The Market Reaction to Stock Splits and the Ability to Earn Abnormal Returns

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Abstract

A stock split is often regarded as a pure cosmetic accounting treatment and yet prior research shows that the market reacts positively upon the arrival of the split announcement. However, up to now, there has not been any convincing explanation for this favourable response while there is intense debate amongst researchers about whether these positive abnormal returns persist in the future. We revisit the issues related to the performance of splitting companies both around and following the announcement date. This allows us to study the information content of the event and assess whether the market has incorporated the implication of such information in a timely manner. In addition, we hope to draw meaningful inference about the profitability of trading following the announcement date. Our findings suggest that there is information in the split announcements, which is positively valued by the market. However, abnormal returns cannot be earned with certainty following the event. This is evident in both the option market and the stock market. Specifically, if informed investors use the option market to trade on their information, then our results indicate that informed investors do not believe in the success of a strategy that buys splitting companies subsequent to the announcement date. This is because the post-split announcement drift does not exist following every split; it is conditioned on whether the firms will split again in the future. While prior studies argue that the long-run abnormal returns are sensitive to the time period, we find that the aggregate long-run abnormal returns are higher in a time period where there is a large proportion of companies that split multiple times. Nevertheless, knowing whether the companies have split multiple times in the past will not lead to positive abnormal returns ex-ante; these returns can only be guaranteed if investors are able to forecast accurately which sample firms will implement another split in the future. Once the

split again condition is controlled for, there is no role for the time period to influence the magnitude and significance of the abnormal returns. We also discover that firms that have not split before consistently outperform firms that have. This implies that instead of buying every company that splits, investors can achieve higher returns by focusing on those that have not split in the recent past. However, the profitability of this strategy depends on the state of the market (bull versus bear market). In summary, the thesis shows that while stock splits are perceived as good news by investors, abnormal returns cannot be guaranteed following the announcement date. The information contained in a stock split is incorporated into stock prices in a timely manner, however, what type of information this event is capturing remains an open question.

Declaration

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Phuong Anh Nguyen

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Chapter 1

Introduction

1.1 Background and motivation

Since the seminal work of Fama, Fisher, Jensen and Roll (1969), event studies have become an important part of corporate finance as they provide one of the cleanest tests on market efficiency. While most early research typically focuses on the behaviour of stock returns in a short window, there is a growing concern over the long-run performance of equities following the event. This is because if part of the price response to new information occurs slowly, then one must examine stock returns over long horizons to obtain a full view of market efficiency. In fact, many studies on long-term returns present evidence of the market either under-reacting or over-reacting to new information. That is, investors can exploit this opportunity to earn positive excess returns.

Most corporate events are not that straightforward. Many events change either the future cash flows or the risk of the firm while the information content of some events is especially complicated. Thus, assessing the market response to these corporate announcements becomes a daunting task since the structure of the firm is no longer the same and the under- or over-reaction that is observed in previous research does not guarantee that risk-adjusted returns can be made. Rather, it may simply suggest that the market needs time to learn about the implication of the new information. This leads to an intense debate between the behavioural finance and the efficient market camps.

The purpose of this thesis is to investigate the market reaction to stock split announcements. In a test of market efficiency, this event allows us to bypass all the limitations that are associated with other events. First, the structure of the company remains the same following the split. The only difference is the number of shares outstanding. Second, regardless of the new information a stock split conveys to the market, the implication of such information should be straightforward (Titman, 2002). Thus, although investors may require some time to learn about the content of the event, one should not expect this learning process to last too long in an efficient market. Due to its simplicity, stock splits provide a clean test concerning the process by which new information is incorporated into stock price. If the market under-reacts to an event that leaves the company materially unchanged, then this questions the ability of the market to respond to information that is more complex.

We ascertain whether investors can earn positive excess returns by trading following stock split announcements. Given that stock splits are "just a finer slicing of a given cake" (Lakonishok and Lev, 1987), the fact that previous research documents positive abnormal returns both around and following the announcement date seems to be a puzzle that remains unsolved. Specifically, while it is generally well-accepted that the market reacts positively to the split announcement, there has not been any convincing explanation(s) for this favourable response. Some authors argue that managers convey their private news about the future performance of the firm through stock splits. In response to this contention, a number of studies examine the relationship between stock splits and the companies' future earnings and share price performance. Their findings often suggest that stock splits do not contain information about the earning power of the firm. On the other hand, evidence of splitting companies outperforming similar firms following the announcement date starts to accumulate and this has been the subject of vigorous debate amongst researchers over the past 20 years. We place great emphasis on companies' post-split performance because it has very important implications for both academics and practitioners. First, the existence of positive abnormal returns following the announcement date seems to suggest market inefficiency. Second, it suggests that investors are able to earn risk-adjusted returns by trading on companies that split their stocks.

1.2 Overview of the thesis

This thesis provides a comprehensive analysis on the market reaction to stock split announcements using data drawn from the U.S. equities market. The thesis comprises three research papers presented in Chapters 3 to 5. Chapter 2 is a brief literature review, which outlines several theories that explain why companies split their stocks. In addition, literature that is specific to a particular research paper is included in the relevant chapter. Although each empirical chapter is designed as a standalone paper, the three research papers are linked by a common theme pertaining to the entire thesis. An overview of each chapter is presented below.

Chapter 2 describes what a stock split is and the underlying reason(s) that motivate companies to split their stocks. The literature review serves the purpose of enhancing readers' understanding on the nature of stock splits. While the theme of our thesis is partly related to the signalling hypothesis, it is necessary to discuss other proposed theories that aim to justify manager's splitting decisions. This chapter provides a literary introduction to the subsequent empirical chapters. More importantly, it highlights the complex nature of stock splits. That is, given the simplicity of the event, there is no consensus amongst researchers on the reason why companies split their stocks.

Chapter 3 presents a test of the market reaction to the split announcements. This allows us to draw inferences on the information content of the event. Evidence from previous studies suggests that stock splits are perceived as good news, which induces a positive reaction by the market. Our first task is to examine whether this conjecture is still valid in today's market. Consistent with previous research, our findings indicate that there are positive abnormal returns in the three-day period surrounding the split announcements. Given that stock splits do convey information that is new to the market, we then examine whether the impact of this event is reduced depending on whether the firms are optioned. Chern, Tandon, Yu and Webb (2008) claims that the firm's optionability status exerts a negative influence on the announcement returns because options improve the informational efficiency of the underlying stock. We repeat this analysis using a different options dataset. Our results indicate that the option market only has a limited ability in lessening the impact of the split announcements. Moreover, whether the options are actively traded do not influence the magnitude and the significance of the abnormal returns. The main conclusion that we draw from chapter 3 is that stock splits contain information that is valuable to investors. However, this raises a critical question: can investors profitably trade on this information? In other words, do the positive excess returns observed around the announcement date persist in the future? We aim to answer this question in the next two empirical chapters.

In chapter 4, we evaluate the impact of the split announcements on the option market. Due to the high degree of leverage and the ability to avoid short-sale restrictions, the option market is an ideal venue for information based trading. Thus, if informed investors believe that they can make money following the split announcements, then this should be reflected in the option market. While we find that there are positive excess returns in the stock market surrounding the announcement date in chapter 3, what matters to investors is the returns in the post-announcement period. Previous studies often claim that asset returns are predictable following the split announcement; however, none of them actually specifies a trading strategy that enables investors to capture these abnormal returns. Brown (2010) argues that predictability is different from profitability. This is because the profitability of an investment depends on the information available at the time the decision was made. The fact that asset returns exhibit a foreseeable pattern ex-post does not guarantee that ex-ante, these returns are exploitable. By analysing the perception of the informed investors regarding the existence of the abnormal returns, this provides the uninformed investors a means of assessing whether trading following stock split announcements is a profitable strategy. We find that informed investors do not believe that they can make money subsequent to the announcement date.

In chapter 5, our focus is on the long-run performance of splitting companies. Although from the view of the informed investors, positive excess returns following the announcement date either do not exist or are not exploitable, one cannot completely disregard a considerable amount of research which claims that the market under-reacts to stock split announcements. The presence of a post-split announcement drift not only contradicts with our finding in chapter 4, it is also the subject of intense debate amongst researchers. In the last empirical chapter, we aim to fill in the last piece of the puzzle. Specifically, we examine whether asset returns are indeed predictable as a result of the event. Consistent with previous research, our findings suggests that there are positive abnormal returns following the announcement date. However, this is not evidence of the market under-reacting to the split announcements. Excess returns do not exist in every split; they are mainly concentrated in companies that split multiple times. Nevertheless, knowing whether a company has split multiple times in the past will not lead to positive abnormal returns. In order to capture these returns, investors need to be able to forecast accurately which companies will split multiple times in the future and this can only be achieved with private information or skill. Moreover, what is quite surprising is that companies that have not split before tend to outperform companies that have - evidence that has not been documented by previous research. Overall, the result from this chapter explains why although positive abnormal returns are observed following the announcement date, to the option investors, these returns are irrelevant.

In chapter 6, we provide an overall conclusion with a discussion of directions for future research.

1.3 Contribution to the literature

The research presented in this thesis makes several important contributions to the literature. Foremost, this thesis provides a comprehensive examination on the market reaction to stock split announcements, both short-run and long-run with the addition of the option market. The findings imply that the market is efficient with respect to stock splits. While this may sound simple, it is the subject of intense discussion over the past 20 years. Although each prior study employs a different benchmark as a proxy for the expected return within a certain timeframe, our result suggests that the benchmark and the time period are not the main reasons why previous researchers reach conflicting conclusions regarding the existence of excess returns. Taken together with our findings, the prior evidence does not contradict, but actually complements each other. The importance of our work lies in the fact that it allows researchers to view the story associated with stock splits as a complete picture. That is, while stock splits convey favourable news to the market, the implication of such information has been incorporated into the stock price in a timely manner.

We do not claim that there are no opportunities for investors to make money based on stock splits. In fact, previous research indicates that if investors buy every split in a strong market, on average, they do realise positive abnormal returns. Our analysis presents a significant improvement to prior studies as we show that instead of buying every company that announces a stock split, investors can focus on those that have not split before. However, investors still need to buy every company that has not split before to earn abnormal returns. Further, the success of this strategy also depends on the state of the market (bull versus bear market). The only way to guarantee positive excess returns is if investors can accurately forecast which splitting companies will announce another split in the future.

The main contribution of our analysis on the option market is that it presents a method of evaluating the profitability of a particular trading strategy. In this case, it is a strategy of buying companies that announce a stock split. One of the limitations regarding tests of the long-run performance of companies following the event date is that the magnitude of the excess returns tends to be sensitive to the benchmark used to estimate the expected return. Moreover, the result from this type of research mainly indicates whether abnormal returns are predictable, it does not imply that these abnormal returns are exploitable. By examining the reaction of the option market to the split announcements, this provides us some indications of whether informed investors believe they can make money from the event. Thus, the significance of the option study lies in the fact that uninformed investors can enhance their trading decision by observing the behaviour of the option investors upon the arrival of any new information. Finally, we do not contend that our approach is the most superior and should be used in all event studies; rather we argue that this method can be employed in conjunction with the traditional tests of long-run abnormal returns. In doing so, both academics and practitioners can obtain a more comprehensive and complete picture regarding the mechanisms in which new information is incorporated into stock prices.

Chapter 2

Literature review

2.1 Introduction

This chapter briefly discusses the relevant literature and highlights the complex nature of a stock split. Although the focus of this thesis is not on what motivates managers to engage in such an activity, it is necessary to provide some background information on this matter. According to some researchers, a stock split is important because of the information that is contained in the event. Thus, understanding the reason behind a stock split not only enhances the readers' understanding on the implication of this announcement, it also forms the basis that allows both researchers and investors to evaluate the market reaction to this event.

This chapter is divided into two sections: the first section explains what a stock split is and the difference between a stock split and a stock dividend. The second section reviews some proposed theories that aim to explain the reason(s) why companies split their stocks.

2.2 What is a stock split?

Firm specific events can be classified into two categories. The first is the non-self selected event, where the timing and execution of the event is known by the market since the firm has obligations to carry out a specific event within a certain time-frame. An example is an earnings announcement. The second category is the self-selected event, where the firm's manager chooses to execute a certain event at a particular point in time. This type of event is specifically conditioned on the manager's knowledge about the firm and therefore is not generally known by the market.

A stock split is a self-selected event. When a company declares a stock split, each share is divided by the split factor. For example, for a 2-1 split, each shareholder receives one additional share for each share held, but the price of the share is reduced by half. Two shares now equal the original value of one share before the split. Thus, the price of the share will decrease but the number of shares will increase proportionately. A stock split is similar to a stock dividend since both events have no effect on the value of what shareholders own. However, a stock dividend of greater than 25 percent is recorded as a stock split. The only difference between the two is the accounting treatment. According to GAAP, firms deduct the dollar value of the stock dividend from retained earnings and add it to the firm's capital account. On the other hand, for a stock split, the value of the newly distributed shares are not subtracted from retained earnings.

2.3 Why do companies split their stocks?

In theory, a stock split is a pure cosmetic accounting treatment. While the benefits associated with stock splits are not clear, companies bear real transaction costs to carry out such operations. Given that stock splits are events that occur on a regular basis, there must be a reason that triggers corporate managers to implement them. Recent studies have proposed a number of theories that explain why a firm splits its stock:

1. *The signalling hypothesis:* In the presence of asymmetric information, managers might use financial decisions to convey their private information to investors (Leland and Pyle, 1977). The signal, which the manager aims to communicate to investors is still subject to further debate, however a manager who possesses unfavourable information about the company's future

performance will be less likely to announce a split. This is because the effect of a split is to reduce the company's share price. Therefore, if the manager expects that the firm's share price will be lower in the future, they may not want to execute a transaction that will decrease the share price further. We will discuss this theory in more details in chapter 3.

