2004; Easley, O'Hara, and Srinivas, 1998). Motivated by these findings, we study stock

option trading volume before extreme price movements in the underlying stock in order to uncover whether informed trading takes place before price shocks.

Our research is related, in terms of the methodological approach, to the strand in the literature that examines informed trading in the options market prior to corporate events. Arnold, Erwin, Nail, and Nixon (2006), for example, find evidence that the preferred venue for traders attempting to profit on anticipated cash tender offer announcements is the options market and that abnormal volume in the option market replaces abnormal volume in the stock market prior to announcements. Jayaraman, Frye, and Sabherwal (2001) find a significant increase in trading activity of options for firms involved in a takeover prior to the rumor of a merger or acquisition, which they argue suggests that a significant level of informed trading takes place in the options market prior to announcements. They suggest that informed traders anticipating the arrival of information can employ a number of option strategies prior to the event and that, irrespective of the strategy, the implication is that these strategies will result to increased call and put trading volumes. Cao, Griffin, and Chen (2003) also find that before extreme informational events the options market plays an important role in price discovery; more specifically they find that prior to takeover announcements, call volume imbalances are strongly positively related to next-day stock returns and that takeover targets with the largest pre-announcement call-imbalance increases experience the highest announcement-day returns.

To anticipate the results, option trading volume tends to increase before positive and negative price shocks and that in up to 65% of price shocks (depending on test periods and significance levels) the hypothesis of abnormal option trading volume cannot be rejected. For example, for positive shocks we find abnormal option trading volume for call contracts (at the 5% level) in about 50% of the events, when a 30-day pre-event period is considered and the benchmark option trading volume is estimated as the average volume for the period 161-41 days before the shock. This percentage is raised to roughly 60% when High Book/Market (B/M) stocks are examined. Furthermore, pre-event option trading volume seems related to post-event abnormal returns especially for High B/M and High Market Value stocks. These results are consistent with recent findings of abnormal stock index option trading before significant changes in the underlying index (Spyrou, 2011).

Our findings have both theoretical and practical implications that are of interest for academics, regulators, and market participants. For instance, if a significant stock price movement is the result of new significant fundamental information about the firm, the abnormal stock option trading volume prior to the information arrival may indicate that information is not simultaneously available to all investors but rather that some market participants have advantaged access to this information. Note also that price shocks may not necessarily be caused by related information: Cutler, Poterba, and Summers (1989) find that few of the largest price shocks in the S&P500 index are caused by particular news events or information. In that case, the finding of abnormal stock option trading volume may indicate that informed market participants anticipate

extreme price movements due to non-fundamental information, e.g. a shift in the attitudes of noise traders. The rest of the paper is organized as follows: section 2 discusses the data and methodology; section 3 presents results on option trading volume before price shocks; section 4 examines whether pre-event option volume is related to post-event stock returns; section 5 concludes the paper.

2. Data and Testing Methodology

The sample for the empirical analysis consists of all the S&P100 Index (ticker symbol: OEX) constituent stocks that have option contracts available for the period between May 2008 and March 2011. The sample stocks are large cap companies in the United States across multiple industry groups. Note that the primary criterion for index inclusion is the availability of individual stock options for each constituent (http://www.standardandpoors.com/indices/sp-100). The unconditional daily change for stock *i* on day *t* is computed as the first difference of the logarithmic price level. All price data and daily option trading volume data are collected from DataStream. Daily option trading volume is defined as the number of option contracts traded on each day (total cumulative volume for all individual option series).

2.1. Extreme events

Previous studies employ various definitions for extreme events or stock price shocks; for example, among previously employed measures are stock price drops of at least

10%, weekly price changes of more than 50%, the largest stock price change in a 300-day window, a monthly price change of 20%, a market return of more than 2%, the top (bottom) 10 percentile of computed abnormal daily returns, etc., (see, Bremer and Sweeney, 1991; Howe, 1986; Atkins and Dyl, 1990; Benou and Richie, 2007; Dennis and Strickland, 2002; Schnusenberg and Madura, 2001; among others). Lasfer et al. (2003) point out that the appropriate definition should account for the varying return volatility form asset to asset and use a rule that is based on the distance of a certain observation from the mean value. For instance, a positive (negative) price shock could be a day where the asset return is above (below) two standard deviations the average return computed over some previous reference period. This approach also accounts for time-variation in risk premia that could lead to serial correlation in returns (Ball and Kothari, 1989; Chan, 1988).

This paper employs a methodology similar to Lasfer et al. (2003) to identify an extreme event: a significant price shock occurs on a day where each stock's return is above (positive shock) or below (negative shock) three standard deviations the average daily stock return computed over the [-60 to -11] days before the given day. The window ends 10 trading days prior to the event day in order to avoid possible price lead-up preceding the shocks. The standard deviation for day *t* is also computed from the observations between day *t*-60 and day *t*-11. Positive and negative shocks are analyzed separately to unveil which strategy investors tend to utilize at each case. For example, a long (short) strategy is implied if call (put) option trading volume

increases before a positive price shock; similarly a long (short) strategy is implied if put (call) option trading volume increases before a negative shock.

2.2. Abnormal option trading volume

If price shocks are anticipated by market participants and there is a link between option markets and informed trading, we should observe abnormal option trading volume for the period preceding price shocks. To test this hypothesis this paper uses a comparison period approach, i.e. the pre-event option trading volume is compared to the trading volume of a benchmark period (see Jayaraman et al., 2001; Cao et al., 2005; Amin and Lee, 1997; Schachter, 1988; among others).

