Informed trading around stock split announcements: Evidence from the option market

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Abstract

Prior research has shown that splitting firms earn positive abnormal returns and that they experience an increase in stock return volatility. If they do, then the option market is an ideal venue to capitalize on this information. By examining option-implied volatility, we assess option investors' perceptions on return and volatility changes arising from stock splits. We find that they do expect higher stock volatility following splits. There is also some evidence of option investors anticipating an abnormal increase in stock prices. On balance though, we contend that they do not expect that splitting firms will earn abnormal returns.

Key words: stock splits, option investors, implied volatility, volatility spread

JEL Classification: G11, G12, G13 and G14

1. Introduction

Over the past forty years, academics and practitioners have documented a number of interesting yet conflicting findings on stock splits. Studies that examine the announcement effect of a split find that the market perceives this information as good news, which induces positive abnormal returns during the short-run announcement window (Grinblatt, Masulis and Titman, 1984, Chern, Tandon, Yu and Webb, 2008, Lin, Singh and Yu, 2009). Following the announcement date, it has been shown that splits exert a strong influence on the future price and volatility of the underlying stocks.[1] Ikenberry, Rankine and Stice (1996), Desai and Jain (1997) and Ikenberry and Ramnath (2002) observe positive return drift that lasts at least one year after the split announcement while Ohlson and Penman (1985) and Dravid (1987) find an increase in stock volatility following the split effective date.

These early findings on long-run abnormal returns and volatility have since been called into question. Byun and Rozeff (2003) show that return drift is not pervasive and that it is only observed in certain periods. Boehme and Danielsen (2007) find that the abnormal returns documented over the longer term are driven by the relatively short period between the announcement date and the effective date. Together, they argue that markets incorporate the split announcement information reasonably efficiently. With regard to stock volatility, Lamoureux and Poon (1987) and Conroy, Harris and Bennett (1990) assert that the higher volatility following splits is due to a higher bid-ask spread. Contrastingly, Peterson and Peterson (1994), Desai, Nimalendran and Venkataraman (1998) and Koski (1998) cast doubt on this explanation, as they find that the bid-ask spread is not the entire

[1] The obvious effect of a split is to lower the stock price according to the split factor. Our tests on the impact of splits on stock prices do not refer to this mechanical change. Rather, our focus is on changes in split-adjusted prices driven by changing investor expectations.

answer. After controlling for measurement effects, they observe an increase in stock volatility after splits.

Despite the plethora of evidence regarding the behavior of splitting firms, so far, researchers only agree that the market generally reacts positively to the split announcement. Contrastingly, the impact of a stock split on long-run returns and volatility is ambiguous. We contend that if a stock split exerts a real influence on stock returns and volatility, then this has important implications for informed investors, as they can utilize their informational advantage to profit from these price patterns. Various theoretical models on informed trading argue that an investor's informational advantage stems from two sources: acquisition of private information (Glosten and Milgrom, 1985, Kim and Verrecchia, 1991) or superior ability to process public information (Kim and Verrecchia, 1994). If a stock split induces positive abnormal returns during the announcement window, then investors who possess an informational advantage about the occurrence of the split can make money by trading before the information becomes public. After the announcement date, if there is an increase in stock volatility and positive return drift, then informed investors should be the first to profit from this price pattern since they are better at interpreting public disclosure than uninformed investors.

Studies by Easley, O'Hara and Srinivas (1998), Cao, Chen and Griffin (2005), Pan and Poteshman (2006) and Roll, Schwartz and Subrahmanyam (2010) show that informed investors prefer to capture mispricing in the option market rather than the stock market. Equity options are advantageous in this regard because they are leveraged bets with a positively skewed return distribution and they are not subject to short sale restrictions. Following Chakravarty, Gulen and Mayhew (2004) and Hayunga and Lung (2013), we infer the belief of informed investors through the lens of option investors.

In particular, we examine option-implied volatility to gauge investor perceptions on changes in future stock returns and volatility. Option-implied volatility is regarded as a better proxy for option valuation compared to conventional measures such as option price or option trading volume (open interest).[2] Implied volatility reflects the demand of an option given the prevailing stock price. A higher implied volatility suggests upward buying pressure on the options. We employ option-implied volatility to assess option investors' perceptions on the future volatility of the stock. To evaluate their views on the existence of positive abnormal returns, we consider two measures of the spread in implied volatility between call and put options, namely the volatility spread and the volatility skew (Cremers and Weinbaum, 2010 and Xing, Zhang and Zhao, 2010). Implied volatility provides insight on the expected volatility of the underlying stock over the life of the option while the spreads have been shown to predict equity returns. Together, these measures allow us to make inferences on the future direction of both the price of the underlying stock and its volatility.

Option-implied volatility is analyzed around stock split announcements over the period January 1998 to December 2012. We observe an increase in implied volatility for the most speculative short-dated options prior to the announcement. Once the news becomes public, the increase in implied volatility is more persistent for options that expire after the effective date. This pattern is broadly observed across all options and within sub-groups of options with varying levels of liquidity. These findings provide two important insights: First, option investors seem to be aware of forthcoming split announcements before they are officially announced and they appear to be trading on this information.

[2] An increase in option price or trading volume does not necessarily indicate higher option demand. Option prices can change due to a change in the price of the underlying stock while trading volume is often unsigned and it increases in both long and short directions.

Second, from the view of these investors, a stock split will increase the volatility of the underlying stock and this increase will mainly occur after the effective date.

Next, inspired by Amin, Coval and Seyhun (2004), who argue that the combined behavior of calls and puts together contains important information about stock prices, we study the option-implied volatility spread and skew. The option-implied volatility spread, developed by Cremers and Weinbaum (2010), measures the aggregate deviation from put-call parity across all valid call and put pairs for a given firm. Their rationale is if informed investors anticipate an increase in the stock price of the underlying, then a useful strategy they can employ is to purchase a call option and/or sell a put option. Such actions will result in a higher implied volatility inverted from call options relative to put options, which gives rise to a deviation in put-call parity. The volatility skew measure (Xing, Zhang and Zhao, 2010) aims to extract information from out-of-the-money put options since these options provide investors the greatest protection against a fall in the underlying's stock price. It is calculated as the difference in implied volatility between out-of-the-money puts and at-the-money calls. If good (bad) news is expected for a given firm, then this should decrease (increase) the demand for out-of-the-money puts. Thus, if a stock split is regarded as positive information by option investors, then this will give rise to a reduction in the volatility skew.

The analysis of option-implied volatility indicates that informed option investors have some insight on forthcoming split announcements. However, the change in both the volatility spread and skew is insignificant throughout the pre-announcement period. This is inconsistent with option investors trying to exploit the abnormal returns observed when firms announce splits. Thus, while there is a general consensus amongst academics that splitting companies earn positive abnormal returns during the short-run announcement window, it seems that from the viewpoint of option investors, these returns are not high enough to induce them to trade. We document a significant and positive (negative) change in the volatility spread (skew) on the day after the announcement and a weakly significant negative change in the volatility skew on the announcement date. This suggests that informed investors believe in the existence of positive abnormal returns following the announcement date and execute their trades in the option market accordingly. However, these findings are not robust to different levels of option liquidity and are to some extent driven by options on smaller cap stocks. Easley, O'Hara and Srinivas (1998) contend that the extent to which informed investors reside in the option market depends on the liquidity of the option market relative to the stock market. A liquid trading environment allows informed investors to extract profits without revealing their private information. Given that the significant changes in the volatility spread and skew are most likely driven by smaller cap stocks with low option liquidity, we contend that the trading behavior of option investors indicates that they do not expect that splitting firms will earn abnormal returns.

The paper contributes to the existing literature in several ways. First, research on the impact of stock splits on the option market has been very limited. Reilly and Gustavson (1985) find that call option returns are positive prior to split announcements but negligible post announcement. French and Dubosfky (1986) observe that the implied volatility of call options increases after the effective date but that high bid-ask spreads would render a trading strategy based on this increase unprofitable. Sheikh (1989) also finds that call option implied volatility increases when splits are effected. However, he shows that option investors did not anticipate the post-split increase in volatility at the time of the announcement. These three studies spanned the period 1976 to 1983 and Sheikh's (1989) sample was the largest with 83 stocks. Our study utilizes both call and put options in a much larger sample and during a recent time period.

Second, unlike previous research, we do not examine the stock returns of splitting firms. To assess the informational value of the event, we analyze the perception of option investors. We contend that this is a cleaner test and that it is more forward looking compared to conventional methods of studying the return distribution. If positive abnormal returns are subject to the time period examined and the return horizon (Byun and Rozeff, 2003 and Boehme and Danielsen, 2008), then average abnormal returns documented over long sample periods will not imply that a split trading strategy is profitable. By examining the trading activity of option investors, we can directly assess their views on profitability. This is because option investors will only trade if they believe that the information contained in the split announcement is valuable and that they can profit from this information.

Third, our research contributes to the information based trading literature. Of particular pertinence is whether public or private information is the driver of the pre-announcement increase in implied volatility. Split predictability has been extensively studied in previous research (Hwang, Keswani and Shackleton, 2008, and Krieger and Peterson, 2009). Using a comprehensive set of publicly available information to predict splits, none of these studies is able to achieve a success rate higher than 44 percent. Our results show that the increase in option implied volatility is observed across a broad range of stocks and in sub-groups of stocks with varying market capitalizations. This "success" rate seems too high to be due to public information alone. A vast number of studies including Ivashina and Sun (2011), Acharya and Johnson (2010), Bodnaruk, Massa and Simonov (2009) and Berkman, McKenzie and Verwijmeren (2013) suggest that much of the pre-event informational advantage of informed investors originates from insider information. Thus, in accord with these studies, we contend that informed option investors are exploiting private information when trading prior to split announcements.