2. *The optimal price or trading range hypothesis:* Practitioners have long contended that the purpose of a stock split is to move a firm's share price into an "optimal trading range". This hypothesis assumes that small investors prefer to buy shares in round lots in order to save transaction costs; however, they cannot afford to do so when the share price is high. By lowering the share price through a stock split, managers can attract more investors, which in turn increase the marketability of the stock. Baker and Gallagher (1980) and Baker and Powell (1993) surveyed the managers of all companies that issued stock splits during the period from 1978 to 1980 and found that the main motive for managers when conducting a stock split is to move the share price into a better trading range. Other evidence that supports this hypothesis includes Lakonishok and Lev (1987), where they find that splitting firms and control firms have similar share prices four to five years before the split. In the period leading up to the split announcement, the share prices of the two groups diverge and this trend reverses after the split is implemented. Lakonishok and Lev (1987) claim that this evidence suggests that a split is a means of realigning the share price back to its "normal" level.

3. *Dispersion of control hypothesis:* If the manager's aim is to have a broad base of shareholders[1], they may also find splitting to be beneficial. This is because a lower share price is more attractive to retail investors. Analysing a sample of 235 NYSE/Amex and NASDAQ firms that split their stocks in the period from April 1993 to March 1994, Schultz (2000) observe a substantial increase in small orders following stock splits and a majority of these are buy orders. Similarly, Angel, Brooks and Mathew (2004) find an increase in the trading activity by retail investors immediately following the split while Easley, O'Hara and Saar (2001) argue that stock splits induce a higher number of uninformed investors. These results are in fact consistent with the notion that stock splits provide managers a means to extend the shareholder base.

4. *The market maker hypothesis:* Angel (1997) claims that the main motivation for splits is to keep the relative tick size within a certain range. The tick size is the minimum change in the share price. If there is a constant absolute tick size on a stock exchange, then managers can affect the relative tick size (the tick size proportionate to the stock price) through a stock split. The reason why companies may strive for an optimal tick size is that the high tick size will increase the profitability of market making, which in turn will improve the liquidity of the underlying stock. In response to this contention, Copeland (1979), Conroy, Harris and Bennet (1990), Gray, Smith and Whaley (1996), Kryzanowski and Zhang (1996) and Schultz (2000) all document a higher

[1] Managers who are worried about a takeover threat may prefer a broad and heterogeneous stockholder base. This is because institutional investors are usually concerned with short-term price performance and therefore, they tend to be quick in tendering their shares to a bidder. Meanwhile, individual investors may not even be aware of a takeover bid to respond to them in a prompt manner.

relative bid-ask spread following stock splits. These findings indicate that stock splits increase the revenue for market makers, which may create more incentives for brokers to promote stocks. However, higher tick size implies higher transaction costs for investors and the optimal tick size is the one that balances the interest of investors and liquidity providers.

5. *Liquidity hypothesis:* Researchers often contend that companies split their stocks to achieve greater liquidity. Although the concept of liquidity is easily understood, it is not easily measured. Using different proxies for liquidity, empirical evidence on the impact of stock splits on liquidity is mixed. Studies by Copeland (1979), Lamoureux and Poon (1987), Conroy, Harris and Benet (1990) and Desai, Nimalendran and Venkataraman (1998) show that while stock splits lower the share price level, they increase the relative bid-ask spreads. In addition, there is a decrease in the split-adjusted volume following the split, which leads them to conclude that splits result in a permanent reduction in liquidity. Meanwhile, Lakonishok and Lev (1987) argue that since there is a substantial increase in the trading volume in the period prior to the split announcement, if the trading volume subsequent to the split is compared with this abnormal volume, it is not surprising that splitting stocks experience a decline in trading volume. They also show that the monthly turnover for splitting firms is almost identical to similar firms as soon as two months after the ex-split date. This leads them to conclude that previous findings do not totally answer the question whether liquidity increases or decreases following a split. Michaluk and Kofman (2001) provide a comprehensive study on the impact of the split announcement on the firm's

liquidity. They employ 31 liquidity measures and find a pervasive decrease in liquidity on all three major U.S. exchanges.

2.4 Conclusion

For many years, researchers have tested the validity of each of the hypotheses discussed and yet, the question of why a company decides to split its stock has not been convincingly answered. In this thesis, we do not aim to investigate the information (if any) that managers try to communicate to the market through a stock split. Rather, our interest is to examine how this type of announcement actually affects shareholders' wealth.

Chapter 3

The information content of the split announcements

3.1 Introduction

While most academics consider a stock split as a pure cosmetic event, the empirical evidence suggests that a stock split seems to be associated with "real" excess returns. Grinblatt, Masulis and Titman (1984) document an increase in shareholders' wealth of about 3.3% in the two-day period surrounding a split announcement. This finding is further supported by Asquith, Healy and Palepu (1989), McNichols and Dravid (1990) and more recently Ikeberry, Rankine and Stice (1996). Previous research has often attributed this positive reaction to the fact that managers signal their private information about the future performance of the firm through a stock split.

Lakonishok and Lev (1987) and Asquith, Healy and Palepu (1989) argue that stock split announcements contain information about the firms' earnings but they do not reflect the managers' expectations of an increase in future earnings. Rather, a stock split announcement mainly suggests that past earnings are likely to be sustainable. Huang, Liano and Pan (2006) find that the firm's future profitability, as measured by the change in earnings, actually falls following the announcement date. Moreover, if the level of short interest captures investors' bearish sentiment, then given that a stock split signals positive information, upon the arrival of this announcement, one should observe a decline in the short interest. Kadiyala and Vetsyupens (2002) do not document evidence that supports this conjecture. From the view of the short traders, a stock split does not convey a positive signal. The average change in the short interest is actually positive as a result of the split announcement. Thus, whether a stock split reflects managers' private news about the future performance of the firm is subject to further debate.

In this chapter, we examine the market reaction to the split announcement during the period 1998-2007 with data drawn from the U.S. equities market. Using the market model and the constant mean return model to estimate expected return, we study the return behaviour of all companies that announce a split for the three-day period [-1, +1] where day zero is the announcement date. Consistent with previous research, our findings suggest that a stock split announcement is perceived as good news, which induces the market to react positively. Next, we evaluate the role of the firm's optionability status in determining the magnitude of the excess returns surrounding the announcement date. Chern, Tandon, Yu and Webb (2008) have examined this conjecture and document evidence that for firms that are listed on the NYSE and Amex, those that have options exhibit lower announcement returns compared to those that do not. However, this result is not observed for NASDAQ stocks.

We repeat their analysis using the options data provided from the OptionMetrics Ivy database. Specifically, we run single and multiple variable cross-sectional regressions where the dependent variable is the three-day cumulative abnormal returns around the announcement date and the independent variables include the firm's optionability status, which equals one if a firm is optioned and zero otherwise, market capitalisation, book-to-market, beta, volatility, trading volume, closing price on the day before the announcement date, number of analysts following and split factor. In contrast to Chern, Tandon, Yu and Webb (2008), in a multiple variable cross-sectional regression framework, we only observe a negative relationship between optionability and the announcement returns for stocks that are listed on the NASDAQ. For NYSE/Amex stocks, the coefficient on the optionability dummy variable is negative; however, it is not significant. The magnitude of the cumulative abnormal returns is only determined by size for this group of stocks. Specifically, firms that have higher market capitalisations experience lower abnormal returns.

Meanwhile, for stocks that are traded on the NASDAQ, in the presence of the size factor, optionability exerts a negative influence on the announcement returns. This evidence suggests the split announcement conveys less new information to stocks that have options compared to those that do not. Thus, optionability does play an important role in improving the informational efficiency of the underlying stocks. Moreover, the cumulative abnormal returns are negatively related to the closing price on the day prior to the announcement date while positively related to the stock's volatility and the split factor.

As an extension to previous research, we evaluate whether the option trading volume and open interest affect the cumulative abnormal returns. Corrado and Truong (2010) argue that options only play an important informational role when the option trading volume is high. Since options offer investors a higher degree of leverage and a means to avoid short-sale restrictions, the option market is an ideal venue for information based trading. However, as the option market is quite illiquid, the ability of options to enhance the informational efficiency of the underlying stocks may depend on the ease with which informed investors can act on their information. Thus, one possible reason why options do not explain the variation in the announcement returns for NYSE/Amex stocks is that some of these options are not actively traded.

To investigate whether option volume and open interest have any impact on the announcement returns, we replace the optionability dummy variable in the regression equation with a variable that captures the option trading volume and open interest during the pre-announcement period. Our evidence indicates that option trading volume and open interest do not exert any influence on the announcement returns. Regardless of which proxies are used to capture the trading activity in the option market, the coefficients on these factors are not significantly different from zero. This pattern is observed across all exchanges. Further, for NASDAQ stocks, the positive relationship between the split factor and cumulative abnormal returns exists in all regression specifications. Thus, there is information in the split factor that is valued by the market for this group of stocks.

In this chapter, we re-examine the information content of the split announcements during the period 1998-2007. Consistent with previous research, we document evidence of a positive excess return in the three-day period surrounding the announcement date. Next, we investigate whether the magnitude of these returns are affected by the firm's optionability status. For stocks that are listed on the NASDAQ, firms that have options exhibit lower announcement returns compared to those that do not. However, this pattern does not exist for firms that are listed on the NYSE and Amex. Thus, our finding is contrary to Chern, Tandon, Yu and Webb (2008). We attribute the difference to the nature of the data being used and the time-period examined. Specifically, Chern, Tandon, Yu and Webb (2008) study the impact of optionability for the period 1975-2004 using data provided by the Chicago Board of Option Exchange (CBOE). Our finding suggests that if optionability plays any important role in enhancing the informational environment of the underlying stocks, then this is only present for NASDAQ stocks. For NYSE/Amex stocks, optionability does not capture any variation in the announcement returns that is unexplained by the firm's market capitalisation.

While our analysis does not make a major contribution to the understanding of the announcement effect associated with stock splits, it certainly provides the foundation for further discussion in the following chapters. We have confirmed that there are positive excess returns upon the announcements of stock splits. However, do these returns imply that investors can make money subsequent to the event? Ikenberry, Rankine and Stice (1996), Desai and Jain (1997) and Ikenberry and Ramnath(2002) document evidence that splitting companies outperform their peers at least one year following the announcement date. However, Byun and Rozeff (2003) and Boehme and Danielsen (2007) claim that the long-run abnormal returns are very sensitive to the benchmark and the time-period studied. Moreover, most of these returns are mainly concentrated from the announcement date to the effective date. We argue that the short-run and long-run performance of companies that announce a split are not mutually exclusive and the process which new information is incorporated into stock prices can be tested by examining the subsequent performance of these companies. In other words, the return behaviour of splitting companies following the announcement date deserves further investigation because this would allow us to assess the implication of this event in a more comprehensive manner. The rest of this chapter is organised as follows: chapter 3.2 discusses the literature, chapter 3.3 outlines the methodology, chapter 3.4 describes the data, chapter 3.5 presents and results and chapter 3.6 concludes.

3.2 Literature review

The first study that examines the impact of the split announcements on stock returns was done by Grinblatt, Masulis and Titman (1984). They argue that a stock split provides managers a valuable channel to communicate with the market. If the manager believes that the firm is undervalued, then by announcing a split, this would trigger the attention of market analysts, thereby having the firm's future cash flows reassessed. In addition, a stock split serves as a more effective signal compared to other forms of communication because competitors do not get access to the private information and managers will not be held responsible for giving out false signal about the future prospects of the firm. Accordingly, investors interpret that a stock split reflects manager's favourable information, which induces positive abnormal returns on the announcement date.

Grinblatt, Masulis and Titman (1984) employ the mean adjusted return methodology developed by Masulis (1980a, 1980b), in which the stock returns around the announcement day are compared with the average daily return for a benchmark period of forty trading days subsequent to the announcement period. They find that the mean three-day return around the announcement date for the entire split sample is much greater than the mean return for a benchmark period. What is interesting is that for the sub-sample where cash dividends were paid but did not increase following the split, the announcement return is still significantly positive. Further, for the sub-sample where no cash dividend was paid in the three years prior to the announcement, the excess return is also significantly positive. Their findings indicate that stock splits are viewed as a positive signal by the market and while stock splits are usually tied with cash dividends, it is not the only reason why the market reacts favourably to the split announcement. In other words, the split itself contains information that is unrelated to the cash dividend and this information is positively valued by the market. Overall, they conclude that the abnormal returns observed around the announcement date cannot be explained by the market anticipating an increase in cash dividends. Rather, they hypothesise that managers signal information about the firms' future earnings or equity values through their split decisions.

In an attempt to provide a plausible explanation for the abnormal returns that occur when a split is announced, Brennan and Copeland (1988) present a theoretical model in which stock splits provide a credible signal about the future prospect of the firm because the stock price level influences the cost of trading. In their model, transaction costs per dollar are negatively related to the firm's stock price and market capitalisation. Given that the manager observes the true value of the firm, every time a split is announced, the manager trades off the increase in the firm's value with the increase in the transaction costs. Thus, managers without any positive information about the value of the firm are not likely to split because this will induce higher transaction costs. In equilibrium, the more favourable the manager's information about the firm, the higher the split factor.

McNichols and Dravid (1990) extend this argument further by providing evidence that managers signal their private information about future earnings through the split factor. They find that after controlling for the pre-split share price and market value of equity, the firm's split factor is positively related to the firm's forecast errors and the announcement returns. This leads them to conclude that from the view of the market participants, the split factor contains information about the future performance of the firm and responds accordingly.

Brennan and Hughes (1991) offer a new insight into this "signalling hypothesis". In their model, managers with favourable information will find it more beneficial to have independent third parties to convey information about the firms. These parties include brokers who make earning forecasts and receive their compensation in the form of commissions paid by investors. Following Merton (1987), investors will only purchase stocks that they know about and thus, by providing earning forecasts, brokers can enhance investors' awareness about the firm. When deciding whether to produce an earning forecast for a particular stock, brokers will compare the cost of the forecast with the commission revenue they will receive. Their model predicts that the number of broker firm's analysts are negatively related to the share price because the trading cost per dollar is a decreasing function of the firm's share price. In other words, the flow of information about the firm should increase if the price is lower. Thus, by announcing a stock split, managers can influence the trading commission revenue and the brokers' incentive to produce a new forecast. A manager who possesses favourable information about the firm's value is more likely to split their stock because this would attract the attention of security analysts so that they will uncover the good news and incorporate that in their earning estimate. Accordingly, the market interprets a stock split as a signal that the manager is optimistic about the future performance of the firm and this explains the positive abnormal returns that are observed around the announcement date.