Option trading volume is defined as in (1), i.e. is logarithmically transformed (see Sanders and Zdanowicz, 1992) to account for the variation in the number of option contracts traded daily:

$$V_{i,t} = \ln(1 + \text{Number of call (put) contracts on stock } i \text{ traded on day } t) \qquad (1)$$

The benchmark period trading volume is defined as the average trading volume for a 100-day period preceding the event and ending 41 days before the event (-141 to -41):

$$\overline{V}_{b,i} = \frac{1}{100} \sum_{t=-140}^{-41} V_{it} \qquad (2)$$

The pre-event option trading volume, or testing period volume, is defined as the average trading volume of the two trading weeks (10 trading days) immediately preceding the day of the large price change:

$$\overline{V}_{p,i} = \frac{1}{10} \sum_{t=-10}^{0} V_{it} \tag{3}$$

The null hypothesis is H_0: $V_{p,i} = V_{b,i}$, i.e. that the pre-event volume is equal to the benchmark volume, and the alternative hypothesis is H_1: $V_{p,i} \neq V_{b,i}$, i.e. that the pre-event volume is different to the benchmark volume. Rejection of the null implies abnormal trading volume before the price shock. Standard *t*-tests are employed to investigate the significance of difference in volume between benchmark and pre-event periods.

2.3. Robustness tests

In order to check the robustness of the results, two further benchmark periods (-161 to -41) and (-181 to -41) and two additional testing periods (-20 and -30 days relative to the event) are also employed in the study, for both call and put option contracts. As a result, we obtain nine different combinations of pre-event and benchmark periods for each type of shock (positive–negative). Furthermore, the analysis for both call and put contracts, both types of shock, and the nine combinations of pre-event and benchmark periods is repeated with various sub-samples of stocks. The sub-sample selection is motivated by previous findings that to the ratio of book-to-market value of equity, and

firm size are leading explanatory variables for the cross-section of average stock returns (e.g. Fama and French, 1992; Lakonishok, Shleifer and Vishny, 1994). More specifically, each year stocks are ranked according to their annual average Book to Market (BM) Value and their annual Average Market Capitalization (MV) and are assigned to six groups: High BM stocks or "value" stocks (stocks with the top 25% B/M Value), Medium BM stocks (stocks with the medium 50% B/M Value), Low BM stocks or "growth" stocks (stocks with the low 25% B/M Value), High MV stocks or "Large Cap" stocks (stocks with the top 25% MV), Medium MV stocks (stocks with the medium 50% MV), and Low MV stocks or "Small Cap" stocks (stocks with the low 25% MV). Finally, since for certain option volume series some null values are observed (that could be due to non-trading days) the above analysis for all specifications is repeated both with and without these observations; the results are qualitatively the same and thus, we report the latter here (the rest are available upon request).

3. Abnormal trading volume before price shocks

3.1. All stocks

Table 1 presents the results for positive and negative shocks for all stocks and for both call and put contracts, when the benchmark trading volume is computed using 141 to 41 days before the event. Panel A presents results for a pre-event period of 10 days, Panel B for a pre-event period of 20 days, and Panel C for a pre-event period of 30

days. Within each Panel, the first line presents the number of positive and negative events (shocks), the second line presents the number of shocks for which the pre-event option trading volume is higher than the benchmark option trading volume ($V_{p,i} > V_{b,i}$), and the third line presents this number in percentage terms. The fourth (fifth) line presents the percentage of events where the null hypothesis of equality is rejected at the 5% (10%) level of significance, while the sixth and seventh lines present the mean benchmark and pre-event option trading volume respectively, in logarithmic terms. The last line presents the average *t*-statistic for the null hypothesis of equality between pre-event and benchmark volume.

The results in Panel A show that, for a pre-event period of 10-days, there are 364 (519) positive (negative) shock days for the sample stocks. In the case of positive shocks in 69.78% (64.01%) of shocks the call (put) option trading volume before the shock is higher than the benchmark trading volume. For 35.16% (45.06%) of the shocks the null hypothesis of equality between the pre-event and benchmark trading volume is rejected for call contracts at the 5% (10%) level, while for 31.87% (39.56%) of the shocks the null of equality is rejected for put trading volume at the 5% (10%) level. The mean benchmark call volume is 7.23 while the mean pre-event call volume is 7.54 (in log terms); the mean benchmark put volume is 6.75 while the mean pre-event put volume is 6.95. The mean absolute *t*-statistic for the null hypothesis is 1.87 and 1.69 for call and put contracts, respectively. In the case of negative shocks in 65.90% (63.39%) of shocks the call (put) option trading volume before the shock is higher than the benchmark trading volume. For 35.84% (43.55%)

of the shocks the null of equality is rejected for call trading volume at the 5% (10%) level, while for 34.30% (43.74%) of the shocks the null of equality is rejected for put trading volume at the 5% (10%) level. The mean benchmark call volume is 7.35 while the mean pre-event call volume is 7.63; the mean benchmark put volume is 6.85 while the mean pre-event put volume is 7.08. The mean absolute *t*-statistic for the null hypothesis is 1.81 and 1.74 for call and put contracts, respectively.

Panels B and C present similar results, although null hypothesis rejection rates and *t*-statistics seem to increase the longer the pre-event period is. Note for instance, that for a pre-event period of 30 days (Panel C) the pre-event volume for call contracts and positive shocks is higher to the benchmark volume in fewer events (254 in the 10-day period against 222 in the 30-day period) but more of these events are statistically significant: now in 46.15% (53.02%) of events the null of equality is rejected at the 5% (10%) level. This pattern is similar for both positive and negative events and both call and put contracts, and indicate that traders seem to take positions up to thirty trading days before the event.

Tables 2 and 3 report the same results for different (longer) benchmark periods and suggest that rejection rates and *t*-statistics increase also with longer benchmark periods: for instance, for a (-181 to -41) benchmark period and a 30-day event period (Table 3, Panel C) the rejection rate for positive shocks and call options at the 5% (10%) level is 54.42% (58.97%) up from 46.15% (53.02%) respectively in Table 1. As before, this pattern holds for both positive and negative shocks and both call and

put contracts. In addition, in all three Tables, rejection rates are slightly higher for call contracts than put contracts. Overall, the results for the full sample suggest that in about 50% - 75% of positive and negative price shocks, pre-event call and put option trading volume is higher to benchmark trading volume. Furthermore, in about 35% - 65% of positive and negative price shocks the null hypothesis of equality between pre-event and benchmark call and put option trading volume is rejected at either the 5% or the 10% level of significance. Also, informed investors seem choose both long and short strategies in anticipation of a price shock.