In addition to the acquisition of private information, a key source of competitive advantage for informed investors is superior analysis of public disclosure (Engelberg, Reed and Ringgenberg, 2012). Given this, the behavior of option investors on or after the announcement date provides further insight on the informational value of stock splits. Our analysis shows that option investors expect an increase in stock volatility after the effective date but that they do not believe that the well-documented abnormal returns are exploitable. The rest of the paper proceeds as follows: Section 2 describes the methods, section 3 outlines the data and sample selection, section 4 discusses the results, section 5 performs sensitivity analysis and section 6 concludes.

2. Methods

Two methods are used to investigate the impact of split announcements on trading behavior in the option market. The first examines the implied volatility of call and put options separately; the second analyzes the implied volatility of call and put options together by examining the volatility spread and skew. The advantage of employing both methods concurrently is that it allows us to disentangle option investors' expectations on changes in future stock returns and volatility. Our event window is the [-5, +5] day period around the split announcement.[3]

In our tests of informed trading in the option market, we examine the daily change in implied volatility, volatility spread and volatility skew. Given that volatility is persistent, implied volatility today is an appropriate proxy for expected implied volatility tomorrow.

[3] To draw inference on the strength of the price discovery process in the option market, Jin, Livnat and Zhang (2010) and Chan, Ge and Lin (2013) run cross sectional regressions of the volatility spread (skew) on future returns. We do not follow this approach. Our focus is not on whether the option measures have any predictive power on subsequent stock returns and volatility. Rather, our interest is on the informational value of the split. An examination of the relationship between the option variables and future stock returns or volatility would consider the extent to which option investors are correctly differentiating the future stock returns or volatility of splitting firms. This tells us little about how option investors perceive stock splits in general. Our tests are focused on the perception of option investors on return distribution changes due to splits.

If the volatility spread and volatility skew are indicators of future stock returns, in the absence of new information, these measures should be constant through time. Thus, we assume that the expected daily change in implied volatility and the volatility spread (skew) is zero. Our approach is consistent with Bollen and Whaley (2004) and Garleanu, Pedersen and Poteshman (2009) who find that changes in implied volatility reflect the net buying pressure of option investors. In addition, Cremers and Weinbaum (2010) argue that it is the change in the option-implied volatility spread rather than the level that is the stronger predictor of future stock returns.

2.1 The impact of splits on stock volatility

Ohlson and Penman (1985) and Dravid (1987) document an increase in stock volatility following the effective date. When firms announce splits, they will disclose on what date the split will be effected. Given that post-announcement, the effective date is known in advance by the market, it is natural to expect informed investors to incorporate this effect in their option valuation. Thus, there should be a difference in the behavior of implied volatility for options that expire before the effective date and those that expire after. The increase in option-implied volatility, if observed, should be stronger in options that expire after the effective date.

As there are many options available for a given stock, this raises the issue of which options are most likely to reflect the belief of informed investors. Liquidity in the option market concentrates in at-the-money options. If option liquidity is a major concern for informed investors, then they should exploit their informational advantage in at-the-money options. However, Jin, Livnat and Zhang (2012) argue that informed investors utilize different types of options to trade on different types of information. In the case of a stock split, although it is not clear which types of options informed investors prefer, if they trade in the option market in anticipation of an increase in the volatility of the underlying stock, then they will likely select options that are the most sensitive to changes in stock volatility. That is, options with the highest vega. Thus, to obtain a single estimate of option-implied volatility for a given stock, we take the weighted average of all available implied volatilities where the weight is the option vega. We compute the implied volatility for options that expire before and after the effective date, separately.

To examine whether option investors expect an increase in stock volatility following the split, we investigate the daily change in implied volatility for call and put options, where the change in implied volatility is given by:

$$\Delta IV_{it} = IV_{it} - IV_{it-1}. \quad (1)$$

ΔIV_{it} is the change in implied volatility for stock *i* on day *t* and IV_{it} is the weighted average of all implied volatilities for stock *i* on day *t* where the weight is the option vega. It is calculated as:

$$IV_{it} = \sum_{j=1}^{N_{i,t}} w_{j,t}^{i} IV_{j,t}^{i}, \quad (2)$$

where $N_{i,t}$ is the number of options traded for stock *i* on day *t* and $IV_{j,t}^{i}$ is the implied volatility of option *j* for stock *i* on day *t*. Thus, we study the daily movement in the aggregate implied volatility across all options for a given stock.

2.2 The impact of splits on stock returns

Although option-implied volatility reflects the demand of option investors, it may not be a reliable predictor of future stock returns. An increase in option-implied volatility may simply be the result of an expected increase in the volatility of the underlying stock. Recent literature including Cremers and Weinbaum (2010) and Xing, Zhang and Zhao (2010) suggest that the behavior of implied volatilities of call and put options together, not in isolation reflect informed trading and predict returns in the equity market. Specifically, Cremers and Weinbaum (2010) argue that if informed investors are optimistic about the underlying stock, then they can either buy a call option or sell a put option. This should increase (decrease) the price of call (put) options, which in turn induces a higher implied volatility inverted from call options relative to put options. They refer to this as the volatility spread or a deviation from put-call parity. Since options on individual stocks are American, put-call parity takes the form of an inequality rather than a strict equality, as it accounts for the early exercise premium.

The change in the volatility spread is calculated as follows:

$$\Delta VS_{it} = VS_{it} - VS_{it-1} . \quad (3)$$

Following Cremers and Weinbaum (2010), the volatility spread VS_{it} for firm *i* on day *t* is:

$$VS_{it} = IV_{i,t}^{calls} - IV_{i,t}^{puts} = \sum_{j=1}^{N_{i,t}} w_{j,t}^{i} \left(IV_{j,t}^{i,call} - IV_{j,t}^{i,put} \right), \quad (4)$$

where *j* represents each pair of call and put options matched on the same strike price and maturity date, and $N_{i,t}$ refers to the number of valid pairs of options on stock *i*. We eliminate option pairs when either the call or put has zero open interest or a bid price of zero. The volatility spread or deviation in put-call parity for a given firm is computed by taking the weighted average of all the available option pairs where the weight is the average open interest in the call and put options.

In addition to the volatility spread, we employ the volatility skew measure developed by Xing, Zhang and Zhao (2010). Unlike the volatility spread, which is designed to capture information in a wide range of options across different strike prices and time to maturities, the option-implied volatility skew specifically captures information in out-of-the-money put options. The volatility skew is calculated as the difference in implied volatility between out-of-the-money put options and at-the-money call options.

Doran, Peterson and Tarrant (2007) and Xing, Zhang and Zhao (2010) show that an increase in demand for out-of-the-money put options relative to at-the-money call options predicts negative stock returns. Jin, Livnat and Zhang (2012) and Chan, Ge and Lin (2014) find that the volatility skew forecasts positive returns as well.

If option investors believe in the existence of positive abnormal returns subsequent to the split announcement, then we should observe a reduction in the volatility skew over the event window. The volatility skew is estimated as follows:

$$SKEW_{i,t} = IV_{i,t}^{OTMP} - IV_{i,t}^{ATMC} , \tag{5}$$

where $SKEW_{i,t}$ is the option-implied volatility skew for stock *i* on day *t*, $IV_{i,t}^{OTMP}$ is the implied volatility of out-of-the-money put options for stock *i* on day *t*, and $IV_{i,t}^{ATMC}$ is the implied volatility of at-the-money call options for stock *i* on day *t*. Following Jin, Livnat and Zhang (2012), we select out-of-the-money put options by first identifying options that have a delta within the range [-0.45, -0.15] and choose the one that has a delta closest to -0.3. At-the-money call options are those whose delta is closest to 0.5 given that delta is higher than 0.4 and less than 0.7. Similar to the volatility spread, we examine the change in the volatility skew. That is,

$$\Delta SKEW_{it} = SKEW_{it} - SKEW_{it-1} . \tag{6}$$

The statistical significance of the change in implied volatility, and the volatility spread (skew) is inferred based on the assumption that the expected daily change in these measures is zero. To verify this condition, we examine the distribution of these changes in a period that is outside the announcement window. The unreported results indicate that the daily changes are centered around zero and are not time varying. However, to ensure that our analysis is not influenced by cross sectional variation in the expected change in implied volatility and the volatility spread (skew), for each firm, we select a benchmark.

Specifically, the expected daily change in implied volatility and the volatility spread (skew) is proxied using the average change in these measures during the period [-100, -20]. The abnormal change in the option variables is then computed by subtracting the appropriate benchmark. The analysis is presented in the appendices. The behavior of the abnormal change in implied volatility and the volatility spread (skew) is very similar to the raw change in these metrics. Thus, we base our inferences on the unadjusted daily change in implied volatility and the volatility spread (skew).[4]

3. Data and sample characteristics

From the OptionMetrics Ivy database, equity option data are collected for the period January 1998 to December 2012. The dataset covers daily closing bid and ask quotes, open interest, volume, implied volatility and the greeks for all exchange-listed call and put options on U.S. equities. Since options on individual stocks are American options, implied volatilities are calculated using the Cox-Ross-Rubinstein (1979) binomial tree model, taking into account discrete dividend payments and the possibility of early exercise using historical LIBOR as the interest rate. Specifically, different values of volatility are inserted into the model until the price of the option approximates to the midpoint of the option's best closing bid-ask prices.