Ikenberry, Rankine and Stice (1996) also find positive excess returns in the five-day period surrounding the split announcement. Moreover, the excess returns are negatively related to size, post-split price and the book-to-market ratio. This suggests that the additional information generated by the split is actually more valuable for small firms compared to large firms. The reason for this might be that there is less information available about small firms since they have less analysts following them and they tend to be ignored by institutional investors. Finally, Conroy and Harris (1999) observe higher excess returns for firms that implement a larger than expected split factor. Simultaneously, financial analysts increase their earnings forecasts for these types of firms, which lead them to conclude that a firm's past history of stock splits plays a crucial role in setting the benchmark price level for the current split. When managers implement a split that allows the stock price to fall below an expected level, both investors and financial analysts interpret this as a signal of favourable information.

While it is generally accepted that the split announcements induce a positive reaction by the market, the existing literature does not entirely support the "signalling hypothesis". If a manager aims to convey their private information through a stock split, then does a stock split contain information about the firm's profitability? Lakonishok and Lev (1987) find that splitting firms exhibit much higher earnings growth compared to the control firms during the pre-split period. However, this pattern does not persist in the future. In the succeeding years following the announcement date, the difference in the earnings growth rate of splitting and control firms are not statistically significant. Asquith, Healy and Palepu (1989) document very similar evidence. Although stock splits may embrace information about the firm's earnings, it is not a signal that managers expect future earnings to increase. Specifically, companies usually split after a period of strong earnings performance but the market does not expect that these earnings are permanent. The positive market reaction observed in previous research is attributed to the fact that the split announcement leads investors to revise their expectations on whether the earnings will reverse in the future. More recently, Huang, Liano and Pan (2006) examines the firm's operating performance following the split announcement using three measures: future earnings change, future earnings and future abnormal earnings. They find that in the year when the split is announced, the firm tends to exhibit the highest earning change. Nevertheless, these earnings changes fall substantially over the subsequent five years. This pattern is robust across all the three measures, which leads them to conclude that stock splits are negatively related to future profitability.

Lamoureux and Poon (1987) present a theoretical model that explains the stock price reaction to a stock split announcement that has little to do with the "signalling hypothesis". Specifically, upon the announcement of a split, the market expects an increase in the trading volume since the resultant lower price attracts a higher number of noise traders. This will lead to an increase in the stock return volatility. Following the argument of Constantinides (1984), the increase in stock volatility is desirable because the U.S. tax system gives preferential treatment to long-term capital gains and short-term capital losses. Thus, a security with high volatility will provide investors the flexibility to realise losses short-term and gains long-term. In other words, by splitting the stock, managers can increase the value of the tax timing option and this is what leads to an increase in the stock price. Similarly, Kadiyala and Vetsuypens (2002) document evidence that stock splits are not a credible signal about the future performance of the firm. If stock splits convey favourable news to the market, then this should lead to a decline in bearish sentiments. In this case, short traders will reduce their short positions in the firm. Their findings indicate that short interest does not decrease around stock split announcements. Overall, the conclusion regarding whether stock splits signal positive information about the future prospect of the firm is mixed.

Chern, Tandon, Yu and Webb (2008) take a different approach in examining the information content of the split announcements. Regardless of the "private" news that a stock split conveys to the market, they argue that a split announcement should have a lesser impact on stocks that have traded options compared to stocks that do not. Following Manaster and Rendleman (1982) and Conrad (1989), they contend that options affect the manner in which prices respond to new information because they provide a superior channel for informed investors to trade on their information. Specifically, the option market offers informed investors a higher degree of leverage and an opportunity to avoid short sale restrictions. In addition, stocks that have options also have a higher number of analysts following them. Using the options data provided by the Chicago Board of Options Exchange, they find significantly lower abnormal returns after the stocks are optioned compared to before. Moreover, in the context of a multiple variable cross-sectional regression framework, stocks with options also exhibit lower abnormal returns compared to stocks that do not have options. This pattern is strongly observed for stocks that are listed on the NYSE and Amex. Overall, they conclude that optionability improves the informational efficiency of the market for the underlying stocks. Specifically, the split announcement conveys less new information for stocks that are optioned compared to ones that are not.

In summary, what we infer from the literature is that a stock split is often associated with positive abnormal returns around the announcement date. While previous research has tried to link this positive market reaction with the signalling effect, up to now, the evidence is inconclusive. However, the magnitude of the announcement returns seems to be affected by a few factors that together capture the information environment of the stocks. In this chapter, we perform a detailed analysis that allows us to study the relationship between the behaviour of the announcement returns and a number of the firm characteristics.

3.3 Methodology

We first examine the market reaction to the split announcements. The announcement return allows us to study the information effect associated with a stock split. Specifically, we calculate the abnormal return (AR) and the cumulative abnormal return in the three-day period around the announcement date. A positive CAR implies that a stock split is perceived as good news, which induces a favourable response from the market. In the second part of the chapter, we study the impact of optionability on the announcement returns. If optionable stocks are associated with greater informational efficiency than non-optionable stocks, then we expect optionable stocks to incorporate the information content of the split announcements in a more prompt manner than non-optionable stocks.

3.3.1 Parametric test of abnormal returns

We define an abnormal return as:

$$AR_{it} = R_{it} - E(R_{it}) \tag{3.1}$$

where R_{it} is the return of security *i* at time *t* and $E(R_{it})$ is the daily expected return for the sample firm. Our event window is [-1, +1] where day zero is the announcement date. Expected returns are measured using the market model and the constant mean return model. The parameters for these two models are estimated over a period [-250, -46] trading days prior to the announcement date. The market model and the constant mean return model may in fact be the two simplest models used to estimate expected returns. In practice, it is possible to use a more sophisticated model, such as a multi-factor model. However, Brown and Warner (1980, 1985) find that the market model and the constant mean return model often yield results that are similar to other more complicated models. In other words, the marginal explanatory power of the additional factors is small and there is little reduction in the variance of the abnormal returns that can be explained by these additional factors.

For the market model, we regress the return of a security against the returns on the market portfolio over the period [-250, -46]. The purpose of the market model is to reduce the variation of the abnormal returns by removing the portion of the return that is related to variation in the market's return. The abnormal return is the disturbance term of the market model calculated on an out of sample basis:

$$AR_{it} = R_{it} - \alpha_i - \beta_i R_{mt} \tag{3.2}$$

where R_{mt} represents the return of the market while α_i and β_i are the regression intercept and slope estimate, respectively, obtained from a least-squares regression of raw returns on contemporaneous market returns over the estimation period. We use the return of the CRSP equally weighted index to proxy for the return of the market portfolio since Brown and Warner (1980) find that event study tests using the return of a value-weighted index were severely mis-specified.

Under the null hypothesis, the abnormal return is normally distributed with a zero conditional mean and conditional variance $\sigma^2(AR_{it})$:

$$\sigma^2(AR_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{T}\left[1 + \frac{\left(R_{mt} - \bar{R}_m\right)^2}{\sum_{\tau=1}^{T}\left(R_{m\tau} - \bar{R}_m\right)^2}\right] \tag{3.3}$$

where T is the number of days in the estimation period and $\bar{R}_m$ is the average return of the market over period T. The conditional variance has two components: the first term is the variance of the security while the second term is the sampling error due to α_i and β_i, which arises because they are estimated outside the event period. As the length of the estimation window becomes large, the second component approaches zero. Following Patell (1976), we divide the abnormal return of the firm's by its standard deviation to control for heteroskedasticity. The standardised abnormal return is:

$$SAR_{i\tau} = \frac{AR_{i\tau}}{\sigma_i} \quad . \tag{3.4}$$

For the constant mean return model, the mean $\hat{K}_i$ and standard deviation $\hat{\sigma}(R_i)$ of a security return in days -250 through -46 are estimated:

$$\hat{K}_i = \frac{1}{T}\sum_{t=-250}^{-46} R_{it} \tag{3.5}$$

$$\hat{\sigma}^2(R_i) = \left[\frac{1}{T}\sum_{t=1}^{T}\left(R_{it} - \hat{K}_i\right)^2\right]\left[1 + \frac{1}{T}\right]. \tag{3.6}$$

Once again, we standardise the abnormal return by its standard deviation:

$$SAR_{it} = (R_{it} - \hat{K}_i) / \hat{\sigma}(R_i) \,. \tag{3.7}$$

To test for the significance of the abnormal returns, we follow Boehmer, Musumeci and Poulsen's (1991) methodology that controls for the increase in the cross-sectional variance of the event date excess returns. The test statistic under the null hypothesis of no abnormal security price performance is:

$$t_{\overline{SAR}} = \frac{\overline{SAR_t}}{\sigma_{\overline{SAR_t}} / \sqrt{N}} \tag{3.8}$$

where $\overline{SAR}_t$ is the average standardised cumulative abnormal return across N securities on event day t and $\sigma_{\overline{SAR_t}}$ is the standard deviation of the average standardised abnormal return and is equal to:

$$\sigma_{\overline{SAR_t}} = \frac{1}{N-1}\sum_{i=1}^{N}\left(SAR_{i,t} - \frac{1}{N}\sum_{i=1}^{N} SAR_{i,t} \right)^2 . \tag{3.9}$$

The cumulative abnormal return is calculated as the sum of the abnormal returns around the announcement date:

$$CAR_i = \sum_{t=1}^{h} AR_{it} \tag{3.10}$$

where h is the length of the announcement window. The Standardised Cumulative Abnormal Return (SCAR) is defined as:

$$SCAR_i = \sum_{t=1}^{h} SAR_{it} \tag{3.11}$$

and the test statistic of zero cumulative abnormal returns around the announcement date is:

$$t_{\overline{SCAR}} = \frac{\overline{SCAR_h}}{\sigma_{\overline{SCAR_h}} / \sqrt{N}} \tag{3.12}$$

where $\sigma_{\overline{SCAR}}$ is the standard deviation of the average standardised cumulative abnormal return and is equal to:

$$\sigma_{\overline{SCAR_h}} = \frac{\sqrt{h}}{N-1}\sum_{i=1}^{N}\left(SCAR_{i,h} - \frac{1}{N}\sum_{i=1}^{N} SCAR_{i,h} \right)^2 . \tag{3.13}$$

3.3.2 Non-parametric test of abnormal returns

In addition to the parametric tests outlined above, we employ two non-parametric tests since these tests require weaker assumptions about the return distribution. They are the generalised signed test and the Corrado-sign rank test. The generalised sign test examines whether the number of stocks with positive cumulative abnormal returns in the event window exceeds the number expected in the absence of abnormal performance. The expected number is estimated based on the proportion of positive abnormal returns during the estimation period.

$$\hat{p} = \frac{1}{n}\sum_{j=1}^{n}\frac{1}{T}\sum_{t=1}^{T} S_{jt} \tag{3.14}$$

where S_{jt} equals to 1 if $AR_{jt} > 0$ and equals to 0 otherwise.

The test statistic uses the normal approximation to the binomial distribution with parameter $\hat{p}$. If w is the number of stocks in the event window for which the cumulative abnormal return is positive, then the generalised sign test statistic is calculated as:

$$Z = \frac{w - n\hat{p}}{\left[n\hat{p}(1-\hat{p})\right]^{1/2}}. \tag{3.15}$$

Next, we compute the statistic under the Corrado rank test. This non-parametric test was first introduced by Corrado (1989) and later refined and discussed by Corrado and Zivney (1992) and Corrado and Truong (2008). The rank test treats the estimation and the event window as single time series and assigns a rank to each daily return for each firm. That is, T_i excess returns from the estimation period plus h_i from the event period. Corrado and Zivney's (1992) test statistic accounts for a variance increase during an event period by defining the following standardised excess return series:

$$X_{it} = SAR_{it} \text{ if } t \in T_i,$$

$$X_{it} = SAR_{it} / \sigma_i \text{ if } t \in h_i .$$

Let K_{it} denotes the rank of the standardised excess returns SAR_{it} within a sample of $T_i + h_i$ excess returns for security *i*. To allow for missing returns, ranks are standardised by dividing by one plus the number of non-missing returns in each firm's excess returns time series according to:

$$U_{it} = K_{it} / (1 + M_i) \tag{3.16}$$

where M_i is the number of non-missing returns for security. This yields order statistics for the uniform distribution with an expected value of one-half. Corrado and Zivney (1992) argue that without this adjustment, the rank test may be mis-specified. The adjusted rank is then used to compute the test statistic:

$$t_{CR} = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \frac{\sum_{t=1}^{h_i} U_{it} - h_i \times 0.5}{S_{Ui}\sqrt{h_i}} \quad . \tag{3.17}$$

Under the null hypothesis of no abnormal performance, the distributions of the rank test statistics converge to a standard normal.

3.3.3 Cross sectional regressions

In this section, we examine the cross-sectional relations between the announcement returns and a number of factors that may affect them. Specifically, we run single and multiple variable cross-sectional regressions of the cumulative abnormal returns on the firm's optionability status, market capitalisation, book-to-market, beta, volatility, trading volume, closing price on the day prior to the announcement date, number of analysts following and split factor. We take a special interest in the first variable, which is whether or not the firm is optioned. A stock is defined as optionable if the firm has options data available during the [-1, +1] period around the announcement date. Otherwise, it is defined as non-optionable. If optionability enhances the informational efficiency of the underlying stock, then the market should be less "surprised" when a split is announced. Thus, in the single variable cross-sectional regression framework, the coefficient on the optionability factor is expected to be negative. However, if optionability does not provide any incremental improvement in the informational efficiency of the underlying stocks after controlling for other relevant factors, then we do not expect any significant relationship between the announcement returns and optionability in the context of a multiple variable cross-sectional regression.