3.2. Value vs Growth and Large vs Small stocks

In order to investigate further whether shocks are anticipated by informed traders stocks are assigned to three sub-samples, based on whether a firm has a High (Table 4), Medium (Table 5), or Low (Table 6) Book/Market value, as discussed in Section 2. The Tables are arranged in the same manner as above and report results based on a (-161 to -41) benchmark period (the sub-sample results present similar characteristics to the full sample results, with respect to the length of the benchmark period; the unreported results are available upon request). The results in Table 4 are similar to the results in Tables 1-3, although the pattern documented above is more pronounced. For example, for a pre-event period of 30-days (Panel C), in 71.25% of events the pre-event volume is higher to the benchmark volume for call contracts and positive shocks (the relevant percentage is 64.62% in Table 2) with a null hypothesis rejection rate of 57.50% at the 5% level of significance and 65% at the 10% level of significance (the

relevant percentages are 48.75% and 55.71% in Table 2). In addition, for High B/M stocks and positive shocks pre-event trading volume is more significant for call contracts rather than put contracts: for a pre-event period of 10 days (Panel A) the null hypothesis is rejected in 50% of events for call contracts and for 35% for put contracts at the 5% level (62.5% and 43.75% respectively at the 10% level); for a pre-event period of 30 days (Panel C) the null hypothesis is rejected in 57.5% of events for call contracts and for 43.75% for put contracts at the 5% level (65% and 50% respectively at the 10% level). The results for the Medium and Low B/M sub-samples (Tables 5 and 6, respectively) are more in line to the results reported in Tables 1-3.

Tables 7, 8, and 9, present results for High, Medium, and Low Market Value stocks, respectively, as discussed in Section 2, for a benchmark period of (-161 to -41) days. As with the B/M sort, the Market Value sub-sample findings present similar characteristics to the full sample findings with respect to the length of the benchmark period (the unreported results are available upon request). Note that, irrespective of the pre-event period and whether a stock is classified as High, Medium, or Low Cap stock in about 50% to 78% of events option trading volume tends to increase before a shock and in about 30% to 60% of the events pre-event volume is statistically different to the benchmark volume. The findings in this sub-section confirm the findings in the previous sub-section, i.e. for the majority of price shocks pre-event option trading volume tends to increase and in roughly 35% - 65% of events this volume is abnormal; the pattern is more pronounced for High B/M stocks.

4. Are post-shock returns related to pre-event option volume?

This section examines whether pre-event abnormal trading volume is related to post-shock abnormal stock returns. This is done by estimating a cross-sectional regression of post-shock Average Cumulative Abnormal Returns (*ACAR*s) on pre-event option volume:

$$ACAR_i = a + bV_{p,i} \tag{4}$$

In (4) $ACAR_i$ is the post-shock Average Cumulative Abnormal Return for stock *i*, for 0, 1, 2, 5, 10, and 15 days subsequent to the shock, and $V_{p,i}$ is the option trading volume for 10, 20, 30 days prior to the event. The results are presented in Tables 10, 11, 12, 13, and 14 for the all-stock sample, for the High B/M sub-sample, the Low B/M sub-sample, the High Market Value sub-sample, and the Low Market Value sub-sample, respectively. This regression is run separately for positive and negative shocks and for call and put contracts.

Panel A in Table 10 reports the slope coefficient and the *t*-statistic from (4) where the right-hand side variable is option trading volume 10 days prior to the shock, while Panel B (Panel C) reports results where the right-hand side variable is option trading volume 20 (30) days prior to the shock. The dependent variable is the abnormal stock return on the event day (*AAR*(0)), and the post event *ACAR*s for 1, 2, 5, 10, and 15 days subsequent to the shock, denoted as *ACAR* (0 to +1),……, *ACAR* (0 to +15). The

results for the all-stock sample indicate that the only statistically significant slope coefficient at the 5% level is the coefficient on the first day abnormal return, for positive shocks and call contracts. In other words, pre-event call option trading volume affects the first day abnormal stock return following positive shocks, on average; the negative coefficient further indicates that the higher (lower) the pre-event option volume the lower (higher) the subsequent stock return. There is also weaker evidence (significant at the 10% level) that this is also the case for put contracts and negative shocks.

For High B/M stocks (Table 11) slope coefficients for *ACAR*s up to 15 days subsequent to a positive shock are statistically significant at the 5% level and positive, for all three pre-event volume periods and for both call and put contracts; for Low B/M stocks (Table 12) there is very weak evidence, at the 5% level, that option trading volume is related to post-shock stock returns. The findings presented in Table 13 (High Cap stocks) indicate that call and put option trading volume is statistically significant at the 5% for post-shock (up to 15 days) returns, mainly for High Market Value stocks and positive shocks; it seems that pre-event volume is positively related to subsequent returns following positive shocks and negatively related to returns following negative shocks. For Low Market Cap stocks (Table 14) the evidence of an association between options trading volume and subsequent returns is much weaker: there is a negative relation between put volume and subsequent returns for positive and negative shocks.

5. Conclusion

This paper examines, for the first time, informed trading in stock option contracts for the period preceding price shocks in the underlying stocks. In efficient equity markets stock price shocks should be due to the arrival of unexpected related significant information. Our findings indicate that for a large percentage of shocks there is abnormal stock option trading volume for the period before the event. This implies that some investors may have privileged access to this information or anticipate significant shifts in prices due to superior analysis. In either case, the options market is used as a venue for their informed trading.