The OptionMetrics data are merged with the CRSP files to identify all splitting stocks with a split factor greater than or equal to 25% that have written options. In the period 1998 to 2012, 1,780 stock splits on 1,109 firms meet this requirement. With regard to the option data, each option record must have information on the strike price, best

[4] Bakshi and Kapadia (2003) contend that option implied volatility may be a biased predictor of future asset volatility due to the existence of a variance risk premium. By employing the change in implied volatility (rather than the level), we mitigate any potential bias arising from cross-sectional and/or time variation in the volatility risk premium. Moreover, the robustness of our findings to abnormal changes in implied volatility should further allay concerns regarding this issue.

closing bid and ask prices, volume, open interest and implied volatility during the period [-10, +10] where Day 0 is the split announcement date. To address the issues related to thinly traded options, we impose the following filters: (1) options with an absolute value of delta less than 0.02 and more than 0.98 are excluded; (2) options must have maturities that range between 10 to 100 days; (3) all options with a bid-ask spread that is greater than the bid-ask mid-point are removed. There are on average 22 (23) call (put) options available on each splitting firm.

3.1 Summary statistics on option liquidity and implied volatility

To draw an initial inference on how the option market behaves in a period outside the split announcement window, the average implied volatility, volume and open interest of call/put options across different levels of moneyness is examined for the 10 day period from [-60 to -50]. Following Bollen and Whaley (2004), we measure the degree of moneyness of an option using the option delta, which represents the risk-neutral probability of the option being in-the-money at expiration.

Panel A of Table 1 reports the mean/median volume (VOL), open interest (OI) and implied volatility (IV) for call options across different levels of moneyness, while panel B reports the same information for put options. In Table 1, we observe some evidence of a U-shaped volatility smile for both call and put options. A volatility smile can bias the results if one examines the change in implied volatility (volatility spread and skew) for one particular option or one pair of options over time, as this change can simply be the result of a daily change in moneyness. To avoid this problem, we do not examine the movement in implied volatility (volatility spread and skew) for one option or one pair of options. As mentioned in section 2, the change in implied volatility and the volatility spread is calculated across all available options while the volatility skew is estimated by matching the implied volatility of an out-of-the-money put and an at-the-money call on a given day.

This procedure minimizes the impact of moneyness on the behavior of implied volatility and the volatility spread (skew).

[Insert Table 1 here]

Table 1 also shows that out-of-the-money and at-the-money options tend to have higher volume and open interest than in-the-money options. This is expected, as trading in the option market is typically motivated by speculation or hedging. Since out-of/at-the-money options are relatively cheaper, they offer investors a higher degree of leverage and a better means to achieve their objective. This in turn makes out-of-/at-the money options more popular amongst investors compared to in-the-money options. Finally, the median volume and open interest for both call and put options are much lower than their means and in some cases equal to zero. This indicates that trading activity in the option market is quite thin where a large fraction of the option trading volume and open interest reside in the contracts of only a few stocks.

3.2 Summary statistics on option liquidity and implied volatility for firms with different market capitalizations

Easley, O'Hara and Srinivas (1998) argue that informed investors' decision to trade in the option market depends on leverage and the liquidity of the option market relative to the stock market. The advantage of a liquid market is that it offers lower trading costs and it allows informed investors to "hide" their information. Another relevant consideration for informed investors when deciding whether to trade options is the behavior of the market makers. When the market makers obtain news, which they deem to have a material price impact, they will adjust the bid and ask prices in a way that inhibits other informed investors from earning abnormal returns. Informed investors faced with this situation can do one of the following: If they believe that abnormal returns cannot be earned based on the current bid and ask prices, they will not trade. If they disagree with the market makers, they can trade in the opposite direction. Finally, if they agree with the market makers and they believe that abnormal returns can still be earned, their trades will drive the bid and ask prices in the same direction initiated by the market makers. In this context, a significant change in implied volatility or the volatility spread (skew) when option liquidity is low is more likely to reflect the perception of the market makers.[5] Contrastingly, when option liquidity is high, changes in these metrics are more likely to be driven by both the market makers and informed option investors. Thus, we contend that a significant change in implied volatility or the volatility spread (skew) observed in liquid options is a stronger signal of informed investors' perceptions compared with illiquid options.

Option trading volume, open interest and bid-ask spreads are important elements of option liquidity, but no single attribute adequately describes liquidity. Therefore, a proxy is required that represents all three elements of option liquidity, and market cap is the proxy selected.[6] The classification scheme employed forms four size portfolios, where the first three groups comprise firms that constitute the S&P 500, S&P 400 and S&P 600 indices while the last group includes firms that do not belong to these three indices. Together, the three S&P indices constitute the S&P 1500 index, accounting for approximately 85% of U.S. market capitalization. In unreported results, the average (median) market cap of stocks in the "other" portfolio is higher (lower) than for S&P 600 stocks. The reason for this is that although small firms dominate the "other" portfolio, this group also contains a number of Nasdaq 100 stocks that are not members of the S&P 1500 Index. By design, Nasdaq 100 firms have high market cap.

[5] Illiquid options suggest a low level of trading activity from option investors. This does not necessarily imply a high degree of agreement between the market makers and other informed investors. The low trading activity may be due to minimal interest by investors in the stock and its options.

[6] Although we have attempted to control for option liquidity by weighting the option pairs according to their average open interest when calculating the volatility spread, this only accounts for the option liquidity within a given stock. Such a procedure does not distinguish stocks that have liquid options from those that do not.

To evaluate whether market cap adequately captures option liquidity, an examination of option trading volume and open interest is performed using options on stocks associated with the four size portfolios, as previously identified. Panel A of Table 2 reports the mean (median) volume, open interest and the average implied volatility for call options across different market cap groups during the period [-60, -50] while panel B reports the same information for put options.

[Insert Table 2 here]

Once again, we observe a U-shape volatility smile across all four capitalization groups. As for option liquidity, there is a monotonic decline in the mean (median) option volume and open interest as one moves from the large cap S&P 500 group to the small cap S&P 600 group. This pattern is present in both call and put options, and at different moneyness levels. Option liquidity for stocks that belong to the "other" group, as measured by the mean (median) trading volume and open interest, is higher than in the S&P 600 index and marginally lower than in the S&P 400 index. The "other" portfolio contains a number of higher capitalized Nasdaq 100 stocks, which exhibit high option liquidity. This explains why the average liquidity of options for the "other" portfolio is higher than the S&P 600 portfolio and only slightly lower than the S&P 400 portfolio. Overall, the results show that option liquidity is increasing in market cap, which supports the use of market cap as a proxy for the level of option liquidity. In addition, stocks that constitute the S&P 500 index not only exhibit the highest option liquidity compared to the other three size groups, the mean (median) option trading volume and open interest for firms in this group is more than triple that of the mid-cap S&P400 group. This is consistent with our earlier evidence that the liquidity in the option market is concentrated in the contracts on a small proportion of stocks.

3.3 *Summary statistics on the option-implied volatility spread and skew*

Next, we examine the volatility spread and skew over a short period preceding the split announcement window. This forms the first reference point on which to base expectations on the behavior of the volatility spread and skew. Panel A of Table 3 reports the full sample mean, median and standard deviation of the option-implied volatility spread and skew during the period [-60, -50]. Panel B reports the same information for firms with different market capitalizations.

[Insert Table 3 here]

Similar to Cremers and Weinbaum (2010) and Xing, Zhang and Zhao (2010), the mean and median volatility spread are negative while for the volatility skew, these values are positive. This indicates that the implied volatilities inverted from put options are relatively higher than those for call options, which reflects option investors' greater concern over downside risks. The findings for the different market cap groups are broadly consistent with the full sample. However, it is observed that the absolute value of the volatility spread and skew decreases as market capitalization increases. This implies that put options are more expensive in small firms compared to large firms. This is expected, as smaller firms are more likely to be subject to short-sale constraints, which leads to higher demand for put options. In addition, the absolute value of the volatility spread is lower than the volatility skew. As mentioned in section 2.2, the volatility skew is designed to extract the information in out-of-the-money put options while the volatility spread captures the information in both call and put options. If the difference in implied volatility between call and put options is mainly driven by the put options, then the magnitude of the volatility spread and skew should be similar, they should just have the opposite sign. Thus, the lower absolute value of the volatility spread indicates that these spread differentials are a function of price pressure in both calls and puts. Consistent with Jin, Livnat and Zhang (2012), this suggests that option investors not only trade in anticipation of negative news but also in anticipation of positive news.

Overall, the summary statistics indicate that trading activity in the option market is quite thin. Option liquidity does increase markedly though as one moves up through the market cap groups. Moreover, without the effect of new information, the volatility spread and the volatility skew are not centered on zero. Thus, to evaluate whether option investors expect positive abnormal returns following stock split announcements, we do not study the level of the volatility spread and skew, rather we examine the change in these two measures.

4. Results

4.1 Implied volatility

4.1.1 Full sample

Table 4 reports the change in implied volatility of both call and put options for the full sample during the [-5, +5] period where Day 0 is the split announcement date. Short (long) maturity options are those that expire before (after) the effective date. For call options, both long and short maturity options experience an increase in implied volatility during the announcement period. Moreover, an increase in implied volatility is also observed before the announcement date. For short maturity options, implied volatility starts to rise from Day -3 (ΔIV 0.67%; t-statistic 3.08) with increasing magnitudes every day until Day 0 when it peaks at 1.24 % (t-statistic 4.51). For options that expire after the effective date, the change in implied volatility is positive and significant. It amounts to 0.25% (t-statistic 2.69) and 1.17% (t-statistic 7.87) on Day -2 and Day 0, respectively. Following the announcement date, while short maturity options show some signs of reversion in implied volatility where ΔIV is negative although insignificant, long maturity options experience a further increase of 0.64% (t-statistic 4.57) on Day +1. That is, short maturity call options exhibit a greater increase in implied volatility compared to long maturity call options before the announcement date, after this date, the reverse holds true.