While the firm's size, book-to-market, beta and volatility are included to capture the firm's characteristics, we use the stock's trading volume and the number of analysts to proxy for the information environment of the firm. We hypothesise that stocks that are more actively traded and followed by a large number of analysts are more informationally efficient than stocks that are not. That is, the split announcements should convey less information to the market for these stocks. Although the closing stock price on the day before the announcement date may share some common information with the firm's market capitalisation, this factor may be able to explain the variation in equity returns that is not captured by other factors. If this is the case, we expect the coefficient on the price factor to be significant in a multi-variable cross-sectional regression framework. Finally, Conroy and Harris (1999) find that excess returns after stock splits are higher when shareholders are surprised by a larger than anticipated split. Thus, stocks with higher split factors should be associated with higher announcement returns than otherwise.

Since the firm's market capitalisation tends to exhibit skewness, we transform this variable into a decile score. Specifically, for each month from January 1998 to December 2007, we rank all NYSE stocks in our population by size (price times the number of shares outstanding) and form 10 size portfolios based on these rankings. NASDAQ and Amex stocks are then classified into the corresponding portfolios. The decile score for a sample firm takes the value of the portfolio that the firm belongs to, which ranges from 1 to 10. We calculate a firm's book-to-market ratio using the book value of equity for the fiscal year ending in calendar year t-1 divided by the market value of common equity. We define book to common equity BE as the COMPUSTAT book value of equity plus deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Preferred stock is the redemption value, liquidation or carrying value. Negative BEs are excluded. Book-to-market equity, B/M is then the common book equity for the fiscal year ending in calendar year t-1, where year t is the current year, divided by the market value of equity of each month in year t. The firm's beta and volatility are estimated in the pre-announcement period (from day -250 to day -30 where day zero is the announcement date). The volume is the natural logarithm of the average trading volume over the same period.

As an extension to previous research, we also study the role of option trading volume and open interest in determining the announcement returns. Our intuition is that since the option market is quite illiquid, the option's ability to improve the informational efficiency of the underlying stock may depend on whether the options are actively traded. However, by studying the impact of the option trading volume (open interest) on the announcement returns, our sample is confined to only optionable stocks.

Therefore, we use two proxies to capture the trading activity in the option market. First, we calculate the average total option trading volume/open interest (both call and put options) during the pre-announcement period. We only focus our attention on at-the-money options[2]. This is because at-the-money options are the most liquid options. If the options are actively traded, then this should be reflected in at-the-money options (Chan, Chung and Johnson, 1993). Meanwhile, if we use the average option trading volume (open interest) across different levels of moneyness, then this could potentially contaminate our results. The reason is that the availability of the option's strike price varies across different stocks. Specifically, for some stocks (Google, Apple), the level of moneyness can range from 0.5 to 1.5, whereas for other stocks, the level of moneyness only fluctuates between 0.7 and 1.3. Since the trading volume and open interest for out-of-the-money and in-the-money options are generally low, if we aggregate the option trading volume and open interest across all different levels of moneyness, then this might have the effect of understating the trading activity for stocks that have a wide range of strike prices.

Similar to size, option trading volume and open interest exhibit a high degree of skewness where most of the option trading volume and open interest are concentrated in a small number of stocks. To address this problem, we transform this variable into a decile score, which ranges from 1 to 10 where 10 indicates the most actively traded options. Our first proxy (Optvol1) compares the impact of stocks with high option trading volume versus stocks with low option trading volume on the announcement

[2] We calculate the level of moneyness for a call option as the stock price divided by the strike price. For an at-the-money put option, the level of moneyness is calculated as the strike price divided by the stock price. At-the-money options are options where the level of moneyness fluctuates between 0.9 and 1.1.

returns. Therefore, our analysis is limited to only optionable stocks. Meanwhile, our second proxy (Optvol2) allows us to combine the impact of optionability and option trading volume into one measure. Specifically, stocks without options will receive a score of zero while stocks with the lowest option trading volume (open interest) will receive a score of one and stocks with the highest option trading volume will receive the score of 10. Our aim is to examine the ability of the option market in improving the information environment of the underlying stocks and that is not captured by the dichotomous variable (options versus no options) and Optvol1. For example, if optionability/Optvol1 does not exert any influence on the announcement returns while there is a difference in the behaviour of the announcement returns for stocks that have high option trading volume compared to stocks without options, then this difference should be captured by Optvol2. We construct the variable option interest (Optint1 and Optint2) in a similar manner as Optvol1 and Optvol2. We examine the following cross-sectional regression equation:

$$CAR_i = \alpha_0 + o_i Opt + s_i Size + b_i B/M + m_i Beta + d_i Volatility + v_i Vol + p_i PRC + n_i Analyst + + f_i FAC \qquad (3.18)$$

where CAR_i is the cumulative abnormal return of firm *i*, *Opt* takes the value of 1 if the stock is optionable and 0 if the stock is not *,* *Size* is the market value decile score, *B/M* is the book-to-market ratio for the stock in the month prior to the announcement date. *Beta* is the slope coefficient obtained from the OLS regression on the CAPM model, *Volatility* is the standard deviation of stock returns while *Vol* is the log of the average trading volume in the pre-announcement period. *Analyst* is the number of analysts following the stock in the previous earnings quarter, *PRC* is the closing share price on the day prior to the announcement date and *FAC* is the split factor. To examine the role of option trading volume/open interest, we replace the *Opt* variable with *Optvol1/Optint1* (option trading volume/open interest for optionable stocks), *Optvol2/Optint2* (option trading volume/open interest for both optionable and non-optionable stocks). The t-statistics are calculated using White (1980)'s method to control for heteroskedasticity.

3.4 Data and sample characteristics

The sample consists of all stock splits during the period 1998-2007, as contained on the Center for Research in Security Prices (CRSP) file. To be included in our sample, the splitting firms have to meet the following criteria: the shares must be common equity (CRSP share codes 10 and 11), which have a split factor greater than or equal to 25 percent. We exclude ADRs, SBIs, REITs and closed-end funds. The announcement date must appear on the CRSP database and the firm must have at least 40 days of return data during the estimation period, which spans from day -250 to day -46 (day zero is the announcement date). Our sample contains 2,783 stock splits. Consistent with past studies, most of the splits are either two for one (53%) or one for two (32%). Table 3.1 reports the distribution of splits across different exchanges:

Table 3.1: Distribution of splits across the three exchanges

This table reports the number of split events for firms that are listed on the NYSE, Amex and NASDAQ. We also report the mean and median market capitalisation (in millions) for splitting companies at the end of the month prior to the announcement date across the three exchanges.

Exchange	N	Mean size	Median size
NYSE	935	11,359	2,700
Amex	134	530	139
NASDAQ	1,714	3,591	543

What we observe from table 3.1 is that a large proportion of splitting companies are NASDAQ stocks. As expected, the mean/median market capitalisation for NASDAQ stocks are lower compared to NYSE stocks. Across the three exchanges, the median size is much smaller than its mean. This indicates that the market capitalisations for some stocks are quite extreme.

In the second part of our chapter, we investigate the relationship between the announcement returns and a number of factors that may affect them. These factors are the firm's optionability status, which takes the value of one if the firm is optioned and zero otherwise, market capitalisations, book-to-market, beta, volatility, trading volume, pre-split share price, number of analysts following and split factor. To be included in this sample, the firms need to have accounting data available in order to calculate the book-to-market ratio as described above. Thus, our sample is reduced to 2,631 split events, where 1,220 events are associated with optionable stocks and 1,411 events are associated with non-optionable stocks. Table 3.2 panel A reports the correlation amongst the independent variables for the full sample while panel B reports the same information for optionable stocks.

Table 3.2: Correlation matrix for the independent variables

This table reports the relationship amongst the independent variables. Panel A reports the correlation matrix for the full sample while panel B reports the same information for optionable stocks only. Opt takes the value of one if the stock is optionable and zero if the stock is not. Optvol2 and Optint2 capture the option trading volume and open interest for both optionable and non-optionable stocks where non-optionable stocks receive a score of zero, stocks with the lowest option trading volume receive a score of one and stocks with the highest option trading volume receive a score of 10. Size is the market value decile score while B/M is the book-to-market ratio for the stock in the month prior to the announcement date. Beta is the slope coefficient obtained from the OLS regression on the CAPM, volatility is the standard deviation of stock returns and volume (VOL) is the log of the average trading volume. These three variables are constructed in the pre-announcement period. PRC is the closing share price on the day prior to the announcement date, Analyst is the number of the analysts following the stock in the previous earnings quarter while FAC is the split factor. In panel B, Optvol1 and Optint1 capture the option trading activity for optionable stocks. These variables represent a decile score, which ranges from 1 to 10 where stocks with the highest option trading volume/open interest receive a score of 10.

Panel A: Correlation matrix for the full sample

	Opt	Optvol2	Optint2	Size	B/M	Beta	Volatility	Vol	PRC	Analyst	FAC
Opt	1.00										
Optvol2	0.78	1.00									
Optint2	0.78	0.97	1.00								
Size	0.65	0.65	0.66	1.00							
B/M	-0.30	-0.31	-0.27	-0.43	1.00						
Beta	0.37	0.42	0.38	0.50	-0.43	1.00					
Volatility	0.01	0.04	-0.03	0.02	-0.34	0.43	1.00				
Vol	0.66	0.71	0.71	0.86	-0.49	0.65	0.17	1.00			
PRC	0.33	0.43	0.40	0.61	-0.35	0.44	0.17	0.50	1.00		
Analyst	0.65	0.76	0.77	0.65	-0.28	0.34	-0.05	0.69	0.36	1.00	
FAC	0.10	0.15	0.14	0.21	-0.06	0.11	0.07	0.11	0.49	0.09	1.00

Table 3.2: continued

Panel B: Correlation matrix for optionable stocks										
	Optvol1	Optint2	Size	B/M	Beta	Volatility	Vol	PRC	Analyst	FAC
Optvol1	1.00									
Optint1	0.92	1.00								
Size	0.53	0.57	1.00							
B/M	-0.24	-0.12	-0.14	1.00						
Beta	0.34	0.23	0.06	-0.32	1.00					
Volatility	0.09	-0.09	-0.07	-0.47	0.54	1.00				
Vol	0.82	0.83	0.65	-0.22	0.35	0.09	1.00			
PRC	0.42	0.33	0.50	-0.25	0.26	0.23	0.36	1.00		
Analyst	0.56	0.59	0.55	-0.16	0.13	-0.05	0.71	0.26	1.00	
FAC	0.25	0.21	0.29	-0.09	0.08	0.04	0.14	0.49	0.10	1.00

In panel A, we observe a strong relationship between the firm's market capitalisation and optionability. The correlation between these two variables is 0.65, which indicates that stocks with options tend to be larger than stocks without options. Apart from size, the firm's optionability is positively related to the average trading volume of the underlying stock (correlation coefficient is 0.66) and the number of analysts following (correlation of 0.65). While the correlation coefficient between the firm's optionability and option volume/open interest is 0.78, this is expected as non-optionable stocks receive an option volume/open interest score of zero. Finally, the correlation between option trading volume and open interest is 0.97. This suggests that, together, these two variables capture the trading activity in the option market. Similar to the firm's optionability, both of these variables are strongly related to stock volume and the number of analysts following. Firm size is positively correlated with the stock's beta (correlation coefficient is 0.5), the pre-split stock price (correlation of is 0.61), stock volume (correlation of 0.86), option volume and open interest (correlation of 0.65 and 0.66, respectively) and the number of analysts following the firm (correlation of 0.65). Meanwhile, it is negatively related to the firm's book-to-market (the correlation of -0.43). The firm's beta on the other hand is positively related to stock volatility (correlation of 0.43) and stock volume (correlation of 0.65).

This indicates that high beta stocks might induce higher trading activity from the stock market compared to low beta stocks. However, it is negatively related to the book-to-market factor (correlation of -0.43). What is quite interesting is that there is a strong correlation between the split factor and the pre-split share price (correlation of 0.49). To some extent, this relationship actually supports the "trading range" hypothesis. That is, stocks with higher share price are more likely to implement a larger split in order to return the share price back to a "normal" trading range.

In panel B, our focus is limited to only optionable stocks. Once again, there is a strong relationship between the firm's market capitalisation, number of analysts following, stock volume, option trading volume and open interest. That is, amongst optionable stocks, firms that have larger market capitalisations, higher number of analysts following and higher trading volume in the underlying stock also generate more trading activity in the option market.

3.5 Results

3.5.1 Market reaction to the split announcements

Panel A of table 3.3 reports the abnormal returns (AR) and cumulative abnormal returns under the market model while panel B reports the same information under the constant mean return model. We break the full sample into contaminated events (simultaneous releases of other information around the split announcements) versus non-contaminated events (pure events). Our announcement window is [-1, +1] where day zero is the announcement date. To test for the significance of the abnormal returns, we employ the standardised cross-section t-test (SCST), generalised sign test (GST) and the Corrado rank test (CRT).

Table 3.3: Market reaction to the split announcements

This table reports the abnormal return and the cumulative abnormal return during the period [-1, +1] where day zero is the announcement date. Expected return is estimated using the market model (MM) and the constant mean return model (CMRT). The significance of the abnormal return is tested based on a standardised cross-sectional t-test (SCST), generalised sign test (GST) and the Corrado rank test (CRT). The full sample is divided into contaminated events versus non-contaminated events.