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Table 1
Abnormal option trading volume before price shocks
Benchmark period: 141 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	364	364	519	519
No of: $V_p > V_b$	254	233	342	329
% of: $V_p > V_b$	69.78%	64.01%	65.90%	63.39%
Reject H_0 at 5%	35.16%	31.87%	35.84%	34.30%
Reject H_0 at 10%	45.60%	39.56%	43.55%	43.74%
Mean V_b	7.23	6.75	7.35	6.85
Mean V_p	7.54	6.95	7.63	7.08
Mean $\|t\|$	1.87	1.69	1.81	1.74
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	364	364	519	519
No of: $V_p > V_b$	241	212	326	285
% of: $V_p > V_b$	66.21%	58.24%	62.81%	54.91%
Reject H_0 at 5%	40.38%	36.81%	36.8%	38.54%
Reject H_0 at 10%	49.45%	43.41%	42.00%	48.17%
Mean V_b	7.23	6.75	7.35	6.85
Mean V_p	7.45	6.85	7.53	6.95
Mean $\|t\|$	2.14	1.88	1.91	1.91
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	364	364	519	519
No of: $V_p > V_b$	222	192	305	260
% of: $V_p > V_b$	60.99%	52.75%	58.77%	50.10%
Reject H_0 at 5%	46.15%	41.21%	39.69%	40.27%
Reject H_0 at 10%	53.02%	49.18%	45.66%	49.52%
Mean V_b	7.23	6.75	7.35	6.85
Mean V_p	7.39	6.79	7.47	6.88
Mean $\|t\|$	2.37	2.16	2.00	2.04

Notes to Table 1:
"Shocks" is the number of days for which an extreme event takes place during the sample period. The null hypothesis (H_0) is that: [$V_b = V_p$], i.e. that the pre-event option volume is equal to the benchmark period volume. The percentage in the line denoted as "Reject H_0 at 5%" and "Reject H_0 at 10%" is the percentage of events for which the null is rejected at the 5% and 10% level of significance, respectively. Mean Volume (V) is defined as [ln(1+number of call (put) contracts of index *i* traded on day *t*]. "Mean V_b" is the mean volume for the benchmark period (i.e. -41 to -141 days) across all events. "Mean V_p" is the mean volume for pre-event period (-10, -20, -30, days) across all events. "Mean $|t|$" is the absolute mean t-statistic for the (H_0).

Table 2
Abnormal option trading volume before price shocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	359	359	517	517
No of: $V_p > V_b$	259	238	344	333
% of: $V_p > V_b$	72.14%	66.30%	66.54%	64.41%
Reject H_0 at 5%	38.72%	34.26%	37.52%	35.01%
Reject H_0 at 10%	48.75%	42.90%	46.03%	43.33%
Mean V_b	7.22	6.73	7.34	6.83
Mean V_p	7.56	6.98	7.63	7.08
Mean $\|t\|$	1.95	1.78	1.83	1.78
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	359	359	517	517
No of: $V_p > V_b$	247	223	331	292
% of: $V_p > V_b$	68.80%	62.12%	64.02%	56.48%
Reject H_0 at 5%	43.73%	40.67%	38.68%	40.43%
Reject H_0 at 10%	52.37%	48.19%	46.81%	47.78%
Mean V_b	7.22	6.73	7.34	6.83
Mean V_p	7.48	6.88	7.54	6.95
Mean $\|t\|$	2.25	2.02	1.99	1.98
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	359	359	517	517
No of: $V_p > V_b$	232	201	312	268
% of: $V_p > V_b$	64.62%	55.99%	60.35%	51.84%
Reject H_0 at 5%	48.75%	45.96%	40.43%	42.75%
Reject H_0 at 10%	55.71%	52.92%	49.13%	49.52%
Mean V_b	7.22	6.73	7.34	6.83
Mean V_p	7.42	6.82	7.48	6.88
Mean $\|t\|$	2.50	2.29	2.10	2.12

Notes to Table 2:
See Notes to Table 1.

Table 3
Abnormal option trading volume before price shocks
Benchmark period: 181 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	351	351	505	505
No of: $V_p > V_b$	261	232	253	350
% of: $V_p > V_b$	74.36%	66.10%	72.08%	69.31
Reject H_0 at 5%	42.45%	37.04%	44.44%	39.01%
Reject H_0 at 10%	49.86%	46.15%	51.28%	46.93%
Mean V_b	7.17	6.67	13.85	7.30
Mean V_p	7.55	6.96	14.52	7.64
Mean $\|t\|$	2.04	1.85	2.11	1.92
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	351	351	505	505
No of: $V_p > V_b$	248	223	242	332
% of: $V_p > V_b$	70.66%	63.53%	68.95%	65.74%
Reject H_0 at 5%	48.15%	43.59%	49.00%	43.76%
Reject H_0 at 10%	55.84%	52.14%	57.83%	51.29%
Mean V_b	7.17	6.67	13.85	7.30
Mean V_p	7.47	6.86	14.33	7.54
Mean $\|t\|$	2.39	2.14	2.47	2.14
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	351	351	505	505
No of: $V_p > V_b$	230	207	221	320
% of: $V_p > V_b$	65.53%	58.97%	62.96%	63.37%
Reject H_0 at 5%	54.42%	50.14%	56.98%	44.75%
Reject H_0 at 10%	58.97%	58.12%	65.24%	54.06%
Mean V_b	7.17	6.67	13.85	7.30
Mean V_p	7.41	6.8	14.22	7.49
Mean $\|t\|$	2.65	2.46	2.80	2.27

Notes to Table 3:
See Notes to Table 1.