[Insert Table 4 here]

This pattern is even stronger for put options. Prior to the announcement date, short maturity options experience a change in implied volatility of 0.50% (t-statistic 3.51) and 0.67% (t-statistic 4.07) on Day -2 and Day -1, respectively. The greatest change in implied volatility occurs on Day 0, it amounts to 1.56% (t-statistic 7.98). However, this positive change in implied volatility is partly reversed on Day +1, where ΔIV is -0.56% (t-statistic -2.50). For put options that expire after the effective date, there is no clear evidence of an increase in implied volatility before Day 0, as ΔIV is negative on Day -3, (ΔIV -0.13%, t-statistic -2.01) and positive on Day -2 (ΔIV 0.20%, t-statistic 3.00). Upon the arrival of the split announcement, long maturity put options experience a significant increase in implied volatility on Day 0 (1.18%) and Day +1 (0.26%). This suggests that the increase in implied volatility for put options that expire after the effective date tends to persist whereas it does not for those that expire before the effective date.

The above results provide a number of important insights. First, it appears that option investors possess an informational advantage about forthcoming splits. Donders and Vorst (1996) find an increase in option implied volatility in the pre-announcement period for scheduled news. They argue that when the disclosure date is known in advance, a higher level of market uncertainty prior to the release of new information is expected. Stock splits are unscheduled corporate events, yet, the implied volatility for both call and put options starts to rise prior to Day 0. This could suggest that option investors possess a superior ability to predict splits or it could be due to information leakage prior to the announcement. Second, option investors prefer to exploit their advantage using short-dated options. Since short-dated options offer the highest degree of speculation on volatility and jumps in the underlying asset's price,[7] this indicates that option investors are either trying to capture the positive abnormal returns or the higher stock volatility due to a split. Although the question of whether option investors believe in the existence of positive abnormal returns following splits cannot be answered based on implied volatility alone, the fact that put options also experience a rise in implied volatility suggests that they do expect higher stock volatility.

4.1.2 Market capitalization sub-groups

To evaluate the impact of option liquidity on implied volatility, we examine options on firms comprising the S&P 500, S&P 400, and S&P 600 indices plus all "other" stocks. The daily change in implied volatility is only reported over the [-2, +2] period in order to conserve space.[8] An examination of Table 5 shows that short maturity options continue to exhibit a stronger increase in implied volatility prior to the announcement date compared to long maturity options. Across the four size groups, both the short maturity call and put options consistently show a significantly positive change in implied volatility on either Day -2 or Day -1, or on both days. For long maturity options though, the evidence is much weaker. Specifically, only the long maturity call options on the "other" group show a significantly positive change in implied volatility prior to the announcement date (Day -2). For the remaining three size groups, while the change in implied volatility is often positive and occasionally significant at the 10 percent level, the magnitude is much smaller. On Day 0, all options regardless of time to maturity and market cap show a significant increase in implied volatility. In sum, the changes in implied volatility across different market

[7] Short-dated options are more exposed to changes in short-term volatility, as the mean-reversion in stock volatility results in the implied volatility of long-dated options being more stable. Moreover, the option gamma, which reflects jump risk(s), is greatest for short dated options.

[8] Outside of the [-2, +2] window, that is for Day -5, -4, -3, +3, +4 and +5, the change in implied volatility is insignificant for all size groups.

capitalization groups on and prior to the announcement date conforms with the behavior in the full sample.

[Insert Table 5 here]

Following this date, the change in implied volatility varies with market capitalization. For call options on the largest cap group (S&P 500 index), the change in implied volatility does not significantly differ from zero for both short and long maturity options. Meanwhile, there is a noticeable difference in the behavior of implied volatility for put options on this group. Specifically, whereas the short maturity put options experience a significant reduction in implied volatility on Day +1 (ΔIV -1.13% t-statistic -3.04), long maturity options do not. For options on stocks that belong to the S&P 400 index, the change in implied volatility on both calls and puts regardless of time to maturity is not significantly different from zero. Finally, options on small cap stocks and the "other" group exhibit a similar change in implied volatility. For these two groups, the change in implied volatility for both short maturity call and put options is insignificant. Long maturity call options show a further increase on Day +1 for the S&P 600 and "other" group. For the puts, implied volatility significantly increases on Day +1 (Day +2) for the S&P 600 ("other") group.

In summary, the behavior of option-implied volatility prior to the announcement date for firms with different market capitalizations suggests that option investors possess information about the occurrence of a stock split before it is officially announced. Given that the increase in implied volatility is observed in all market cap groups, it is unlikely that this is due to option investors predicting impending split announcements solely based on publicly available information. Our findings are thus suggestive of option investors trading on private information. Following the split announcement, the change in implied volatility supports Ohlson and Penman (1985) and Dravid's (1987) conjecture of an increase in stock volatility after the effective date. Across all market cap groups, long maturity options experience a stronger increase in implied volatility compared to short maturity options. However, the higher implied volatility observed in both short and long maturity options might be due to informed investors using options for speculative reasons to bet on a directional change in future stock prices rather than on volatility changes. If so, this would be consistent with An, Ang, Bali and Cakici (2013) who find that changes in implied volatility predict future returns. Thus, there is a need to distinguish whether changes in option-implied volatility reflect a change in investors' perceptions on the volatility or returns of the underlying stock. This leads to our final tests, which are the analysis of the option-implied volatility spread and skew.

4.2 Volatility spread and volatility skew

A positive (negative) change in the volatility spread (skew) prior to the announcement date suggests that option investors possess private information about the coming event and that they believe they can earn positive abnormal returns during the announcement period. A significant change in these two measures on or after Day 0 reflects option investors' interpretation of the event, and whether they anticipate positive return drift following the split announcement. Although it is possible that the behavior of the volatility spread and skew prior to Day 0 reflects the belief of option investors regarding both the announcement and long-run returns, we contend that it is more likely to be associated with the announcement returns. Our reasoning is as follows: Prior to day 0, option investors are likely to be speculating on whether splits will occur. They will probably close their positions shortly after the information becomes public. Their risks would be much greater if they are betting on long-run returns before the splits are announced rather than waiting for the formal announcement.

4.2.1 Full sample

Table 6 presents the change in the volatility spread and skew during the period [5, +5]. Prior to the announcement date, there is virtually no evidence of a positive (negative) change in the volatility spread (skew) for both long and short maturity options. The change in the volatility spread for short maturity options is positive and significant at 10 percent on Day -5 (ΔIV 0.23%, t-statistic 1.83). However, we are cautious in interpreting this as evidence of option investors believing that they can profit from any abnormal returns generated once splits are announced. This is because the magnitude of this increase is quite small and Day -5 is relatively far from the announcement day. According to Skinner (1997), informed investors tend to exploit their informational advantage immediately before the event. The fact that we do not observe a significantly positive change in any other days prior to Day 0 suggests that it is unlikely that option investors believe that they can profit from price reactions on impending split announcements. Chern, Tandon, Yu and Webb (2008) find that although significant, the positive abnormal return on the day before the announcement is significantly less for optioned stocks compared to non-optioned stocks. This could in part explain the trading behavior of option investors prior to the announcement. However, on the announcement date, the abnormal return for both groups is of similar magnitude and is significant.

[Insert Table 6 here]

Next, we shift our attention to the volatility spread and skew after the announcement date. This allows us to gain insights on the way informed investors process the information contained in the split. For the volatility spread, while we do not observe a significantly positive change in the volatility spread on Day 0, the change in the volatility spread is positive and significant on Day +1 for the long-dated options (0.31 percent, t-statistic 2.41). The volatility skew starts to decrease on Day 0 ($\Delta SKEW$ -0.14 percent, t-statistic -1.71) and shows a stronger reduction on Day +1 ($\Delta SKEW$ -0.19 percent, t-statistic -2.27). As mentioned in section 2, the volatility spread and skew are constructed differently, yet, both of these measures are significant on Day +1 for the same type of options (long maturity options). This indicates that the results are robust to different methods of extracting the opinions of option investors. Overall, we find some evidence of option investors trading in the option market in anticipation of positive post-announcement abnormal returns. In addition, the fact that it is the long maturity options that experience a significantly positive (negative) change in the volatility spread (skew) perhaps suggests that option investors believe that the drift exists over the longer term.

4.2.2 Market capitalization sub-groups

Table 7 reports the change in the volatility spread (skew) for options on firms with different market capitalizations. The purpose of this analysis is twofold: First, to evaluate the robustness of the above findings at varying levels of option liquidity and second, to shed light on which (if any) of the groups of stocks option investors believe that they can make money from.

[Insert Table 7 here]

Table 7 shows that for options on the most liquid stocks (i.e., constituents of the S&P 500 index), we do not observe a significantly positive (negative) change in the volatility spread (skew) on any day during the [-2, +2] window.[9] In fact, long maturity options on stocks on this group actually exhibit a negative and significant change in the volatility spread on the announcement date (ΔVS -0.44%, t-statistics -2.06). The change in the volatility skew on these options is positive on this date, although insignificant. This

[9] In the broader [-5, +5] window, the change in the volatility spread is significant and positive on Day +4 for S&P 500 long maturity options. This suggests some reversal of the significant negative change in the volatility spread observed on Day 0. As for the change in the volatility skew, it is positive and significant on Day -3 for the short S&P 500 options. Additionally, ΔSKEW is significantly negative for the long maturity S&P 400 options and the short maturity "Other" options on Day -3 and Day -4, respectively. These few significant changes in spreads and skews do not affect the inferences reached in this section.

indicates that option investors do not expect positive long-run abnormal returns in the large cap group.