Abnormal return(s) around the announcement date										
	Model		All events	Pure events	Contam. events	Model		All events	Pure events	Contam. events
Day -1	MM	Mean	0.0018	0.0024	0.0005	CMRT	Mean	0.0015	0.0022	-0.0001
		SCST	*(3.35)*	*(3.22)*	*(1.25)*		SCST	*(2.26)*	*(2.56)*	*(0.25)*
		GST	*(3.40)*	*(3.30)*	*(1.56)*		GST	*(1.24)*	*(3.30)*	*(1.58)*
		CRT	*(2.99)*	*(2.63)*	*(1.44)*		CRT	*(1.44)*	*(2.63)*	*(0.02)*
Day 0	MM	Mean	0.0141	0.0155	0.0111	CMRT	Mean	0.0141	0.0155	0.0111
		SCST	*(17.77)*	*(14.81)*	*(9.97)*		SCST	*(16.75)*	*(13.83)*	*(9.53)*
		GST	*(17.30)*	*(15.28)*	*(8.70)*		GST	*(16.66)*	*(15.28)*	*(8.73)*
		CRT	*(18.07)*	*(14.93)*	*(10.19)*		CRT	*(16.63)*	*(14.93)*	*(9.37)*
Day 1	MM	Mean	0.0109	0.0110	0.0107	CMRT	Mean	0.0104	0.0107	0.0098
		SCST	*(14.04)*	*(10.61)*	*(9.27)*		SCST	*(12.68)*	*(9.80)*	*(8.07)*
		GST	*(15.15)*	*(11.96)*	*(9.84)*		GST	*(15.35)*	*(11.96)*	*(9.91)*
		CRT	*(15.99)*	*(12.12)*	*(10.66)*		CRT	*(14.25)*	*(12.12)*	*(9.15)*
Day [-1, 1]	MM	Mean	0.0262	0.0282	0.0216	CMRT	Mean	0.0255	0.0279	0.0202
		SCST	*(21.89)*	*(21.89)*	*(13.13)*		SCST	*(19.66)*	*(19.66)*	*(11.52)*
		GST	*(21.92)*	*(17.22)*	*(13.69)*		GST	*(20.31)*	*(16.33)*	*(12.11)*
		CRT	*(21.14)*	*(16.96)*	*(6.62)*		CRT	*(18.44)*	*(15.13)*	*(5.50)*

Under the market model, there is evidence of positive abnormal returns during the three-day period around the announcement date. For the full sample, the abnormal return amounts to 0.18% on day -1, 1.41% on day 0 and 1.09% on day +1. All of these abnormal returns are significant at the 1% level using the standardised cross-section t-test, generalised sign test and the Corrado rank test. Together, this generates a total excess return of 2.62% during the event window. However, when the full sample is separated into contaminated and non-contaminated events, the abnormal return is only positive and significant on day -1 for the pure split sub-sample. For the contaminated sub-sample, the abnormal return although positive, is not significant. This is confirmed by both parametric and non-parametric tests. Meanwhile, these sub-samples together yield positive and significant abnormal returns on day 0 and day +1. Specifically, on the announcement date, the excess return is 1.55% (SCST is 14.81) and 1.11% (SCST is 9.97) for the non-contaminated and contaminated sub-samples, respectively. On day +1, these excess returns amount to 1.10% (SCST is 10.61) and 1.07% (SCST is 9.27) for the two sub-samples. Thus, on each of the trading days around the announcement window, the pure event sub-sample consistently generates higher excess returns compared to the contaminated sub-sample. Overall, the cumulative abnormal return for the non-contaminated sub-sample is 2.82% (SCST is 21.89) while for the contaminated sample, it is 2.16% (SCST is 13.13).

Using the constant mean return model, there is no clear evidence of whether excess returns exist on day -1 for the full sample. Specifically, the abnormal return is 0.15%, while it is significant under the standardised cross-section t-test, under the generalised sign test and Corrado rank test, it is not significant at the 5% level. The main reason is that the excess return on the contaminated sample is close to zero. What we also notice is that although the abnormal return for this sub-sample is negative, (-0.1%), the test statistics are actually positive (SCST is 0.25, GST is 1.58 and CRT is 0.02). This is because all the test statistics are calculated based on the standardised abnormal returns. The abnormal return for the pure event sample is once again positive on day -1, it amounts to 0.22%, and is significant at 5% (SCST is 2.56). For the remaining two days of the announcement window, the constant mean return model yields very similar results to the market model. On the announcement date, the abnormal return for the full sample is 1.41%; for the non-contaminated and contaminated sub-sample, this figure is 1.55% and 1.11%, respectively. The excess return continues to be positive and significant on day +1. Specifically, the abnormal return is 1.04% for the full sample, 1.07% for the pure event sample and 0.98% for the contaminated sample. All of these excess returns are significant at the 1% level using the standardised cross-section t-test, generalised sign test and the Corrado rank test. The cumulative abnormal returns are positive and significant for the full sample, as well as the two sub-samples.

Overall, our findings are consistent with Grinblatt, Masulis and Titman, (1984) and McNichols and Dravid (1990), in that stock splits are perceived as good news and attract positive market reactions around the announcement date. Moreover, the fact that the pure event sub-sample consistently exhibits higher excess returns compared to the contaminated sub-sample further strengthens this result. That is, there is information in the split announcement that causes a positive reaction from the market and the announcement excess returns are not due to other events that occur at around the same time. Finally, the magnitude of the excess return on day -1 is much smaller compared to day 0 and day 1. This indicates that there is little evidence that the market "knows" about a split before it is actually announced.

3.5.2 Single variable cross-sectional regressions

In this section, we run the single variable cross-sectional regressions where the dependent variable is the three-day cumulative abnormal returns around the announcement date. We use two proxies to capture the trading activity in the option market (Optvol1/Optint1 and Optvol2/Optint2). The construction of the first proxy (Optvol1/Optint1) is limited to only optionable stocks whereas the second proxy (Optvol2/Optint2) combines the impact of option trading volume and open interest for both optionable and non-optionable stocks into one measure. Thus, we estimate the regression equation for the full sample and optionable stocks separately.

3.5.2.1 Full sample

Table 3.4 reports the single variable cross-sectional regression between the three-day cumulative abnormal return (CAR) and each of the independent variables. Since the trading volume of NYSE/Amex and NASDAQ stocks are not directly comparable, we report the results of the cross-sectional regressions separately for these two markets. Panel A of table 3.4 reports the intercepts, coefficients and the adjusted R-squared when the dependent variable, cumulative abnormal return (CAR) is calculated under the market model (MM), while panel B reports the same information under the constant mean return model (CMRT).

Table 3.4: Single variable cross-sectional regressions for the full sample

This table reports the results of the single variable cross-sectional regression for the full sample. The dependent variable is the three-day cumulative abnormal return around the announcement date. The independent variables are firm's optionability status (Opt), option trading volume and open interest (Optvol2/Optint2), market capitalisation (Size), book-to-market (B/M), beta, volatility, log of the average trading volume (Vol), pre-split share price (PRC), number of analysts following and split factor (Fac). The variable optionability takes the value of one if the stock is optioned and zero otherwise. Optvol2/Optint2 represents a score that ranges from 0 to 10 where non-optionable stocks receive a score of 0 and optionable stocks receive a score from 1 to 10.

Panel A: Single variable cross-sectional regressions where the expected return is estimated using MM

	NYSE/Amex			NASDAQ		
	Intercept	Coeff.	Adj R^2	Intercept	Coeff.	Adj R^2
Opt	0.0288	-0.0168	0.0243	0.0390	-0.0210	0.0141
	(11.08)	*(-5.14)*		*(14.63)*	*(-4.90)*	
Optvol2	0.0254	-0.0021	0.0207	0.0361	-0.0026	0.0087
	(11.57)	*(-4.75)*		*(14.51)*	*(-3.89)*	
Optint2	0.0252	-0.0019	0.0186	0.0358	-0.0026	0.0080
	(11.34)	*(-4.51)*		*(14.46)*	*(-3.75)*	
Size	0.0542	-0.0050	0.0613	0.0522	-0.0042	0.0193
	(11.66)	*(-8.22)*		*(12.19)*	*(-5.71)*	
B/M	0.0123	0.0168	0.0057	0.0262	0.0155	0.0014
	(4.51)	*(2.62)*		*(7.94)*	*(1.81)*	
Beta	0.0191	-0.0011	-0.0009	0.0333	-0.0027	-0.0001
	6.13	*(-0.35)*		*(9.69)*	*(-0.90)*	
Volatility	0.0138	0.1967	0.0004	0.0102	0.5981	0.0183
	(3.42)	*(1.17)*		*(2.40)*	*(5.57)*	
Vol	0.0811	-0.0052	0.0363	0.0696	-0.0035	0.0082
	(8.00)	*(-6.28)*		*(6.64)*	*(-3.77)*	
PRC	0.0310	-0.0002	0.0177	0.0391	-0.0002	0.0054
	(9.34)	*(-4.40)*		*(11.61)*	*(-3.12)*	
Analyst	0.0271	-0.0011	0.0215	0.0384	-0.0014	0.0112
	(11.18)	*(-4.84)*		*(14.19)*	*(-4.39)*	
FAC	0.0201	-0.0022	-0.0005	0.0153	0.0198	0.0096
	(6.44)	*(-0.71)*		*(3.52)*	*(4.07)*	

Table 3.4: continued

Panel B: Single variable cross-sectional regressions where the expected return is estimated using CMRT						
	NYSE/Amex			NASDAQ		
	Intercept	Coeff.	Adj R^2	Intercept	Coeff.	Adj R^2
Opt	0.0276	-0.0173	0.0234	0.0376	-0.0194	0.0105
	(10.11)	*(-5.05)*		*(13.28)*	*(-4.26)*	
Optvol2	0.0240	-0.0021	0.0195	0.0348	-0.0023	0.0060
	(10.42)	*(-4.62)*		*(13.16)*	*(-3.26)*	
Optint2	0.0239	-0.0020	0.0179	0.0346	-0.0024	0.0058
	(10.23)	*(-4.43)*		*(13.17)*	*(-3.22)*	
Size	0.0527	-0.0050	0.0555	0.0498	-0.0039	0.0144
	(10.76)	*(-7.81)*		*(10.94)*	*(-4.95)*	
B/M	0.0114	0.0153	0.0040	0.0259	0.0141	0.0009
	(3.95)	*(2.27)*		*(7.39)*	*(1.56)*	
Beta	0.0175	-0.0010	-0.0009	0.0316	-0.0016	-0.0005
	(5.36)	*(-0.32)*		*(8.67)*	*(-0.52)*	
Volatility	0.0090	0.3474	0.0028	0.0055	0.7141	0.0234
	(2.11)	*(1.97)*		*(1.21)*	*(6.29)*	
Vol	0.0793	-0.0052	0.0325	0.0692	-0.0035	0.0073
	(7.43)	*(-5.94)*		*(6.21)*	*(-3.58)*	
PRC	0.0296	-0.0002	0.0164	0.0362	-0.0001	0.0023
	(8.50)	*(-4.24)*		*(10.12)*	*(-2.18)*	
Analyst	0.0260	-0.0011	0.0215	0.0364	-0.0012	0.0068
	(10.21)	*(-4.84)*		*(12.67)*	*(-3.47)*	
FAC	0.0193	-0.0030	-0.0001	0.0137	0.0210	0.0096
	(5.90)	*(-0.95)*		*(2.96)*	*(4.07)*	

Consistent with our expectations, our variable of interest, the stock's optionability induces a negative effect on the cumulative abnormal returns. In addition, both of the coefficients on option volume and open interest are negative and significant. For NYSE/Amex stocks, the coefficient on the option volume and open interest are -0.0021 (t-statistic is -4.75) and -0.0019 (t-statistic is -4.51), respectively. For NASDAQ stocks, they are both -0.0026 and are significant at 5%. The firm's market capitalisation exerts a negative influence on the cumulative abnormal returns around the announcement date. Specifically, the coefficient on the size factor for NYSE/Amex stocks is -0.005 (t-statistic is -8.22) while for NASDAQ stocks, it is -0.0042 (t-statistic is -5.71)[3]. Similar to size, stocks with a higher price on the day before the announcement date exhibit lower abnormal returns. The coefficient on this factor is significantly negative, and it amounts to -0.0002 for both NYSE/Amex and

[3] We also estimated this equation using the log of the firm's market capitalisation and find similar results to those that are based on the size decile score.

NASDAQ stocks. This indicates that stocks that have higher market capitalisations/share price prior to the announcement date will likely experience lower abnormal returns.

Meanwhile, the book-to-market factor affects the announcement returns across the three exchanges differently. Specifically, the coefficient on the book-to-market factor is positive and significant for NYSE/Amex stocks and it amounts to 0.0168 (t-statistic is 2.62); for NASDAQ stocks, this coefficient although positive, is not significant at the 5% level (t-statistic is 1.81). The relationship between the announcement returns and the stock's volatility is also not uniformly observed across different exchanges. While there is not a significant relationship between the cumulative abnormal returns and the stock's volatility for firms that are traded on the NYSE/Amex, NASDAQ stocks on the other hand exhibit a significantly positive relationship between the cumulative abnormal return and stock volatility. The stock's beta, however, does not generate any impact on the cumulative abnormal return across the different exchanges. The split factor does not create a significant effect on the announcement returns for NYSE/Amex stocks, however, for NASDAQ stocks, firms that announce a larger split have higher announcement returns. Finally, both stock trading volume and number of analysts following have a negative effect on the cumulative abnormal returns around the announcement date. This pattern is consistently observed across all exchanges.

The results of the single variable cross-sectional regressions when expected returns are estimated under the constant mean return model are comparable to the market model. Specifically, we observe a negatively significant relationship between the announcement returns and the firm's optionability status, option volume and open interest, market capitalisation, stock trading volume, share price and the number of analysts following. On the other hand, firms with higher volatility are more likely to have higher abnormal returns around the announcement date. This pattern exists for both NYSE/Amex and NASDAQ stocks. Similar to our results earlier, the book-to-market factor exerts a positive influence on the announcement returns for stocks that are traded on the NYSE/Amex; for stocks that are traded on the NASDAQ although the coefficient on the book-to-market factor is positive, it is not statistically significant. Meanwhile, the coefficient on the split factor is only positive for NASDAQ stocks, for NYSE/Amex stocks, it does not differ from zero.

In summary, the findings of the single variable cross-sectional regressions allow us to infer that the cumulative abnormal returns around the announcement date are negatively related to optionability, option trading volume and open interest, firm size, price on the day prior to the announcement date, average trading volume, and the number of analysts following. This is expected because these factors are reasonable proxies for the firm's information and liquidity environment. Our main interest is whether the firm's optionability status can enhance the informational efficiency of the underlying stocks after controlling for other relevant factors.