Table 4
Abnormal option trading volume before price shocks
High Book/Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	80	80	111	111
No of: $V_p > V_b$	61	58	74	72
% of: $V_p > V_b$	76.25%	72.50%	66.67%	64.86%
Reject H_0 at 5%	50.00%	35.00%	39.64%	33.33%
Reject H_0 at 10%	62.50%	43.75%	48.65%	38.74%
Mean V_b	7.39	6.90	7.54	7.03
Mean V_p	7.81	7.17	7.84	7.31
Mean $\|t\|$	2.07	1.77	1.86	1.70
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	80	80	111	111
No of: $V_p > V_b$	55	52	68	65
% of: $V_p > V_b$	68.75%	65.00%	61.26%	58.56%
Reject H_0 at 5%	51.25%	42.50%	36.94%	32.43%
Reject H_0 at 10%	58.75%	45.00%	46.85%	40.54%
Mean V_b	7.39	6.90	7.54	7.03
Mean V_p	7.68	7.05	7.74	7.16
Mean $\|t\|$	2.39	1.94	1.91	1.76
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	80	80	111	111
No of: $V_p > V_b$	57	45	64	59
% of: $V_p > V_b$	71.25%	56.25%	57.66%	53.15%
Reject H_0 at 5%	57.50%	43.75%	39.64%	32.43%
Reject H_0 at 10%	65.00%	50.00%	51.35%	42.34%
Mean V_b	7.39	6.90	7.54	7.03
Mean V_p	7.65	7.00	7.68	7.07
Mean $\|t\|$	2.69	2.23	2.00	1.82

Notes to Table 4:
See Notes to Table 1.

Table 5
Abnormal option trading volume before price shocks
Medium Book/Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	163	163	253	253
No of: $V_p > V_b$	120	112	170	161
% of: $V_p > V_b$	73.62%	68.71%	67.19%	63.64%
Reject H_0 at 5%	34.36%	33.13%	33.20%	32.41%
Reject H_0 at 10%	45.40%	43.56%	40.71%	39.53%
Mean V_b	7.27	6.82	7.34	6.88
Mean V_p	7.64	7.09	7.60	7.10
Mean $\|t\|$	1.80	1.72	1.67	1.75
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	163	163	253	253
No of: $V_p > V_b$	118	108	167	143
% of: $V_p > V_b$	72.39%	66.26%	66.01%	56.52%
Reject H_0 at 5%	41.10%	39.88%	32.41%	40.71%
Reject H_0 at 10%	49.08%	48.47%	41.11%	47.43%
Mean V_b	7.27	6.82	7.34	6.88
Mean V_p	7.55	7.00	7.53	6.98
Mean $\|t\|$	2.06	1.96	1.79	1.94
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	163	163	253	253
No of: $V_p > V_b$	105	96	156	127
% of: $V_p > V_b$	64.42%	58.90%	61.66%	50.20%
Reject H_0 at 5%	43.56%	46.63%	33.60%	41.11%
Reject H_0 at 10%	51.53%	53.37%	40.71%	46.64%
Mean V_b	7.27	6.82	7.34	6.88
Mean V_p	7.47	6.94	7.46	6.91
Mean $\|t\|$	2.30	2.24	1.87	2.08

Notes to Table 5:
See Notes to Table 1.

Table 6
Abnormal option trading volume before price shocks
Low Book/Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	128	128
No of: $V_p > V_b$	62	53	82	82
% of: $V_p > V_b$	65.96%	56.38%	64.06%	64.06%
Reject H_0 at 5%	31.91%	31.91%	42.19%	38.28%
Reject H_0 at 10%	41.49%	38.30%	53.13%	52.34%
Mean V_b	7.11	6.63	7.28	6.78
Mean V_p	7.42	6.88	7.64	7.07
Mean $\|t\|$	1.81	1.72	1.98	1.81
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	128	128
No of: $V_p > V_b$	59	48	80	68
% of: $V_p > V_b$	62.77%	51.06%	62.50%	53.13%
Reject H_0 at 5%	40.43%	38.30%	47.66%	42.19%
Reject H_0 at 10%	51.06%	46.81%	53.91%	52.34%
Mean V_b	7.11	6.63	7.28	6.78
Mean V_p	7.39	6.76	7.53	6.93
Mean $\|t\|$	2.08	1.93	2.17	2.05
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	128	128
No of: $V_p > V_b$	54	44	76	66
% of: $V_p > V_b$	57.45%	46.81%	59.38%	51.56%
Reject H_0 at 5%	48.94%	46.81%	50.00%	51.56%
Reject H_0 at 10%	53.19%	54.26%	59.38%	58.59%
Mean V_b	7.11	6.63	7.28	6.78
Mean V_p	7.32	6.70	7.50	6.88
Mean $\|t\|$	2.31	2.21	2.33	2.25

Notes to Table 6:
See Notes to Table 1.

Table 7
Abnormal option trading volume before price shocks
High Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	159	159
No of: $V_p > V_b$	74	70	106	106
% of: $V_p > V_b$	78.72%	74.47%	66.67%	66.67%
Reject H_0 at 5%	36.17%	35.11%	40.25%	39.62%
Reject H_0 at 10%	48.94%	43.62%	47.17%	47.80%
Mean V_b	8.63	8.23	8.71	8.28
Mean V_p	9.02	8.58	8.99	8.53
Mean $\|t\|$	1.95	1.94	1.85	1.96
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	159	159
No of: $V_p > V_b$	68	66	106	89
% of: $V_p > V_b$	72.34%	70.21%	66.67%	55.97%
Reject H_0 at 5%	47.87%	39.36%	37.74%	42.77%
Reject H_0 at 10%	53.19%	47.87%	44.65%	46.54%
Mean V_b	8.63	8.23	8.71	8.28
Mean V_p	8.93	8.44	8.9	8.39
Mean $\|t\|$	2.21	2.17	1.89	2.05
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	94	94	159	159
No of: $V_p > V_b$	59	50	94	74
% of: $V_p > V_b$	62.77%	53.19%	59.12%	46.54%
Reject H_0 at 5%	48.94%	52.13%	38.99%	47.17%
Reject H_0 at 10%	54.26%	56.38%	46.54%	51.57%
Mean V_b	8.63	8.23	8.71	8.28
Mean V_p	8.87	8.38	8.85	8.33
Mean $\|t\|$	2.47	2.55	2.04	2.32

Notes to Table 7:
See Notes to Table 1.