For the mid-cap group, we observe a positive and significant change in the volatility spread for short maturity options on Day -1 (ΔVS 0.90 percent, t-statistic 3.25). The volatility skew for the same type of option is negative although insignificant. Since the positive change in the volatility spread is observed prior to Day 0 in short-dated options, we interpret this as evidence of informed investors believing that positive abnormal returns could be earned during the announcement window for this particular group of stocks. Finally, the behavior of the volatility spread and skew for the small cap and "other" groups are quite similar. Specifically, both groups experience a significantly negative change in the volatility skew on the announcement date, $\Delta SKEW$ amounts to -0.59 percent (t-statistic -3.03) and -0.27 percent (t-statistic -1.91) for stocks that constitute the S&P 600 index and the "other" group, respectively. Since the option liquidity on these two groups is rather low, we are cautious in concluding that option investors believe in the existence of post-announcement abnormal returns for small stocks and those that are not constituents of the S&P 1500 index. Subsequent to Day 0, while the change in the volatility skew for the "other" group is insignificant, options on the small cap group show a significantly positive change in the volatility skew on Day +2 (0.34 percent, t-statistic 2.56).

In summary, option investors seem to be aware of impending split announcements, yet, the volatility spread and skew are insignificant prior to Day 0. Thus, option investors do not appear to be trading in anticipation of positive abnormal returns upon the announcement. While it is widely accepted in academic research that the market reacts positively to a split, the abnormal returns are probably not large enough to induce option investors to participate. Once the split information becomes public, the behavior of the option-implied volatility spread and skew varies with firms' market capitalizations. The findings on the full sample in section 4.2.1 are robust to different methods of extracting the belief of informed investors, but they are not robust to different levels of option liquidity. We do observe significantly negative changes in the volatility skew on the announcement date for options on smaller stocks, which could suggest that informed investors expect positive return drift. However, since the option liquidity for these groups is low, the change in the volatility skew is more likely to be due to market makers adjusting bid-ask spreads rather than trading by informed option investors.

5. Sensitivity to simultaneous information releases

When splits are announced, it is common for firms to announce other information simultaneously. As an example, for around 30 percent of our sample, stock splits and cash dividends are concurrently announced. To test the robustness of our findings, we repeat the analysis for firms that do not have a simultaneous release of other information during the period [-10, +10] around the announcement date. The results are reported in Table 8. To conserve space, we do not separate the sample into firms that belong to the S&P 500, S&P400, S&P 600 and the “other” group.

[Insert Table 8 here]

The behavior of option implied volatility, and the volatility spread and skew are consistent with our earlier results. There is evidence of an increase in implied volatility in both call and put options prior to Day 0. Once the split is announced, the increase in implied volatility is stronger and more persistent for options that expire after the effective date. With regard to the volatility spread and skew, once again, we see a significantly positive (negative) change in the volatility spread (skew) on Day +1. In unreported results, we find that this significant change is mainly driven by stocks that belong to the S&P 600 index and the “other” group. In sum, our findings are robust to the simultaneous release of other information.

6. Conclusion

Studying the perception of informed investors around stock split announcements provides an opportunity to assess the value of the information contained in splits. If informed investors migrate to the option market due to leverage and the ability to avoid short sale restrictions, then by examining a single option measure, namely option-implied volatility, we are able to draw inferences on the belief of informed investors regarding both future stock returns and volatility. Our findings indicate that option investors do not expect a significant change in the returns of the underlying stock because of a split. Although prior studies have reached a general consensus that the market reacts positively to split announcements, the trading activity of option investors prior to the announcement suggests that they are not trying to capture these returns. Once the information becomes public, their behavior also does not strongly suggest an upward drift in the stock price of splitting firms. While there is some evidence of a significantly positive (negative) change in the volatility spread (skew) for the full sample, this finding is not robust at different levels of option liquidity and is not observed in the most liquid options. The results indicate that trading by option investors is largely motivated by their expectations on future changes in stock volatility. Prior to the announcement, they employ short-dated options to speculate on future volatility changes due to impending split announcements. Once splits are announced, their trades reflect an expectation of an increase in volatility after the effective date. These views of option investors on the information content of splits can help inform the broader market.

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Table 1: Summary statistics on option liquidity and implied volatility

This table reports the liquidity and implied volatility for both call and put options at different levels of moneyness for the 10 day period [-60 to -50] where Day 0 is the split announcement date. The option's degree of moneyness is measured using option delta, which is the risk-neutral probability of the option being in-the-money at expiration. Panel A reports the mean/median volume (VOL), open interest (OI) and implied volatility (IV) for call options while panel B reports the same information for put options. The sample period is 1998-2012.

Panel A: Call options

Moneyness index	Option delta	Mean OI	Median OI	Mean Vol	Median Vol	Mean IV
Deep out-of-the-money	0.02<delta<=0.125	1480	287	91	2	0.5521
Out-of-the-money	0.125<delta<=0.375	940	151	114	5	0.5240
At-the-money	0.375<delta<=0.625	825	139	117	7	0.5538
In-the-money	0.625<delta<=0.875	649	89	50	0	0.5601
Deep in-the-money	0.875<delta<=0.98	444	45	13	0	0.6462

Panel B: Put options

Moneyness index	Option delta	Mean OI	Median OI	Mean Vol	Median Vol	Mean IV
Deep out-of-the-money	-0.125<delta<=-0.02	1068	201	49	0	0.6716
Out-of-the-money	-0.375<delta<=-0.125	676	80	71	0	0.5853
At-the-money	-0.625<delta<=-0.375	380	25	50	0	0.5682
In-the-money	-0.875<delta<=-0.625	213	6	17	0	0.5341
Deep in-the-money	-0.98<delta<=-0.875	161	0	6	0	0.5840

Table 2: Summary statistics on option liquidity and implied volatility for firms with different market capitalizations

This table reports the liquidity and implied volatility for call and put options on stocks that belong to the S&P 500 (large cap stocks), S&P 400 (mid cap stocks) and S&P 600 indices (small cap stocks), and “other” stocks (stocks that are not part of any of these three indices). Panel A reports the mean/median volume (VOL), open interest (OI), and the average implied volatility for call options during the period [-60 to -50] where Day 0 is the split announcement date. Panel B reports the same information for put options. The sample period is 1998-2012.

Panel A: Call options

Index	Option delta	Mean OI	Median OI	Mean Vol	Median Vol	Mean IV
S&P 500	0.02<delta<=0.125	2625	638	151	12	0.3940
	0.125<delta<=0.375	2179	557	261	29	0.3802
	0.375<delta<=0.625	2077	594	293	34	0.3982
	0.625<delta<=0.875	1616	359	124	5	0.4149
	0.875<delta<=0.98	1001	165	29	0	0.5289
S&P400	0.02<delta<=0.125	801	264	56	0	0.5127
	0.125<delta<=0.375	532	134	61	2	0.4811
	0.375<delta<=0.625	522	142	70	5	0.5019
	0.625<delta<=0.875	403	88	25	0	0.5000
	0.875<delta<=0.98	222	30	6	0	0.6117
S&P 600	0.02<delta<=0.125	197	74	14	0	0.5972
	0.125<delta<=0.375	226	50	24	0	0.5115
	0.375<delta<=0.625	219	53	25	0	0.5140
	0.625<delta<=0.875	167	35	11	0	0.5206
	0.875<delta<=0.98	106	12	3	0	0.6209
Other	0.02<delta<=0.125	629	166	50	0	0.7787
	0.125<delta<=0.375	401	95	57	1	0.6962
	0.375<delta<=0.625	371	88	60	5	0.7140
	0.625<delta<=0.875	300	56	27	0	0.7249
	0.875<delta<=0.98	230	36	9	0	0.8054

Panel B: Put options

Index	Option delta	Mean OI	Median OI	Mean Vol	Median Vol	Mean IV
S&P 500	-0.125<delta<=-0.02	2219	751	93	3	0.5094
	-0.375<delta<=-0.125	1691	455	167	13	0.4247
	-0.625<delta<=-0.375	995	169	130	6	0.4075
	-0.875<delta<=-0.625	517	48	43	0	0.4010
	-0.98<delta<=-0.875	360	10	13	0	0.4455
S&P400	-0.125<delta<=-0.02	525	134	22	0	0.6101
	-0.375<delta<=-0.125	399	78	43	0	0.5247
	-0.625<delta<=-0.375	223	24	29	0	0.5109
	-0.875<delta<=-0.625	110	4	9	0	0.4794
	-0.98<delta<=-0.875	54	0	4	0	0.5281
S&P 600	-0.125<delta<=-0.02	288	59	12	0	0.6391
	-0.375<delta<=-0.125	168	30	18	0	0.5458
	-0.625<delta<=-0.375	94	10	10	0	0.5212
	-0.875<delta<=-0.625	60	0	4	0	0.5001
	-0.98<delta<=-0.875	22	0	1	0	0.6178
Other	-0.125<delta<=-0.02	397	105	27	0	0.8678
	-0.375<delta<=-0.125	271	42	37	0	0.7611
	-0.625<delta<=-0.375	156	11	23	0	0.7358
	-0.875<delta<=-0.625	102	1	8	0	0.7066
	-0.98<delta<=-0.875	85	0	3	0	0.7883

Table 3: Summary statistics on the volatility spread and skew

This table outlines the distribution of the volatility spread and skew for the period [-60 to -50] where Day 0 is the split announcement date. Panel A reports the summary statistics for the full sample while Panel B reports the same information for each market capitalization group. The volatility spread is calculated as the weighted average of the difference in implied volatility across all valid call and put options pairs matched on the same strike price and maturity date. The weight is the average open interest of the call and put options. The volatility skew is the difference in implied volatility of out-of-the-money put and at-the-money call options. Out-of-the-money put options are those with delta closest to -0.3 and at-the-money call options are those with delta closest to 0.5. The sample period is 1998-2012.