3.5.2.2 Optionable stocks

Panel A of table 3.5 reports the results of the single variable cross-sectional regressions on optionable stocks where the expected return is estimated using the market model while panel B reports the same information under the constant mean return model. Since the trading volume of NYSE/Amex and NASDAQ stocks are not directly comparable, we report the results of the cross-sectional regressions separately for these two markets. Panel A reports the intercepts, coefficients and the adjusted R-squared of the single variable cross-sectional regression where the expected return is estimated under the market model (MM) while panel B reports the same information under the constant mean return model (CMRT).

Table 3.5: Single variable cross-sectional regressions for optionable stocks

This table reports the results of the single variable cross-sectional regressions for the optionable stocks. The dependent variable is the three-day cumulative abnormal returns around the announcement date. The independent variables are option trading volume and open interest (Optvol1/Optint1), market capitalisation (Size), book-to-market (B/M), beta, volatility, log of the average trading volume (Vol), pre-split share price (PRC), number of analysts following and split factor (Fac). Optvol1/Optint1 represents a decile score that ranges from 1 to 10 where stocks with the lowest option trading volume/open interest receive a score of 1 and stocks with the highest option trading volume/open interest receive a score of 10.

Panel A: Single variable cross-sectional regressions where the expected return is estimated using MM

	NYSE/Amex			NASDAQ		
	Intercept	Coeff.	Adj R^2	Intercept	Coeff.	Adj R^2
Optvol1	0.0150	-0.0006	0.0002	0.0159	0.0003	-0.0015
	(3.96)	*(-1.07)*		*(2.37)*	*(0.30)*	
Optint1	0.0131	-0.0003	-0.0012	0.0150	0.0005	-0.0013
	(3.27)	*(-0.47)*		*(2.33)*	*(0.46)*	
Size	0.0278	-0.0019	0.0024	0.0221	-0.0006	-0.0015
	(2.64)	*(-1.58)*		*(1.71)*	*(-0.36)*	
B/M	0.0070	0.0145	0.0026	0.0250	-0.0424	0.0047
	(2.16)	*(1.62)*		*(5.13)*	*(-1.94)*	
Beta	0.0044	0.0071	0.0042	0.0038	0.0104	0.0050
	(0.28)	*(1.91)*		*(0.49)*	*(1.99)*	
Volatility	0.0226	-0.5022	0.0089	0.0106	0.1875	0.0002
	(4.82)	*(-2.58)*		*(1.43)*	*(1.05)*	
Vol	0.0272	-0.0012	-0.0006	0.0203	-0.0002	-0.0017
	(1.34)	*-0.78*		*(0.60)*	*(-0.08)*	
PRC	0.0139	0.0000	-0.0010	0.0176	0.0000	-0.0017
	(3.17)	*(-0.64)*		*(3.18)*	*(0.01)*	
Analyst	0.0156	-0.0004	0.0012	0.0172	0.0000	-0.0017
	(4.31)	*(-1.33)*		*(3.04)*	*(0.09)*	
FAC	0.0088	0.0029	-0.0010	0.0000	0.0207	0.0068
	(1.93)	*(0.62)*		*(0.00)*	*(2.25)*	

Table 3.5: continued

Panel B: Single variable cross-sectional regressions where the expected return is estimated using CMRT						
	NYSE/Amex			NASDAQ		
	Intercept	Coeff.	Adj R^2	Intercept	Coeff.	Adj R^2
Optvol1	0.0156	-0.0010	0.0019	0.0139	0.0007	-0.0011
	(3.78)	*(-1.48)*		*(1.93)*	*(0.60)*	
Optint1	0.0142	-0.0007	0.0001	0.0143	0.0007	-0.0011
	(3.25)	*(-1.02)*		*(2.05)*	*(0.57)*	
Size	0.0309	-0.0024	0.0038	0.0057	0.0016	-0.0004
	(2.70)	*(-1.84)*		*(0.41)*	*(0.89)*	
B/M	0.0071	0.0101	0.0001	0.0265	-0.0507	0.0062
	(2.02)	*(1.04)*		*(5.06)*	*(-2.16)*	
Beta	0.0033	0.0071	0.0032	-0.0024	0.0151	0.0105
	(0.74)	*(1.74)*		*(-0.30)*	*(2.69)*	
Volatility	0.0165	-0.2814	0.0012	0.0011	0.4406	0.0073
	(3.21)	*(-1.32)*		*(0.13)*	*(2.31)*	
Vol	0.0398	-0.0023	0.0013	0.0045	0.0010	-0.0015
	(1.81)	*(-1.35)*		*(0.12)*	*(0.36)*	
PRC	0.0133	0.0000	-0.0008	0.0117	0.0001	0.0008
	(2.78)	*(-0.71)*		*(1.97)*	*(1.23)*	
Analyst	0.0158	-0.0005	0.0026	0.0136	0.0004	-0.0006
	(4.00)	*(-1.62)*		*(2.23)*	*(0.81)*	
FAC	0.0083	0.0021	-0.0013	-0.0057	0.0275	0.0112
	(1.69)	*(0.40)*		*(-0.63)*	*(2.78)*	

In panel A, both option volume and open interest do not exert a significant influence on the cumulative abnormal returns. This trend exists across all exchanges. Moreover, when our sample is only limited to optionable stocks, the firm's market capitalisation no longer exerts a significant influence on the announcement returns. The coefficient on the size factor is -0.0019 (t-statistic is -1.58) and -0.0006 (t-statistic is -0.36) for NYSE/Amex and NASDAQ stocks, respectively. Similarly, we do not observe any relationship between the closing stock price on the day before the announcement date and the cumulative abnormal returns. This indicates that there is a clear difference in the information environment between optionable and non-optionable stocks. Once this is controlled for, there is no role for firm size or the pre-split share price to reduce the impact of the split announcement on stock returns.

For firms that traded on the NYSE and Amex, stocks with higher volatility are associated with lower cumulative abnormal returns around the announcement date.

This pattern, however, does not exist for NASDAQ stocks. Specifically, the coefficient on stock volatility amounts to -0.5022 (t-statistic is -2.58) for NYSE/Amex stocks; for NASDAQ stocks, this figure amounts to 0.1875 (t-statistic is 1.05). The stock beta exhibits a positive relationship with the cumulative abnormal returns around the announcement date. This result is consistently observed across all exchanges. Although the coefficient on the book-to-market factor is positive for NYSE/Amex stocks (0.0145), it is not significant (t-statistic 1.62). However, for NASDAQ stocks, the coefficient on this factor is significantly negative at the 10% level, amounts to -0.0424 (t-statistic is -1.94). This is in contrast with the result from the single variable regressions for the full sample. Specifically, at the full sample level, the coefficient on stock beta does not differ from zero while the coefficient on the book-to-market factor is significantly positive for NYSE/Amex stocks. Thus, the findings from the sub-sample analysis allow us to infer that the previous relationship between the stock beta and book-to-market with the announcement returns may be influenced by whether the stocks are optioned. This problem should be addressed in a multiple variable cross-sectional regression framework where the optionability factor is controlled for. Finally, for NASDAQ stocks, firms with higher split factors are associated with higher announcement returns. This is consistent with the full sample results.

The findings from the constant mean return model are comparable to those using the market model. Specifically, our variables of interest, option volume and open interest, once again do not exert any influence on the cumulative abnormal returns regardless of the exchanges that the firms are listed on. Both of the firm’s market capitalisation and the closing stock price prior to the announcement date do not explain the variation in equity returns around the announcement date. However, for NASDAQ stocks, the coefficient on stock volatility is positively related to the cumulative abnormal returns. For NYSE/Amex stocks, this figure is negative, and amounts to -0.2814 (t-statistic -1.32). This result is actually different from the market model where the coefficient on the stock volatility is significantly negative for NYSE/Amex stocks and is close to zero for NASDAQ stocks. Meanwhile, the coefficient on stock beta under the constant mean return model is similar to the market model. That is, there is a positive relationship between the firm's beta and the announcement returns. Although this finding is stronger for NASDAQ stocks (t-statistic is 2.69), it is also evident for NYSE and Amex stocks (t-statistic is 1.73). Finally, the split factor exhibits a significant positive relationship with the announcement returns while the coefficients on the last two factors, stock volume and the number of analysts following, do not differ from zero.

Overall, our sub-sample result suggests that it is unlikely that option trading volume and open interest will have significant explanatory power on the announcement returns. However, there is a possibility that there is a difference in the return behaviour for stocks that are not optioned and stocks that have high option trading volume/open interest. In addition, the relationship between some of the independent variables and the cumulative abnormal returns may be influenced by whether the stocks are optioned. All of these issues should be resolved in a multiple variable cross-sectional regression framework.

3.5.3 Multiple variable cross-sectional regressions

Table 3.6 reports the results of the multiple variable cross-sectional regressions where the dependent variable is the three-day cumulative abnormal returns around the announcement date. Panel A reports the intercepts, coefficients and the adjusted R-squared when the dependent variable, cumulative abnormal return (CAR) is calculated using the market model (MM), while panel B reports the same information using the constant mean return model (CMRT). To investigate the ability of the option market to enhance the informational efficiency of the underlying stocks, we employ three measures. The first is the optionability variable, which takes the value of one if the stock is optioned, and zero if the stock is not optioned. The second variable is Optvol1, which is a decile score that ranges from 1 to 10. Stocks that have highest option trading volume will receive a decile score of 10 where stocks that have the lowest option trading volume will receive a decile score of one. The final measure, Optvol2, combines the impact of whether the stock is optioned and whether the option is actively traded into one measure. Specifically, non-optionable stocks will receive an Optvol2 decile score of zero while optionable stocks will receive an Optvol2 decile score that ranges from 1 to 10 depending on whether the options are actively traded. Since the trading activity in the option market is also captured by the option open interest, we create the optint1 and optint2 variables in a similar manner as Optvol1 and Optvol2

Table 3.6: Multiple variable cross-sectional regressions

This table reports the results of the multiple variable cross-sectional regressions where the dependent variable is the three-day cumulative abnormal returns around the announcement date. The independent variables are the firm's optionability status (Opt), option trading volume and open interest, market capitalisation (Size), book-to-market (B/M), beta, volatility, log of the average trading volume (Vol), pre-split share price (Prc), number of analysts following (Analyst), and split factor (Fac). Two measures are used to capture the trading activity in the option market. Optvol1/Optin1 represent a decile score, which ranges from 1 to 10 where stocks with the lowest option trading volume (open interest) receives a score of 1 and stocks with the highest option trading volume receives a score of 10. Optvol2 /Optint2 represent a score that ranges from 0 to 10 where non-optionable stocks receive a score of 0 and optionable stocks receive a score from 1 to 10.

Panel A: Multiple variable cross-sectional regressions where the expected return is estimated using MM

	Intercept	Opt	Opvol1	Optvol2	Optint1	Optint2	Size	B/M	Beta	Volatility	Vol	PRC	Analyst	FAC	Adj R^2
NYSE/Amex	0.0468	-0.0026					-0.0054	-0.0001	0.0074	-0.0400	0.0005	0.0000	0.0001	0.0026	0.0597
	(2.72)	*(-0.59)*					*(-3.79)*	*(-0.01)*	*(1.94)*	*(-0.22)*	*(0.23)*	*(-0.38)*	*(0.20)*	*(0.66)*	
	-0.0006		-0.0009				-0.0020	0.0037	0.0105	-0.6441	0.0029	0.0000	-0.0002	0.0056	0.0171
	(-0.02)		*(-0.82)*				*(-1.01)*	*(0.38)*	*(2.42)*	*(-2.95)*	*(0.78)*	*(-0.38)*	*(-0.59)*	*(0.95)*	
	0.0471			-0.0001			-0.0057	-0.0002	0.0073	-0.0463	0.0005	0.0000	0.0000	0.0026	0.0594
	(2.56)			*(-0.09)*			*(-4.04)*	*(-0.03)*	*(1.92)*	*(-0.25)*	*(0.23)*	*(-0.32)*	*(0.06)*	*(0.66)*	
	0.0235				0.0002		-0.0019	0.0043	0.0103	-0.6523	0.0006	0.0000	-0.0002	0.0051	0.0160
	(0.62)				*(0.13)*		*(-0.95)*	*(0.44)*	*(2.37)*	*(-2.98)*	*(0.15)*	*(-0.55)*	*(-0.60)*	*(0.86)*	
	0.0522					0.0005	-0.0056	-0.0005	0.0074	-0.0466	0.0000	0.0000	-0.0001	0.0025	0.0598
	(2.83)					*(0.67)*	*(-4.01)*	*(-0.06)*	*(1.95)*	*(-0.25)*	*(0.00)*	*(-0.39)*	*(-0.28)*	*(0.65)*	
NASDAQ	0.0022	-0.0136					-0.0047	0.0016	0.0038	0.7356	0.0014	-0.0002	0.0003	0.0308	0.0684
	(0.11)	*(-2.24)*					*(-2.89)*	*(0.15)*	*(0.80)*	*(5.73)*	*(0.61)*	*(-3.29)*	*(0.66)*	*(5.81)*	
	0.0435		-0.0009				-0.0027	-0.0513	0.0147	-0.1538	-0.0020	-0.0001	0.0005	0.0279	0.0127
	(0.68)		*(-0.46)*				*(-1.01)*	*(-1.89)*	*(2.07)*	*(-0.64)*	*(-0.33)*	*(-1.42)*	*(0.73)*	*(2.64)*	
	0.0052			-0.0009			-0.0052	0.0025	0.0040	0.7345	0.0010	-0.0002	0.0002	0.0305	0.0658
	(0.25)			*(-0.80)*			*(-3.24)*	*(0.23)*	*(0.84)*	*(5.72)*	*(0.44)*	*(-3.03)*	*(0.31)*	*(5.73)*	
	0.0782				0.0008		-0.0023	-0.0488	0.0137	-0.1069	-0.0056	-0.0001	0.0005	0.0263	0.0126
	(1.19)				*(0.41)*		*(-0.87)*	*(-1.81)*	*(1.93)*	*(-0.42)*	*(-0.88)*	*(-1.53)*	*(0.80)*	*(2.50)*	
	0.0086					-0.0001	-0.0053	0.0022	0.0038	0.7328	0.0007	-0.0002	0.0000	0.0302	0.0655
	(0.41)					*(-0.07)*	*(-3.25)*	*(0.20)*	*(0.81)*	*(5.69)*	*(0.32)*	*(-3.09)*	*(-0.08)*	*(5.68)*	