Table 8
Abnormal option trading volume before price shocks
Medium Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	170	170	242	242
No of: $V_p > V_b$	120	107	156	150
% of: $V_p > V_b$	70.59%	62.94%	64.46%	61.98%
Reject H_0 at 5%	34.12%	30.59%	36.36%	33.88%
Reject H_0 at 10%	44.71%	38.24%	44.63%	42.98%
Mean V_b	7.1	6.65	7.06	6.59
Mean V_p	7.41	6.85	7.3	6.81
Mean $\|t\|$	1.78	1.59	1.77	1.74
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	170	170	242	242
No of: $V_p > V_b$	116	103	147	127
% of: $V_p > V_b$	68.24%	60.59%	60.74%	52.48%
Reject H_0 at 5%	42.35%	39.41%	38.43%	41.74%
Reject H_0 at 10%	52.94%	47.65%	46.69%	52.07%
Mean V_b	7.1	6.65	7.06	6.59
Mean V_p	7.35	6.77	7.22	6.67
Mean $\|t\|$	2.12	1.85	1.94	1.98
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	170	170	242	242
No of: $V_p > V_b$	108	95	141	121
% of: $V_p > V_b$	63.53%	55.88%	58.26%	50.00%
Reject H_0 at 5%	47.06%	44.12%	40.50%	44.21%
Reject H_0 at 10%	54.71%	51.76%	47.52%	52.48%
Mean V_b	7.1	6.65	7.06	6.59
Mean V_p	7.29	6.72	7.16	6.6
Mean $\|t\|$	2.37	2.1	2.03	2.08

Notes to Table 8:
See Notes to Table 1.

Table 9
Abnormal option trading volume before price shocks
Low Market Value Stocks
Benchmark period: 161 to 41 days

	Panel A: Pre-event period 10 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	95	95	116	116
No of: $V_p > V_b$	65	61	82	77
% of: $V_p > V_b$	68.42%	64.21%	70.69%	66.38%
Reject H_0 at 5%	48.42%	40.00%	36.21%	31.03%
Reject H_0 at 10%	55.79%	50.53%	47.41%	37.93%
Mean V_b	6.03	5.4	6.02	5.35
Mean V_p	6.38	5.64	6.46	5.68
Mean $\|t\|$	2.23	1.96	1.92	1.61
	Panel B: Pre-event period 20 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	95	95	116	116
No of: $V_p > V_b$	63	54	78	76
% of: $V_p > V_b$	66.32%	56.84%	67.24%	65.52%
Reject H_0 at 5%	42.11%	44.21%	39.66%	33.62%
Reject H_0 at 10%	50.53%	49.47%	50.00%	40.52%
Mean V_b	6.03	5.4	6.02	5.35
Mean V_p	6.26	5.52	6.33	5.58
Mean $\|t\|$	2.53	2.17	2.24	1.87
	Panel C: Pre-event period 30 days			
	Positive shocks		**Negative shocks**	
	Call Contracts	**Put Contracts**	**Call Contracts**	**Put Contracts**
Number of shocks	95	95	116	116
No of: $V_p > V_b$	65	56	77	73
% of: $V_p > V_b$	68.42%	58.95%	66.38%	62.93%
Reject H_0 at 5%	51.58%	43.16%	42.24%	33.62%
Reject H_0 at 10%	58.95%	51.58%	56.03%	40.52%
Mean V_b	6.03	5.4	6.02	5.35
Mean V_p	6.2	5.46	6.26	5.49
Mean $\|t\|$	2.75	2.38	2.35	1.94

Notes to Table 9:
See Notes to Table 1.

Table 10
Regressing post-announcement ACARs on pre-announcement trading volume
All Stocks

		Positive Shocks		Negative Shocks	
		Calls	**Puts**	**Calls**	**Puts**
		Panel A: Pre-event period 10 days			
AAR (0)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-1.10	-0.74	1.20	1.13
ACAR (0 to +1)	coefficient	-0.01*	0.00**	0.00	0.00**
	t-statistic	-2.13	-1.78	1.38	1.71
ACAR (0 to +2)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-0.17	0.03	1.11	1.38
ACAR (0 to +5)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.21	0.49	0.98	1.18
ACAR (0 to +10)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.42	0.72	0.91	1.58
ACAR (0 to +15)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-1.10	-0.74	1.20	1.13
		Panel B: Pre-event period 20 days			
AAR (0)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-1.35	-0.59	1.63	1.48
ACAR (0 to +1)	coefficient	-0.01*	0.00	0.00	0.00**
	t-statistic	-2.32	-1.63	1.60	1.76
ACAR (0 to +2)	coefficient	0.00	0.00	0.00	0.00**
	t-statistic	-0.11	0.34	1.55	1.71
ACAR (0 to +5)	coefficient	0.00	0.01	0.00	0.00
	t-statistic	0.31	1.00	1.32	1.54
ACAR (0 to +10)	coefficient	0.00	0.01	0.00	0.01**
	t-statistic	0.52	1.20	1.38	1.84
ACAR (0 to +15)	coefficient	0.00	0.01	0.00	0.01
	t-statistic	0.00	0.00	0.00	0.00
		Panel C: Pre-event period 30 days			
AAR (0)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-1.23	-0.56	1.48	1.28
ACAR (0 to +1)	coefficient	-0.01*	0.00	0.00	0.00
	t-statistic	-2.05	-1.50	1.59	1.61
ACAR (0 to +2)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.36	0.64	1.61	1.58
ACAR (0 to +5)	coefficient	0.00	0.01	0.01	0.00
	t-statistic	0.80	1.34	1.66	1.54
ACAR (0 to +10)	coefficient	0.01	0.01	0.01**	0.01
	t-statistic	1.02	1.54	1.72	1.85
ACAR (0 to +15)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-1.23	-0.56	1.48	1.28

Notes to Table 10:
The results presented above refer to the slope coefficient from the following cross section regression: $ACAR_i = a + bV_{p,i}$, where $ACAR_i$ is the post-event ACAR as follows: AAR (0), AAR (0 to +1), ACAR (0 to +2), ACAR (0 to +5), ACAR (0 to +10), ACAR (0 to +15), and $V_{p,i}$ is the pre event option trading volume.