Panel A: Full sample

		Volatility spread	Volatility skew
	Mean	-0.0174	0.0318
	25 percentile	-0.0294	0.0024
	Median	-0.0089	0.0214
	75 percentile	0.0035	0.0440
	Standard deviation	0.0556	0.0415

Panel B: Different market capitalizations

Index		Volatility spread	Volatility skew
S&P 500	Mean	-0.0084	0.0239
	25 percentile	-0.0175	0.0035
	Median	-0.0054	0.0184
	75 percentile	0.0039	0.0341
	Standard deviation	0.0353	0.0262
S&P 400	Mean	-0.0097	0.0293
	25 percentile	-0.0217	0.0035
	Median	-0.0059	0.0215
	75 percentile	0.0056	0.0419
	Standard deviation	0.0438	0.0351
S&P 600	Mean	-0.0132	0.0327
	25 percentile	-0.0258	0.0008
	Median	-0.0073	0.0226
	75 percentile	0.0059	0.0463
	Standard deviation	0.0497	0.0415
Other	Mean	-0.0258	0.0398
	25 percentile	-0.0465	0.0017
	Median	-0.0165	0.0265
	75 percentile	0.0019	0.0575
	Standard deviation	0.0633	0.0520

Table 4: Implied volatility around stock split announcements

This table reports the change in implied volatility for call and put options around the split announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. The event window is [-5, +5] where Day 0 is the announcement date. The sample period is 1998-2012. Numbers in parentheses are the t-statistic of the means. *,** indicate significance at the 10% and 5% level, respectively.

	Call		**Put**	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0035*	0.0014	0.0021	0.0012*
	(1.75)	*(1.20)*	*(1.62)*	*(1.75)*
-4	-0.0002	-0.0002	0.0023*	0.0008
	(-0.08)	*(-0.17)*	*(1.70)*	*(1.03)*
-3	0.0067**	-0.0012	0.0019	-0.0013**
	(3.08)	*(-1.08)*	*(1.37)*	*(-2.01)*
-2	0.0089**	0.0025**	0.0050**	0.0020**
	(3.57)	*(2.69)*	*(3.52)*	*(3.00)*
-1	0.0084**	0.0015	0.0067**	-0.0004
	(3.54)	*(1.48)*	*(4.07)*	*(-0.61)*
0	0.0124**	0.0117**	0.0156**	0.0118**
	(4.51)	*(7.87)*	*(7.98)*	*(11.74)*
1	-0.0025	0.0064**	-0.0056**	0.0026**
	(-0.94)	*(4.57)*	*(-2.50)*	*(2.41)*
2	0.0030	-0.0004	0.0015	-0.0003
	(1.04)	*(-0.34)*	*(0.70)*	*(-0.40)*
3	0.0049	0.0000	0.0023	0.0012
	(1.63)	*(0.04)*	*(1.31)*	*(1.63)*
4	0.0014	-0.0009	0.0026	-0.0001
	(0.56)	*(-0.91)*	*(1.47)*	*(-0.14)*
5	0.0010	-0.0001	0.0016	0.0007
	(0.35)	*(-0.14)*	*(0.83)*	*(1.04)*

Table 5: Implied volatility for firms with different market capitalizations

This table reports the change in implied volatility for call and put options on stocks that belong to the S&P 500, S&P 400 and S&P 600 indices, and the "other" group (stocks that do not constitute any of the three indices). The event window is [-2, +2] where Day 0 is the split announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. The sample period is 1998-2012. *, ** indicate significance at the 10% and 5% level, respectively.

		Call		**Put**	
Index	Day	Short maturity	Long maturity	Short maturity	Long maturity
S&P 500	-2	0.0068*	0.0009	0.0056**	0.0029*
		(1.91)	*(0.52)*	*(2.66)*	*(1.89)*
	-1	0.0012	0.0017	0.0049**	-0.0013
		(0.37)	*(1.14)*	*(2.48)*	*(-0.96)*
	0	0.0084**	0.0051**	0.0138**	0.0115**
		(2.39)	*(2.18)*	*(3.70)*	*(6.68)*
	1	-0.0058	0.0031	-0.0113**	-0.0018
		(-1.36)	*(1.37)*	*(-3.04)*	*(-1.08)*
	2	0.0016	-0.0005	-0.0004	-0.0019
		(0.34)	*(-0.24)*	*(-0.13)*	*(-1.12)*
S&P 400	-2	0.0021	0.0018	0.0053**	0.0011
		(0.50)	*(1.04)*	*(2.27)*	*(0.96)*
	-1	0.0094**	0.0020	0.0012	-0.0005
		(2.07)	*(0.82)*	*(0.45)*	*(-0.45)*
	0	0.0108**	0.0122**	0.0151**	0.0106**
		(2.66)	*(3.75)*	*(3.98)*	*(6.22)*
	1	-0.0006	0.0028	-0.0011	0.0022
		(-0.11)	*(1.05)*	*(-0.36)*	*(1.35)*
	2	-0.0031	-0.0014	0.0019	0.0003
		(-0.79)	*(-0.63)*	*(0.43)*	*(0.24)*
S&P 600	-2	0.0145**	0.0036*	0.0020	0.0010
		(2.80)	*(1.80)*	*(0.58)*	*(0.77)*
	-1	0.0051	0.0007	0.0095**	-0.0003
		(1.00)	*(0.34)*	*(2.68)*	*(-0.22)*
	0	0.0142**	0.0131**	0.0137**	0.0093**
		(2.54)	*(4.60)*	*(3.19)*	*(4.48)*
	1	0.0043	0.0075**	-0.0010	0.0021
		(0.76)	*(3.14)*	*(-0.20)*	*(1.23)*
	2	0.0014	0.0003	0.0084*	0.0043**
		(0.20)	*(0.13)*	*(1.87)*	*(3.14)*
Other	-2	0.0116*	0.0034*	0.0066**	0.0029**
		(1.94)	*(1.77)*	*(2.06)*	*(2.10)*
	-1	0.0164**	0.0017	0.0102**	0.0002
		(2.99)	*(0.85)*	*(2.52)*	*(0.15)*
	0	0.0159**	0.0151**	0.0189**	0.0146**
		(2.25)	*(4.88)*	*(5.00)*	*(6.79)*
	1	-0.0057	0.0104**	-0.0070	0.0062**
		(-1.04)	*(3.25)*	*(-1.34)*	*(2.40)*
	2	0.0099	-0.0002	-0.0024	-0.0031*
		(1.58)	*(-0.09)*	*(-0.52)*	*(-1.79)*

Table 6: Volatility spread and volatility skew around stock split announcements

This table reports the change in the option-implied volatility spread and skew. The volatility spread is calculated as the weighted average difference in implied volatility between call and put options matched on the same strike price and maturity date. The weight is the average open interest of the call and put options. The volatility skew is the difference in implied volatility between out-of-the-money put options and at-the-money call options. An out-of-the-money put option is one whose delta is closest to -0.3 and an at-the-money call option is one whose delta is closest to 0.5. The event window is [-5, +5] where Day 0 is the announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. The sample period is 1998-2012. *, ** indicate significance at the 10% and 5% level, respectively.

	Volatility spread		**Volatility skew**	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0007	0.0023*	-0.0003	-0.0007
	(0.46)	*(1.83)*	*(-0.26)*	*(-0.90)*
-4	-0.0004	-0.0012	-0.0020	-0.0005
	(-0.25)	*(-1.22)*	*(-1.57)*	*(-0.83)*
-3	0.0002	-0.0003	0.0013	0.0001
	(0.14)	*(-0.35)*	*(1.18)*	*(0.11)*
-2	-0.0003	0.0007	-0.0003	-0.0007
	(-0.16)	*(0.71)*	*(-0.21)*	*(-1.04)*
-1	0.0023	0.0003	-0.0016	0.0007
	(1.49)	*(0.28)*	*(-1.44)*	*(1.07)*
0	-0.0015	0.0007	0.0002	-0.0014*
	(-0.78)	*(0.50)*	*(0.18)*	*(-1.71)*
1	0.0002	0.0031**	-0.0002	-0.0019**
	(0.11)	*(2.41)*	*(-0.13)*	*(-2.27)*
2	-0.0004	0.0002	0.0002	0.0003
	(-0.19)	*(0.18)*	*(0.14)*	*(0.40)*
3	-0.0007	-0.0011	0.0010	0.0004
	(-0.40)	*(-1.03)*	*(0.86)*	*(0.66)*
4	0.0002	-0.0007	-0.0011	0.0004
	(0.11)	*(-0.72)*	*(-0.84)*	*(0.70)*
5	-0.0035**	-0.0013	-0.0012	0.0009
	(-2.05)	*(-1.29)*	*(-1.09)*	*(1.35)*

Table 7: Volatility spread and volatility skew around stock split announcements for firms with different market capitalizations

This table reports the change in the option-implied volatility spread and skew on stocks that belong the S&P 500, S&P 400 and S&P 600 indices, and the "other" group (stocks that do not constitute any of the three indices). The event window is [-2, +2] where Day 0 is the split announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. The sample period is 1998-2012. *, ** indicate significance at the 10% and 5% level, respectively.