Table 3.6: continued

Panel B: Multiple variable cross-sectional regressions where the expected return is estimated using CMRT															
	Intercept	Opt	Opvol1	Optvol2	Optint1	Optint2	Size	B/M	Beta	Volatility	Vol	PRC	Analyst	FAC	Adj R^2
NYSE/Amex	0.0421	-0.0034					-0.0051	0.0001	0.0066	0.1337	0.0004	0.0000	0.0000	0.0013	0.0538
	(2.32)	*(-0.74)*					*(-3.36)*	*(0.02)*	*(1.63)*	*(0.69)*	*(0.19)*	*(-0.24)*	*-0.03*	*(0.32)*	
	0.0110		-0.0010				-0.0016	0.0014	0.0103	-0.4124	0.0013	0.0000	-0.0002	0.0051	0.0055
	(0.27)		*(-0.82)*				*(-0.73)*	*(0.13)*	*(2.15)*	*(-1.73)*	*(0.32)*	*(-0.23)*	*-0.49*	*(0.78)*	
	0.0422			-0.0001			-0.0054	0.0000	0.0064	0.1258	0.0005	0.0000	-0.0001	0.0013	0.0533
	(2.18)			*(-0.15)*			*(-3.64)*	*(0.00)*	*(1.59)*	*(0.65)*	*(0.20)*	*(-0.15)*	*(-0.18)*	*(0.32)*	
	0.0373				0.0002		-0.0015	0.0021	0.0100	-0.4214	-0.0012	0.0000	-0.0002	0.0045	0.0044
	(0.90)				*(0.12)*		*(-0.67)*	*(0.19)*	*(2.10)*	*(-1.76)*	*(-0.29)*	*(-0.41)*	*(-0.50)*	*(0.69)*	
	0.0492					0.0003	-0.0055	-0.0006	0.0059	0.0958	0.0000	0.0000	-0.0003	0.0018	0.0536
	(5.33)					*(0.41)*	*(-5.31)*	*(-0.08)*	*(1.65)*	*(0.51)*	*(1.46)*	*(-0.42)*	*(-0.72)*	*(0.43)*	
NASDAQ	0.0169	-0.0129					-0.0037	0.0035	0.0036	0.9091	-0.0014	-0.0002	0.0008	0.0294	0.0646
	(0.77)	*(-2.00)*					*(-2.12)*	*(0.29)*	*(0.73)*	*(6.66)*	*(-0.58)*	*(-2.74)*	*(1.62)*	*(5.22)*	
	0.0539		-0.0009				-0.0001	-0.0293	0.0154	0.1294	-0.0061	-0.0001	0.0010	0.0292	0.0163
	(0.78)		*(-0.44)*				*(-0.05)*	*(-1.01)*	*(2.03)*	*(0.50)*	*(-0.93)*	*(-1.00)*	*(1.39)*	*(2.57)*	
	0.0192			-0.0010			-0.0042	0.0043	0.0039	0.9083	-0.0017	-0.0002	0.0007	0.0292	0.0626
	(0.87)			*(-0.82)*			*(-2.43)*	*(0.37)*	*(0.77)*	*(6.65)*	*(-0.70)*	*(-2.50)*	*(1.26)*	*(5.16)*	
	0.0932				0.0010		0.0003	-0.0267	0.0144	0.1846	-0.0102	-0.0001	0.0011	0.0274	0.0163
	(1.32)				*(0.47)*		*(0.11)*	*(-0.92)*	*(1.89)*	*(0.68)*	*(-1.49)*	*(-1.11)*	*(1.47)*	*(2.42)*	
	0.0058					-0.0003	-0.0050	0.0065	0.0022	0.8923	0.0000	-0.0002	0.0005	0.0292	0.0622
	(0.60)					*(-0.26)*	*(-3.61)*	*(0.57)*	*(0.48)*	*(6.57)*	*(-0.45)*	*(-2.41)*	*(0.83)*	*(5.17)*	

Under the market model, the coefficient on optionability, which takes the value of one if the stock is optioned and zero otherwise, is negative, and it amounts to -0.0026 (t-statistic is -0.59) for NYSE/Amex stocks and -0.0136 (t-statistic is -2.24) for NASDAQ stocks. Thus, if optionability enhances the informational efficiency of the underlying stocks after controlling for the other factors, then this is only observed in NASDAQ stocks. On the other hand, the cumulative abnormal return around the announcement date is negatively associated with the firm's market capitalisation. For firms that traded on the NYSE/Amex, the coefficient on the size factor is -0.0054 (t-statistic is -3.79); for NASDAQ stocks, this amounts to -0.0047 (t-statistic is -2.89). The closing stock price on the day prior to the announcement date is also negatively related to the announcement returns, however, it is only significant for NASDAQ stocks, for NYSE/Amex stocks, the coefficient on the price factor is not statistically different from zero. As mentioned earlier, in the single variable cross-sectional regression framework, the pre-announcement share price exerts a negative influence across all exchanges. Thus, for NYSE/Amex stocks, in the presence of the other firms' characteristics, the closing price on day -1 does not have any explanatory power on the cumulative abnormal returns. However, for NASDAQ stocks, the coefficient on the price factor is -0.0002 (t-statistic is -3.29). In this case, the pre-announcement share price actually contains some information that is relevant in explaining the announcement returns and is not captured by the other factors.

While stock beta does not exert any significant influence on the cumulative abnormal returns in a single variable cross-sectional regression, in a multiple variable cross-sectional regression, the coefficient on stock beta is 0.0074 (t-statistic is 1.94) for NYSE/Amex stocks; for NASDAQ stocks, the coefficient on this factor although positive (0.0038), is not significant (t-statistic is 0.8). Together with our result from section 3.5.2.2, this allows us to infer that the ability of beta to explain variation in equity returns for the full sample is undermined by the optionability nature of the stocks. Once this is controlled for, stock beta actually demonstrates a positive relationship with the cumulative abnormal returns, at least for NYSE/Amex stocks.

Similar to the price factor, stock volatility only exhibits a major impact on NASDAQ stocks. Specifically, we observe a positive relationship between stock volatility and the three-day cumulative abnormal returns for NASDAQ stocks; for NYSE/Amex stocks, although there is a negative relationship between these two variables, it is not significantly different from zero. This is consistent with our result from the single variable regressions. Thus, the relationship between stock volatility and the announcement returns is not influenced by the control variables. Finally, NASDAQ firms that have a higher split factor experience higher abnormal returns around the announcement date. Although this pattern is not observed in NYSE/Amex stocks, it certainly provides evidence that there is information in the split factor itself, which determines the market reaction to the split announcement for NASDAQ stocks.

Since the option market is quite illiquid, the option's ability to explain the variation in equity returns may depend on whether the options are actively traded. Specifically, the reason why we do not observe a significant negative relationship between optionability and the announcement returns for NYSE/Amex stocks is because the trading activity for some options are especially low. Thus, in our second regression equation, we replace the Opt variable with Optvol1 and Optint1. As mentioned earlier, this regression is limited to only optionable stocks. Here, the option volume and open interest do not exert any influence on the cumulative abnormal returns around the announcement date. For both NYSE/Amex and NASDAQ stocks, the coefficients on the Optvol1 and Optint1 are not significantly different from zero. Consistent with the result from the single variable regression, while the closing share price and the firm's market capitalisation do not exhibit any relationship with the announcement returns, the coefficient on stock volatility is significantly negative for NYSE/Amex stocks. For NASDAQ stocks, this figure is close to zero. This pattern exists regardless of whether Optvol1 or Optint1 is included as the independent variable. Meanwhile, we observe a positive relationship between stock beta and the cumulative abnormal returns across all exchanges. Finally, for firms that are traded on the NASDAQ, stocks that have a larger split factor are associated with higher abnormal returns around the announcement date.

While the option volume and open interest are not able to explain the variation in the announcement returns, it is possible that there is a difference in the behaviour of the announcement returns between non-optionable stocks and stocks that have actively traded options. To investigate whether such a relationship exists, we replace Optvol1/Optint1 with Optvol2/Optint2. Thus, our regression is estimated for the full sample. Once again, the coefficient on the size factor is significantly negative across all exchanges. For NASDAQ stocks, the closing price on the day before the announcement date also exhibits a negative relationship on the cumulative abnormal returns. However, we do not observe any relationship between both Optvol2/Optint2 and the abnormal returns around the announcement date. In fact, when we employ Optvol2/Optint2 as one of the independent variables, then this yields very similar results compared to the regression with the dichotomous optionability variable.

Specifically, the coefficient on stock beta is positive for NYSE/Amex stocks while the split factor exerts a positive influence on the abnormal returns for NASDAQ stocks. If the option market plays any important role in improving the informational efficiency of the underlying stocks, then this is certainly not captured in the option volume and open interest. Specifically, while the optionability variable is able to explain some of the variation in the abnormal returns for NASDAQ stocks, both of the option volume and open interest variables do not exhibit any explanatory power across all exchanges.

In panel B, we observe comparable findings under the constant mean return model. For NYSE/Amex stocks, the dichotomous variable, Opt does not seem to influence the announcement returns. In fact, the firm's market capitalisation is the only variable that exhibits a significant influence on the announcement returns. The coefficient on the size factor is -0.0052 (t-statistic is -3.36). Meanwhile, for NASDAQ stocks, optionable stocks are associated with lower abnormal returns compared to non-optionable stocks, after controlling for other factors. In addition to the firm's market capitalisation, the closing stock price one day prior to the announcement date also exhibits a negative relationship with the announcement returns. Similar to the result from the market model, both of the stock volatility and the split factor exert a positive influence on the cumulative abnormal returns.

When we replace the dummy variable Opt with Optvol1/Optint1 and Optvol2/Optint2, which take into account the trading activity of the options, we do not observe a significant relationship between the announcement returns and any one of these variables. Thus, there is no evidence that stocks with high option trading activity experience lower abnormal returns compared to stocks with low option trading activity and non-optionable stocks. When the regression is estimated with only optionable stocks, we observe a positive relationship between the stock beta and the announcement returns. Finally, consistent with our result earlier, while the coefficients on the stock volatility and beta might vary with the sample size (full sample versus only optionable stocks), the split factor consistently exerts a positive influence on the cumulative abnormal returns for NASDAQ stocks regardless of the sample size.

In summary, we aim to investigate the role of the option market in enhancing the informational role of the stock market. We employ similar control variables as Chern, Tandon, Yu and Webb (2008) but our findings are actually contrary. Specifically, they find that for NYSE/Amex stocks, the abnormal returns are significantly lower for stocks that have options compared to stocks that do not. However, this pattern is not observed for firms that traded on the NASDAQ. Our results indicate that if optionability enhances the informational efficiency of the underlying stocks, then this only exists in NASDAQ stocks. Moreover, incorporating the trading activity of the option market into this measure does not increase the explanatory power of this variable. We conclude that the abnormal returns around the announcement date are greatly influenced by the firms' market capitalisation. Once controlled for, the other variables only exhibit a limited ability in explaining the variation in the abnormal returns around the announcement date. We also observe that for NASDAQ stocks, there is information in the split factor that is valued by investors, which induces them to react positively.

3.6 Conclusion

We begin our analysis by examining the market reaction to the split announcements. Using the market model and the constant mean model to estimate expected returns, we document evidence of positive excess returns in the three-day period surrounding the announcement date. This leads us to infer that this event is perceived as good news, which generates a favourable response by the market. Next, we investigate whether the magnitude of these returns are affected by the firm's optionability status. If stocks that have options are associated with greater informational efficiency compared to stocks that do not, then the split announcements may convey less new information to the market for these stocks. Specifically, we replicate Chern, Tandon, Yu and Webb's (2008) study using the options data provided by the OptionMetrics Ivy database. In contrast to Chern, Tandon, Yu and Webb (2008), our findings indicate that the firm's optionability status does not exhibit any significant influence on the announcement returns for stocks that are listed on the NYSE and Amex. Meanwhile, there is a negative relationship between the abnormal returns and optionability for firms that are listed on the NASDAQ. As an extension to their research, we examine whether the ability of options to explain the variation in the announcement returns depend on whether these options are actively traded. Our evidence indicates that option volume and open interest do not exhibit any explanatory power on the cumulative abnormal returns.

We attribute the reason(s) for the limited ability of options to explain the variation in equity returns as follows: first, the option market only has a partial role in improving the informational efficiency of the underlying stocks. After controlling for factors that are known to affect equity returns, the explanatory power of optionability is substantially reduced. Second, it is possible that there is only a weak link between the announcement returns and the firm's optionability status because this event does not induce speculative trading activity by the option investors. Since the option market is considered an ideal venue for information based trading, the ability of options to reduce the information effect of the split announcements may depend on whether part of that information has been reflected in the option market. Therefore, if the option investors are not concerned about the content of this announcement, then we should not expect any strong association between the firm's optionability status and the cumulative abnormal returns. However, this is only a preliminary result because the relationship between optionability and the announcement returns does not reveal the reaction of the option market to the split announcement. If a stock split leads to positive excess returns in the future, then this should draw the attention of the option investors. In fact, it will be interesting to study the impact of this new information on the option market because it allows us to assess the profitability of trading following the event date. We aim to examine this conjecture more closely in the second empirical chapter.

Chapter 4

The behaviour of the option market around stock split announcements

4.1 Introduction

In chapter 3, we have confirmed the existence of positive excess returns surrounding the split announcements. However, what matters to investors is whether they can make money once this information has arrived to the market. While previous studies assert that asset returns are predictable following the split announcements, none of them actually outlines the process to exploit this trend. According to Brown (2010), predictability is different from profitability. This is because the profitability of a trading strategy is dependent on the information available at the time the trades were made. The fact that asset returns are predictable following certain corporate announcements does not guarantee that these returns are exploitable.