Table 11
Regressing post-announcement ACARs on pre-announcement trading volume
High Book/Market Value Stocks

		Positive Shocks		Negative Shocks	
		Calls	**Puts**	**Calls**	**Puts**
		Panel A: Pre-event period 10 days			
AAR (0)	coefficient	0.01*	0.01*	0.00	0.00
	t-statistic	2.22	2.36	-0.23	-0.75
ACAR (0 to +1)	coefficient	0.01	0.01	0.00	0.00
	t-statistic	1.43	1.66	-0.20	-0.42
ACAR (0 to +2)	coefficient	0.03*	0.02*	0.00	0.00
	t-statistic	2.67	2.64	0.37	0.06
ACAR (0 to +5)	coefficient	0.03*	0.03*	0.00	0.00
	t-statistic	2.40	2.40	0.67	0.07
ACAR (0 to +10)	coefficient	0.03*	0.03*	0.01	0.00
	t-statistic	2.23	2.32	0.70	0.40
ACAR (0 to +15)	coefficient	0.01*	0.01*	0.00	0.00
	t-statistic	2.22	2.36	-0.23	-0.75
		Panel B: Pre-event period 20 days			
AAR (0)	coefficient	0.01**	0.01*	0.00	0.00
	t-statistic	1.81	2.42	-0.17	-0.53
ACAR (0 to +1)	coefficient	0.01	0.01**	0.00	0.00
	t-statistic	1.04	1.75	-0.34	-0.34
ACAR (0 to +2)	coefficient	0.02*	0.02*	0.00	0.00
	t-statistic	2.45	2.75	0.30	0.25
ACAR (0 to +5)	coefficient	0.03*	0.03*	0.00	0.00
	t-statistic	2.32	2.58	0.48	0.36
ACAR (0 to +10)	coefficient	0.03*	0.03*	0.01	0.01
	t-statistic	2.10	2.42	0.74	0.71
ACAR (0 to +15)	coefficient	0.01**	0.01*	0.00	0.00
	t-statistic	1.81	2.42	-0.17	-0.53
		Panel C: Pre-event period 30 days			
AAR (0)	coefficient	0.01**	0.01*	0.00	0.00
	t-statistic	1.71	2.40	-0.21	-0.62
ACAR (0 to +1)	coefficient	0.01	0.01**	0.00	0.00
	t-statistic	1.00	1.69	-0.28	-0.38
ACAR (0 to +2)	coefficient	0.03*	0.03*	0.00	0.00
	t-statistic	2.57	2.85	0.43	0.19
ACAR (0 to +5)	coefficient	0.03*	0.03*	0.00	0.00
	t-statistic	2.46	2.69	0.60	0.31
ACAR (0 to +10)	coefficient	0.03*	0.03*	0.01	0.00
	t-statistic	2.20	2.52	0.80	0.64
ACAR (0 to +15)	coefficient	0.01**	0.01*	0.00	0.00
	t-statistic	1.71	2.40	-0.21	-0.62

Notes to Table 11:
See Notes to Table 10.

Table 12
Regressing post-announcement ACARs on pre-announcement trading volume
Low Book/Market Value Stocks

		Positive Shocks		Negative Shocks	
		Calls	**Puts**	**Calls**	**Puts**
		Panel A: Pre-event period 10 days			
AAR (0)	coefficient	0.00	0.00	0.00**	0.00**
	t-statistic	-0.61	-0.07	1.88	1.97
ACAR (0 to +1)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-0.15	0.21	1.26	1.45
ACAR (0 to +2)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.97	1.23	0.50	0.39
ACAR (0 to +5)	coefficient	0.01	0.01	0.00	0.00
	t-statistic	1.44	1.26	1.03	0.82
ACAR (0 to +10)	coefficient	0.01**	0.01	0.00	0.00
	t-statistic	1.76	1.65	0.47	0.53
ACAR (0 to +15)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	-0.61	-0.07	1.88	1.97
		Panel B: Pre-event period 20 days			
AAR (0)	coefficient	0.00	0.00	0.00*	0.00*
	t-statistic	-0.38	0.13	2.17	2.23
ACAR (0 to +1)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.05	0.43	1.36	1.60
ACAR (0 to +2)	coefficient	0.00	0.01	0.00	0.00
	t-statistic	1.10	1.53	1.03	0.86
ACAR (0 to +5)	coefficient	0.01	0.01	0.00	0.00
	t-statistic	1.41	1.62	1.31	1.30
ACAR (0 to +10)	coefficient	0.01	0.01	0.00	0.00
	t-statistic	1.74	2.02	0.74	1.06
ACAR (0 to +15)	coefficient	0.00	0.00	0.00*	0.00*
	t-statistic	-0.38	0.13	2.17	2.23
		Panel C: Pre-event period 30 days			
AAR (0)	coefficient	0.00	0.00	0.00*	0.00**
	t-statistic	-0.26	0.08	2.00	1.90
ACAR (0 to +1)	coefficient	0.00	0.00	0.00	0.00
	t-statistic	0.20	0.44	1.31	1.50
ACAR (0 to +2)	coefficient	0.00	0.01	0.00	0.00
	t-statistic	1.29	1.58	0.95	0.87
ACAR (0 to +5)	coefficient	0.01**	0.01**	0.00	0.00
	t-statistic	1.70	1.85	1.42	1.41
ACAR (0 to +10)	coefficient	0.01*	0.01*	0.00	0.00
	t-statistic	2.08	2.24	0.99	1.28
ACAR (0 to +15)	coefficient	0.00	0.00	0.00*	0.00**
	t-statistic	-0.26	0.08	2.00	1.90

Notes to Table 12:
See Notes to Table 10.