		Volatility spread		**Volatility skew**	
Index	Day	Short maturity	Long maturity	Short maturity	Long maturity
S&P 500	-2	-0.0003	0.0001	-0.0009	-0.0015
		(-0.08)	*(0.04)*	*(-0.49)*	*(-1.43)*
	-1	-0.0009	-0.0005	-0.0008	0.0008
		(-0.44)	*(-0.32)*	*(-0.51)*	*(0.68)*
	0	-0.0021	-0.0044**	0.0016	0.0019
		(-0.77)	*(-2.06)*	*(0.68)*	*(1.21)*
	1	0.0019	0.0040	-0.0022	-0.0027
		(0.57)	*(1.74)**	*(-0.79)*	*(-1.56)*
	2	0.0004	-0.0006	-0.0004	0.0003
		(0.14)	*(-0.28)*	*(-0.22)*	*(0.30)*
S&P 400	-2	-0.0015	0.0001	0.0031	-0.0010
		(-0.67)	*(0.10)*	*(1.04)*	*(-0.87)*
	-1	0.0090**	0.0014	-0.0041	0.0006
		(3.25)	*(0.73)*	*(-1.55)*	*(0.49)*
	0	-0.0025	-0.0005	-0.0008	0.0013
		(-0.70)	*(-0.22)*	*(-0.36)*	*(0.90)*
	1	-0.0035	0.0025	0.0023	-0.0019
		(-0.90)	*(1.13)*	*(0.74)*	*(-1.15)*
	2	-0.0005	-0.0009	-0.0022	0.0005
		(-0.17)	*(-0.50)*	*(-0.73)*	*(0.32)*
S&P 600	-2	-0.0008	0.0019	-0.0026	0.0001
		(-0.22)	*(1.02)*	*(-0.89)*	*(0.09)*
	-1	0.0032	0.0007	-0.0006	0.0002
		(0.87)	*(0.33)*	*(-0.21)*	*(0.10)*
	0	-0.0020	0.0018	-0.0045	-0.0059**
		(-0.53)	*(0.77)*	*(-1.50)*	*(-3.03)*
	1	0.0024	0.0038	0.0007	-0.0020
		(0.53)	*(1.44)*	*(0.18)*	*(-1.03)*
	2	-0.0068*	-0.0014	0.0035	0.0034**
		(-1.78)	*(-0.69)*	*(1.07)*	*(2.56)*
Other	-2	0.0010	0.0006	-0.0004	-0.0004
		(0.25)	*(0.32)*	*(-0.16)*	*(-0.32)*
	-1	-0.0001	-0.0002	-0.0015	0.0011
		(-0.03)	*(-0.09)*	*(-0.67)*	*(0.87)*
	0	0.0001	0.0044	0.0022	-0.0027*
		(0.02)	*(1.39)*	*(0.79)*	*(-1.91)*
	1	-0.0002	0.0023	-0.0002	-0.0012
		(-0.04)	*(0.85)*	*(-0.07)*	*(-0.83)*
	2	0.0032	0.0027	0.0006	-0.0019
		(0.74)	*(1.04)*	*(0.17)*	*(-1.36)*

Table 8: Sensitivity to simultaneous information releases

This table reports the change in option implied volatility, volatility spread and volatility skew for the subset of firms that do not have a simultaneous release of other information during the period [-10, +10] where Day 0 is the split announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. The sample period is 1998-2012. *, ** indicate significance at the 10% and 5% level, respectively. Panel A depicts the change in option implied volatility while Panel B reports the change in option volatility spread and volatility skew.

Panel A: Implied volatility around stock split announcements

	Call		**Put**	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0052*	0.0025	0.0020	0.0006
	(1.91)	*(1.65)*	*(1.16)*	*(0.65)*
-4	-0.0001	-0.0004	0.0029*	0.0010
	(-0.03)	*(-0.27)*	*(1.69)*	*(0.99)*
-3	0.0089**	-0.0010	0.0017	-0.0013
	(3.31)	*(-0.67)*	*(0.91)*	*(-1.55)*
-2	0.0120**	0.0039**	0.0055**	0.0033**
	(3.65)	*(3.23)*	*(3.01)*	*(3.40)*
-1	0.0075**	0.0011	0.0065**	-0.0003
	(2.38)	*(0.87)*	*(3.06)*	*(-0.36)*
0	0.0129**	0.0118**	0.0165**	0.0106**
	(3.44)	*(6.28)*	*(6.49)*	*(8.54)*
1	-0.0043	0.0070**	-0.0085**	0.0031**
	(-1.28)	*(3.92)*	*(-2.94)*	*(2.23)*
2	0.0034	-0.0004	0.0009	-0.0007
	(0.94)	*(-0.27)*	*(0.34)*	*(-0.67)*
3	0.0051	0.0010	0.0022	0.0019**
	(1.26)	*(0.59)*	*(0.91)*	*(1.98)*
4	0.0019	-0.0017	0.0029	0.0001
	(0.58)	*(-1.38)*	*(1.19)*	*(0.07)*
5	0.0057	0.0012	0.0048*	0.0007
	(1.47)	*(0.90)*	*(1.82)*	*(0.75)*

Panel B: Volatility spread and volatility skew around stock split announcements

	Volatility spread		Volatility skew	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0010	0.0035**	-0.0006	-0.0012
	(0.60)	*(2.48)*	*(-0.50)*	*(-1.33)*
-4	-0.0009	-0.0010	-0.0016	-0.0006
	(-0.57)	*(-1.01)*	*(-1.29)*	*(-0.93)*
-3	0.0003	-0.0004	0.0016	0.0001
	(0.21)	*(-0.44)*	*(1.46)*	*(0.19)*
-2	-0.0001	0.0004	-0.0004	-0.0005
	(-0.05)	*(0.45)*	*(-0.35)*	*(-0.82)*
-1	0.0024	0.0004	-0.0014	0.0007
	(1.57)	*(0.42)*	*(-1.27)*	*(0.97)*
0	-0.0015	0.0009	0.0002	-0.0011
	(-0.76)	*(0.64)*	*(0.13)*	*(-1.40)*
1	0.0013	0.0031**	-0.0012	-0.0020**
	(0.65)	*(2.49)*	*(-0.82)*	*(-2.53)*
2	-0.0007	0.0002	0.0010	0.0004
	(-0.40)	*(0.21)*	*(0.80)*	*(0.66)*
3	-0.0008	-0.0010	0.0015	0.0003
	(-0.45)	*(-0.92)*	*(1.30)*	*(0.41)*
4	0.0004	-0.0009	-0.0021*	0.0006
	(0.26)	*(-0.88)*	*(-1.67)*	*(1.04)*
5	-0.0033**	-0.0005	-0.0011	0.0009
	(-1.97)	*(-0.50)*	*(-0.94)*	*(1.29)*

Appendix A: Summary statistics for the change in option implied volatility, volatility spread and volatility skew

This table reports the mean, median, standard deviation, skewness and kurtosis of the change in option implied volatility, volatility spread and volatility skew during the period [-100, -20] where Day 0 is the split announcement date. Numbers in parentheses are the t-statistic of the means.

	Δ*IV* Call	**Δ*IV* Put**	**Δ*VS***	**Δ*SKEW***
Mean	-0.000036	-0.000060	-0.000016	-0.000041
	(-0.24)	*(-0.57)*	*(-0.11)*	*(-0.35)*
Median	-0.000330	-0.000311	0.000046	0.000032
Standard Deviation	0.054	0.038	0.051	0.038
Skewness	-0.086	0.810	0.066	0.811
Kurtosis	64	102	128	146

Appendix B: Abnormal change in implied volatility around stock split announcements

This table reports the abnormal change in implied volatility for call and put options around the split announcement date. The abnormal change in implied volatility is the change in implied volatility during the event window less the expected change in implied volatility. The expected change in implied volatility is estimated using the average change in implied volatility during the period [-100, -20] where Day 0 is the announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. Numbers in parentheses are the t-statistic of the means. *,** indicate significance at the 10% and 5% level, respectively

	Call		**Put**	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0037*	0.0016	0.0019	0.0009
	(1.79)	*(1.31)*	*(1.46)*	*(1.34)*
-4	-0.0003	-0.0001	0.0025*	0.0012
	(-0.16)	*(-0.10)*	*(1.83)*	*(1.60)*
-3	0.0069**	-0.0008	0.0020	-0.0010
	(3.14)	*(-0.71)*	*(1.43)*	*(-1.51)*
-2	0.0090**	0.0027**	0.0052**	0.0023**
	(3.55)	*(2.76)*	*(3.65)*	*(3.34)*
-1	0.0081**	0.0018*	0.0062**	-0.0004
	(3.38)	*(1.69)*	*(3.79)*	*(-0.60)*
0	0.0124**	0.0115**	0.0152**	0.0116**
	(4.42)	*(7.53)*	*(7.76)*	*(11.41)*
1	-0.0016	0.0065**	-0.0056**	0.0025**
	(-0.61)	*(4.58)*	*(-2.49)*	*(2.35)*
2	0.0032	-0.0005	0.0016	-0.0003
	(1.10)	*(-0.40)*	*(0.78)*	*(-0.37)*
3	0.0041	0.0001	0.0023	0.0014*
	(1.40)	*(0.10)*	*(1.28)*	*(1.88)*
4	0.0011	-0.0009	0.0031*	0.0001
	(0.45)	*(-0.86)*	*(1.68)*	*(0.13)*
5	0.0020	0.0004	0.0016	0.0006
	(0.69)	*(0.35)*	*(0.81)*	*(0.95)*