Table 13
Regressing post-announcement ACARs on pre-announcement trading volume
High Market Value Stocks

		Positive Shocks		Negative Shocks	
		Calls	**Puts**	**Calls**	**Puts**
		Panel A: Pre-event period 10 days			
AAR (0)	coefficient	0.01*	0.01	-0.01	-0.01
	t-statistic	2.97	3.36	-1.60	-1.68
ACAR (0 to +1)	coefficient	0.01*	0.01	-0.01	0.00
	t-statistic	2.75	2.85	-1.41	-0.73
ACAR (0 to +2)	coefficient	0.03*	0.03	-0.01	-0.01
	t-statistic	2.78	2.98	-1.86	-1.09
ACAR (0 to +5)	coefficient	0.04*	0.04	-0.01	0.00
	t-statistic	2.61	2.67	-1.44	-0.41
ACAR (0 to +10)	coefficient	0.04*	0.05	-0.01	0.00
	t-statistic	3.11	3.27	-0.88	0.03
ACAR (0 to +15)	coefficient	0.01*	0.01	-0.01	-0.01
	t-statistic	2.97	3.36	-1.60	-1.68
		Panel B: Pre-event period 20 days			
AAR (0)	coefficient	0.01	0.01*	0.00	0.00
	t-statistic	1.65	2.17	-0.94	-1.10
ACAR (0 to +1)	coefficient	0.01	0.01**	-0.01**	-0.01
	t-statistic	1.48	1.78	-1.94	-1.32
ACAR (0 to +2)	coefficient	0.02**	0.02*	-0.01*	-0.01**
	t-statistic	1.82	2.24	-2.36	-1.69
ACAR (0 to +5)	coefficient	0.03**	0.03*	-0.01*	-0.01
	t-statistic	1.80	2.17	-2.16	-1.30
ACAR (0 to +10)	coefficient	0.03*	0.04*	-0.01	0.00
	t-statistic	2.22	2.60	-1.35	-0.65
ACAR (0 to +15)	coefficient	0.03	0.04	-0.01	-0.01
	t-statistic	0.01	0.01	0.00	0.00
		Panel C: Pre-event period 30 days			
AAR (0)	coefficient	0.01*	0.01*	-0.01**	-0.01*
	t-statistic	2.21	2.59	-1.83	-2.02
ACAR (0 to +1)	coefficient	0.01*	0.01*	-0.01**	-0.01
	t-statistic	2.08	2.19	-1.88	-1.38
ACAR (0 to +2)	coefficient	0.03*	0.03*	-0.01*	-0.01**
	t-statistic	2.74	2.93	-2.35	-1.80
ACAR (0 to +5)	coefficient	0.04*	0.04*	-0.01	0.00
	t-statistic	2.64	2.79	-1.38	-0.83
ACAR (0 to +10)	coefficient	0.05*	0.05*	0.00	0.00
	t-statistic	3.03	3.19	-0.63	-0.15
ACAR (0 to +15)	coefficient	0.01*	0.01*	-0.01**	-0.01*
	t-statistic	2.21	2.59	-1.83	-2.02

Notes to Table 13:
See Notes to Table 10.

Table 14
Regressing post-announcement ACARs on pre-announcement trading volume
Low Market Value Stocks

		Positive Shocks		Negative Shocks	
		Calls	**Puts**	**Calls**	**Puts**
		Panel A: Pre-event period 10 days			
AAR (0)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.28	-1.54	0.05	0.24
ACAR (0 to +1)	coefficient	-0.01	-0.01*	0.00	0.00
	t-statistic	-1.29	-1.99	-0.08	0.07
ACAR (0 to +2)	coefficient	-0.01	-0.02*	0.00	0.00
	t-statistic	-1.15	-2.32	0.16	-0.50
ACAR (0 to +5)	coefficient	-0.02	-0.03*	-0.01	-0.02*
	t-statistic	-1.41	-2.27	-0.81	-2.06
ACAR (0 to +10)	coefficient	-0.02	-0.03*	-0.02**	-0.03*
	t-statistic	-1.60	-2.34	-1.87	-2.57
ACAR (0 to +15)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.28	-1.54	0.05	0.24
		Panel B: Pre-event period 20 days			
AAR (0)	coefficient	-0.01	0.00	0.00	0.00
	t-statistic	-1.35	-1.01	0.31	0.29
ACAR (0 to +1)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.50	-1.47	-0.02	-0.06
ACAR (0 to +2)	coefficient	-0.01	-0.02	0.00	0.00
	t-statistic	-1.38	-1.61	0.16	-0.33
ACAR (0 to +5)	coefficient	-0.02	-0.02	-0.01	-0.02**
	t-statistic	-1.63	-1.60	-1.08	-1.78
ACAR (0 to +10)	coefficient	-0.02**	-0.02	-0.02	-0.03*
	t-statistic	-1.73	-1.67	-1.67	-2.44
ACAR (0 to +15)	coefficient	-0.01	0.00	0.00	0.00
	t-statistic	-1.35	-1.01	0.31	0.29
		Panel C: Pre-event period 30 days			
AAR (0)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.43	-1.14	0.13	-0.07
ACAR (0 to +1)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.50	-1.52	-0.15	-0.38
ACAR (0 to +2)	coefficient	-0.01	-0.02	0.00	0.00
	t-statistic	-1.17	-1.65	0.15	-0.34
ACAR (0 to +5)	coefficient	-0.02	-0.02	-0.01	-0.02**
	t-statistic	-1.34	-1.56	-1.06	-1.80
ACAR (0 to +10)	coefficient	-0.02	-0.02	-0.02	-0.03*
	t-statistic	-1.50	-1.61	-1.42	-2.25
ACAR (0 to +15)	coefficient	-0.01	-0.01	0.00	0.00
	t-statistic	-1.43	-1.14	0.13	-0.07

Notes to Table 14:
See Notes to Table 10.