Appendix C: Abnormal change in implied volatility for firms with different market capitalizations

This table reports the abnormal change in implied volatility for options on stocks that belong to the S&P 500, S&P 400 and S&P 600 indices, and the "other" group (stocks that do not constitute any of the three indices). The abnormal change in implied volatility is the change in implied volatility during the event window less the expected change in implied volatility. The expected change in implied volatility is estimated using the average change in implied volatility during the period [-100, -20] where Day 0 is the announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. Numbers in parentheses are the t-statistic of the means. *,** indicate significance at the 10% and 5% level, respectively

		Call		Put	
Index	Day	Short maturity	Long maturity	Short maturity	Long maturity
S&P 500	-2	0.0065*	0.0009	0.0057**	0.0030**
		(1.81)	*(0.50)*	*(2.68)*	*(1.96)*
	-1	0.0012	0.0017	0.0049**	-0.0013
		(0.39)	*(1.14)*	*(2.47)*	*(-0.99)*
	0	0.0080**	0.0046*	0.0139**	0.0113**
		(2.27)	*(1.93)*	*(3.70)*	*(6.53)*
	1	-0.0059	0.0031	-0.0115**	-0.0018
		(-1.36)	*(1.37)*	*(-3.06)*	*(-1.07)*
	2	0.0017	-0.0005	-0.0004	-0.0018
		(0.37)	*(-0.23)*	*(-0.13)*	*(-1.07)*
S&P 400	-2	0.0031	0.0016	0.0053**	0.0013
		(0.72)	*(0.92)*	*(2.27)*	*(1.09)*
	-1	0.0081*	0.0020	0.0015	-0.0002
		(1.79)	*(0.81)*	*(0.56)*	*(-0.23)*
	0	0.0108**	0.0116**	0.0140**	0.0101**
		(2.71)	*(3.57)*	*(3.73)*	*(5.95)*
	1	0.0017	0.0027	-0.0002	0.0024
		(0.32)	*(1.03)*	*(-0.08)*	*(1.44)*
	2	-0.0033	-0.0012	0.0020	0.0003
		(-0.82)	*(-0.57)*	*(0.46)*	*(0.23)*
S&P 600	-2	0.0139**	0.0037*	0.0026	0.0013
		(2.69)	*(1.83)*	*(0.76)*	*(1.03)*
	-1	0.0060	0.0012	0.0078**	-0.0004
		(1.18)	*(0.58)*	*(2.40)*	*(-0.30)*
	0	0.0136**	0.0127**	0.0137**	0.0090**
		(2.41)	*(4.41)*	*(3.16)*	*(4.37)*
	1	0.0062	0.0081**	-0.0029	0.0017
		(1.10)	*(3.43)*	*(-0.63)*	*(1.05)*
	2	0.0010	0.0003	0.0081*	0.0043**
		(0.14)	*(0.11)*	*(1.78)*	*(3.09)*
Other	-2	0.0120*	0.0039*	0.0069**	0.0034**
		(1.92)	*(1.94)*	*(2.09)*	*(2.31)*
	-1	0.0159**	0.0021	0.0097**	0.0002
		(2.81)	*(0.99)*	*(2.31)*	*(0.12)*
	0	0.0165**	0.0154**	0.0185**	0.0147**
		(2.26)	*(4.76)*	*(4.84)*	*(6.60)*
	1	-0.0059	0.0104**	-0.0060	0.0064**
		(-1.05)	*(3.14)*	*(-1.12)*	*(2.38)*
	2	0.0112*	-0.0005	-0.0017	-0.0031*
		(1.73)	*(-0.20)*	*(-0.37)*	*(-1.74)*

Appendix D: Abnormal change in the volatility spread and volatility skew around stock split announcements

This table reports the abnormal change in the option-implied volatility spread and skew. The abnormal change in the volatility spread (skew) is the change in the volatility spread (skew) during the event window less the expected change in these variables. The expected change in the volatility spread (skew) is estimated using the average change in the volatility spread (skew) during the period [-100, -20] where Day 0 is the announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. Numbers in parentheses are the t-statistic of the means. *,** indicate significance at the 10% and 5% level, respectively

	Volatility spread		**Volatility skew**	
Day	Short maturity	Long maturity	Short maturity	Long maturity
-5	0.0008	0.0026**	-0.0003	-0.0008
	(0.49)	*(2.05)*	*(-0.29)*	*(-0.96)*
-4	-0.0008	-0.0009	-0.0015	-0.0005
	(-0.54)	*(-0.91)*	*(-1.21)*	*(-0.74)*
-3	0.0007	-0.0003	0.0012	0.0001
	(0.45)	*(-0.33)*	*(1.09)*	*(0.11)*
-2	-0.0002	0.0005	-0.0004	-0.0006
	(-0.09)	*(0.52)*	*(-0.30)*	*(-0.85)*
-1	0.0023	0.0004	-0.0013	0.0007
	(1.50)	*(0.44)*	*(-1.14)*	*(0.98)*
0	-0.0016	0.0007	0.0001	-0.0012
	(-0.80)	*(0.50)*	*(0.10)*	*(-1.43)*
1	0.0012	0.0032**	-0.0010	-0.0021**
	(0.59)	*(2.52)*	*(-0.68)*	*(-2.58)*
2	-0.0005	0.0000	0.0009	0.0006
	(-0.25)	*(0.03)*	*(0.71)*	*(0.89)*
3	-0.0009	-0.0010	0.0014	0.0003
	(-0.52)	*(-0.89)*	*(1.19)*	*(0.44)*
4	0.0006	-0.0008	-0.0019	0.0006
	(0.36)	*(-0.77)*	*(-1.44)*	*(0.92)*
5	-0.0033*	-0.0007	-0.0011	0.0009
	(-1.91)	*(-0.75)*	*(-0.98)*	*(1.38)*

Appendix E: Abnormal change in the volatility spread and volatility skew for firms with different market capitalizations

This table reports the abnormal change in the option-implied volatility spread and skew on stocks that belong to the S&P 500, S&P 400 and S&P 600 indices, and the "other" group (stocks that do not constitute any of the three indices). The abnormal change in the volatility spread (skew) is the change in the volatility spread (skew) during the event window less the expected change in these variables. The expected change in the volatility spread (skew) is estimated using the average change in the volatility spread (skew) during the period [-100, -20] where Day 0 is the announcement date. Long maturity options expire after the effective date while short maturity options expire before the effective date. Numbers in parentheses are the t-statistic of the means. *,** indicate significance at the 10% and 5% level, respectively

		Volatility spread		**Volatility skew**	
Index	Day	Short maturity	Long maturity	Short maturity	Long maturity
S&P 500	-2	-0.0003	-0.0001	-0.0009	-0.0013
		(-0.10)	*(-0.06)*	*(-0.46)*	*(-1.25)*
	-1	-0.0007	-0.0003	-0.0008	0.0008
		(-0.35)	*(-0.21)*	*(-0.48)*	*(0.74)*
	0	-0.0026	-0.0048**	0.0017	0.0022
		(-0.95)	*(-2.24)*	*(0.73)*	*(1.36)*
	1	0.0022	0.0042*	-0.0022	-0.0027
		(0.65)	*(1.77)*	*(-0.78)*	*(-1.53)*
	2	0.0005	-0.0006	-0.0004	0.0004
		(0.14)	*(-0.29)*	*(-0.20)*	*(0.30)*
S&P 400	-2	-0.0011	-0.0002	0.0030	-0.0006
		(-0.50)	*(-0.11)*	*(0.99)*	*(-0.56)*
	-1	0.0086**	0.0019	-0.0037	0.0008
		(3.07)	*(0.95)*	*(-1.41)*	*(0.61)*
	0	-0.0021	-0.0006	-0.0007	0.0015
		(-0.60)	*(-0.28)*	*(-0.31)*	*(1.01)*
	1	-0.0028	0.0026	0.0022	-0.0020
		(-0.72)	*(1.12)*	*(0.73)*	*(-1.20)*
	2	-0.0008	-0.0007	-0.0020	0.0005
		(-0.25)	*(-0.35)*	*(-0.67)*	*(0.34)*
S&P 600	-2	-0.0005	0.0012	-0.0025	0.0004
		(-0.14)	*(0.64)*	*(-0.82)*	*(0.21)*
	-1	0.0034	0.0011	-0.0003	-0.0001
		(0.93)	*(0.55)*	*(-0.10)*	*(-0.03)*
	0	-0.0025	0.0017	-0.0047	-0.0056**
		(-0.65)	*(0.71)*	*(-1.56)*	*(-2.86)*
	1	0.0045	0.0052**	-0.0014	-0.0035**
		(1.11)	*(2.17)*	*(-0.44)*	*(-2.09)*
	2	-0.0066*	-0.0019	0.0040	0.0035**
		(-1.69)	*(-0.90)*	*(1.20)*	*(2.59)*
Other	-2	0.0010	0.0010	-0.0008	-0.0005
		(0.27)	*(0.47)*	*(-0.33)*	*(-0.39)*
	-1	0.0000	-0.0004	-0.0009	0.0010
		(-0.01)	*(-0.20)*	*(-0.38)*	*(0.73)*
	0	0.0005	0.0052	0.0018	-0.0026*
		(0.11)	*(1.57)*	*(0.66)*	*(-1.86)*
	1	0.0009	0.0016	-0.0017	-0.0008
		(0.20)	*(0.59)*	*(-0.60)*	*(-0.58)*
	2	0.0029	0.0024	0.0025	-0.0011
		(0.66)	*(0.93)*	*(0.96)*	*(-0.81)*