We take a different approach in examining the success of a strategy that buys splitting companies once this information has become public. Specifically, we study whether informed investors anticipate positive excess returns as a result of the event. The new method has two advantages: first, it answers the question of whether informed investors believe they can earn abnormal returns as opposed to whether these returns are predictable following the event date. This is certainly important information to uninformed investors, which can potentially enhance their trading decisions. Second, our test is not limited to long-run returns, rather if there is any window of opportunity to profit from the split announcement (both short-run and long-run), then this should be valued by informed investors. This leads us to the question of who the informed investors are and where do they trade?

In the presence of information asymmetry and short sale constraints, Black (1975) is the first who claimed that the option market might induce informed traders to transact in options rather than stocks. If this were the case, then one would expect the option market to play an important informational role in the price discovery process of the underlying securities. Indeed, an impressive range of researchers including Manaster and Rendleman (1982), Bhattacharya (1987), Vijh (1988, 1990), Anthony (1988), Conrad (1989), Stoll and Whaley (1990), Chan, Chung and Johnson (1993) and Srinivas (1993) have tried to establish the linkage between the option market and the stock market. However, these studies often reach inconclusive evidence as to which of the two markets reflect new information earlier. More recently, findings from Easley, O'Hara and Srinivas (1998), Cao, Chen and Griffin (2005), Pan and Poteshman (2006) and Chakravarty, Gulen and Mayhew (2004) together suggest that the option market is a venue for information based trading. Specifically, Easley, O'Hara and Srinivas (1998) and Pan and Poteshman (2006) argue that signed trading volume in the option market can help forecast stock returns. Meanwhile, Cao, Chen and Griffin (2000) document abnormal trading volume in the options market prior to takeover announcements. Finally, Chakravarty, Gulen and Mayhew (2004) find evidence of significant price discovery in the option market.

If trading following the split announcements is a free lunch, then the option market is an ideal venue for informed investors to exploit such opportunities. This is because the option market offers a much higher degree of leverage compared to the underlying stock market. Since investors in the options market are more sophisticated and their trades carry more information, the fact that the split announcement is information that is valued by the option investors is a signal to the uninformed investors that a stock split is perhaps a "buy". However, under the assumptions of perfect capital markets, a martingale diffusion process for the underlying asset returns and the ability to replicate option payoffs using the underlying asset and the risk-free asset, standard option pricing models such as the Black-Scholes (1973) model and the binomial model predict that only six factors are relevant in determining the price of an option. These factors are the price of the underlying asset, exercise price, volatility, time to maturity, risk-free interest rate and dividends on the underlying asset. Other factors that may affect the price of the underlying asset such as expected future stock returns are not priced. If this is the case, then even if abnormal returns could be earned with certainty in the future, this will not be reflected in the option price. Nevertheless, once the perfect market assumption is relaxed, it becomes difficult to replicate the option payoffs, which leads the option prices to deviate from the prices of the replicating portfolios (Figlewski, 1989, Figlewski and Webb, 1993 and Grossman, 1995). This opens the opportunity for other factors such as expected future stocks returns and risk aversions to have an influence on option pricing.

Unlike studies that use option trading volume to draw inference about the future movement in the price of the underlying stock (Easley, O'Hara and Srinivas, 1998, Pan and Poteshman, 2006), our focus is on the option implied volatility. Specifically, we examine the behaviour of the option implied volatility for all splitting companies for the period 1998-2007. Our reasons for not using the change in the option price or trading volume are as follows: first, the change in the option price may simply be a result of a change in the price of the underlying stock. Second, it is rather difficult to interpret the information content of the option trading volume. Specifically, trading volume is often unsigned; an increase in the option trading volume does not signify that there is higher demand for a particular option. On the other hand, both call and put options are positively related to volatility. An increase in the implied volatility suggests that there is upward buying pressure on the option. That is, implied volatility reflects the demand of the option given the prevailing stock price.

We first examine the change in the implied volatility for call and put options during the announcement period. This allows us to evaluate the impact of this new information on the behaviour of call and put options separately. We find that, in aggregate, there is evidence of an increase in the implied volatility for both call and put options. However, this pattern varies with the option's moneyness and time to maturity. For options that are at-the-money, while there is a permanent increase in the implied volatility for the options that expire after the effective date (long maturity options), the increase in the implied volatility for the options that expire before the effective date (short maturity options) is rather short-lived. Specifically, for the long maturity options, the positive change in the implied volatility is sustainable following the announcement date. On the other hand, for the short maturity options, this change is quickly reversed in the subsequent days following the announcement date. With options that are in-/out-of-the-money, while there is evidence of an increase in the implied volatility for the long maturity options, the short maturity options do not experience any major changes in the implied volatility as a result of the split announcement. This is not only consistent with the notion that the split announcement is perceived as a positive signal by the option market, it also supports Ohlson and

Penman's (1985) conjecture that there is a permanent increase in the stock volatility following the effective date. Specifically, the implied volatility of an option is often regarded as the market forecast of future return volatility of the underlying stock over the remaining life of the option. If there is an increase in the stock volatility after the effective date, as previous research has claimed (Ohlson and Penman 1985, Dravid, 1987, Dubofsky, 1991 and Koski, 1998), then this should mainly influence the implied volatility of options that expire after the effective date. For options that expire before the effective date, while there might be an increase in the implied volatility on the announcement date, one does not expect this new level of implied volatility to sustain at that level.

We then repeat our analysis for stocks with different market capitalisations after showing that the firm's market capitalisation is a reasonable proxy for option liquidity. Our aim is to investigate whether the above pattern in the behaviour of the option implied volatility is robust at varying levels of liquidity. Unlike most studies in the option literature where the focus is on the option market in aggregate, we emphasise the importance of liquidity. This is because trading activity in the option market is not as heavy as the underlying stock market while a high proportion of informed investors reside in the option market. This raises the need for the option market makers to impound the effect of new information into the option price in a timely manner. Thus, if we observe a change in implied volatility when the liquidity level is low, then this change is likely to be the result of the market makers adjusting the option price to reflect the information content of the split announcement. In contrast, if there is a substantial change in the option implied volatility when the liquidity level is high, then it is likely that this change is due to the trading activity in the option market and thereby reflects the view of the option investors.

We find that for at-the-money options on stocks that belong to the S&P500 index (the most liquid options), there is a clear difference in the behaviour of the implied volatility for options that expire after the effective date versus those that expire before. Specifically, although both the long and short maturity options show a positive change in the implied volatility on the announcement date, this change seems to be only a temporary effect for the short maturity options. That is, following the announcement date, the implied volatility of the short maturity options returns to its pre-announcement level. While this pattern is observed in options on stocks that are not part of the S&P1500 index, it is not evident in options on stocks that are part of the S&P400 and S&P600 index. For these two groups, while there is an increase in the implied volatility for the long maturity at-the-money options, the abnormal change in the implied volatility for the short maturity options is not statistically different from zero. Thus, our finding indicates that the increase in the stock volatility following the effective date has been incorporated in the option market from the announcement date. As for the out-of-the-money and in-the-money options, except for stocks that belong to the S&P600 index and the "other" group (stocks that do not belong to the S&P1500 index), we find no evidence of an increase in the implied volatility for both the long and short maturity options for firms that belong to the S&P500 and S&P400 index. This suggests that the increase in the implied volatility observed in out-of-the-money and in-the-money call and put options is driven by the small stocks and stocks that do not belong to the S&P1500 index. Thus, most of the reaction in the option market, whether it originates from the market makers or the option investors, seems to reside in at-the-money options.

Investigating the implied volatility of the call and the put options alone will not allow us to infer whether investors actually trade in the option market in anticipation of a future increase in the stock price. This is because the increase in the option implied volatility might simply reflect the actual increase in the volatility of the underlying stocks. Meanwhile, if there are positive excess returns to be earned following the split announcements, then one profitable strategy investors can employ is to either purchase a call option or sell a put option. This buying/selling pressure in turn will increase the call price and lower the put price, thereby creating a positive spread between the implied volatility of the call and the put option[4].

The idea of examining call and put options simultaneously is not original to this research. Easley, O'Hara and Srinivas (1998) argued in their model that option contracts are not redundant securities because put-call parity does not need to hold in the absence of a complete market. If put-call parity held at every instant, then analysing the behaviour of the put would be pointless because it provides no information that was not already in the call and in the stock. Given there is asymmetric information, their model predicts that buying a call or selling a put are trades that will benefit from a rise in the stock price and these trades carry positive information about future stock prices. That is, the behaviour of the calls and puts together, not in isolation, contain information about the underlying stock returns.

[4] A positive volatility spread is not evidence that an arbitrage opportunity exists in the option market. Rather, it suggests there is more buying activity in the call options relative to put options.

From here, many studies including Amin, Coval and Seyhun (2004), Seyhun and Wang (2006) and Cremers and Weinbaum (2010) have tried to establish the interrelationship between the option market and the stock market through the study of the volatility spread between call and put options. While the nature of their research is quite different, there is one common theme in their findings: there is a strong linkage in the option volatility spreads and the returns of the underlying stocks.

We apply the test of the option volatility spread in an event study context and find that although there is a positive change in the option volatility spread one day after the announcement date; this change is mainly a result of firms that belong to the S&P600 index. However, even for this particular group of stocks, it is very unlikely that the positive change in the volatility spread is driven by the option investors anticipating that excess returns can be made following the split announcements; rather it reflects a timing difference in which the market makers react to new information. Meanwhile, for options on firms that are part of the remaining three size groups, there is no evidence of a positive volatility spread as a result of the split announcements. This suggests that from the view of the option investors, it is doubtful that post-announcement excess returns exist. The increase in the option implied volatility observed earlier mainly reflects an increase in the actual volatility of the underlying stock.

In this chapter, we follow a different path in answering the question of whether trading following the split announcement is profitable. Predictability is different to profitability, however, it is difficult to differentiate these two concepts. Since informed investors tend to migrate to the option market in order to achieve higher leverage and avoid short-sale restrictions, by analysing the perception of the option investors regarding the information content of the split announcements, this provides uninformed investors a means to evaluate the ability to earn excess returns following such announcements. Our findings support Fama, Fisher, Jensen and Roll (1969), Byun and Rozeff (2003) and Boehme and Danielsen's (2007) contention that stock splits are not a free lunch. In the view of the option investors, the abnormal returns documented in Ikenberry, Rankine and Stice (1996), Desai and Jain (1997) and Ikenberry and Ramnath (2002) either do not exist or are not exploitable. While the main aim of our study is not to test the forecasting ability of the option implied volatility, we certainly provide evidence that Ohlson and Penman's (1985) conjecture is likely to be valid. In contrast to Sheikh (1989), our result is consistent with Deng and Julio (2005) in that the permanent increase in the stock volatility as a result of the split has been incorporated quickly in the option market. Finally, we present a comprehensive description of liquidity in the option market. Specifically, options are much more levered securities compared to the underlying stocks and out-of-the-money options are the most attractive in terms of leverage. Yet, most of the speculation activity takes place in at-the-money options. The main reason for this is that the exceptionally high bid-ask spreads in out-of-the-money options discourage investors from trading in these options. The rest of this chapter proceeds as follows: section 4.2 reviews the literature, section 4.3 outlines the data and sample selection, section 4.4 presents the methodology, section 4.5 discusses the results and section 4.6 concludes.

4.2 Literature review

Ohlson and Penman (1985) are the first to study the behaviour of stock return volatility prior and subsequent to the ex-date of stock splits. They find that on average, stock variances are significantly higher following the ex-split date. Their analysis is based on 1,257 stock splits with a split factor greater than or equal to 100% for the period July 1962 to December 1981. To examine whether there is a change in the behaviour of the firm's volatility surrounding the event, they compare the stock return variances from the periods that follow the announcement date but precede the effective date with the return variances after the effective date. They find that on average, the return variance increased by 28-35 percent following the effective date. They also show that this increase in return volatility is not a temporary effect since there is no reduction in the stock volatility one year following the split. One possible explanation is that investors are overly concerned with the absolute changes in price and therefore over-react to information in low priced stocks. That is, stock volatilities are higher only when the shares go ex-date. The increase in return variances is inconsistent with an informationally efficient market, where prices respond instantaneously and in an unbiased fashion to new information. Thus, they emphasise the need for further investigation on this matter.

Following this evidence, Dravid (1987) extends the work of Ohlson and Penman (1985) in all types of stock distributions while Dubofsky (1991) compares the changes in volatility for NYSE and Amex stocks. Both these papers reach very similar findings to Ohlson and Penman (1985), which leads them to conclude that there is a permanent increase in return variability following the effective date. Meanwhile, a number of researchers have related this substantial increase in return volatility to measurement errors. Specifically, Blume and Stambaugh (1983), Gottlieb and Kalay (1985) and Amihud and Mendelson (1987) show that bid-ask spreads and price discreteness induce an upward bias in the estimated volatility of observed stock returns. Since bid-ask spreads tend to be higher at lower price levels, it is sensible to infer that the increase in return volatility following the splits may simply be a result of measurement biases. In response to this possibility, Koski (1998) find that almost none of the increase in realised volatility documented in previous research is due to bid-ask spreads or price discreteness.

If there is a genuine increase in the return volatility following the splits, then it is reasonable to expect this change in volatility is impounded in option pricing. Currently, there are three major studies that examine the impact of the split announcements on the option market. The first two of these studies are by Sheikh (1989) and Klein and Peterson (1988). Sheikh (1989) studies 83 options on splitting companies from January 1978 to December 1983 and Klein and Peterson study 96 options from January 1978 to December 1984. Their contention is that if implied volatility reflects the market's expectations of future volatility over the life of the option, then the implied volatility of a call option that expires after the effective date should also increase. In an efficient option market, the increase should occur at the announcement of the split when the information becomes public. Together, these studies find no change in the implied volatilities of splitting stocks compared to the implied volatility of control firms on the split announcement date.

For each split, Sheikh (1989) matches the call option of the sample firm with the call option of a firm from the same two-digit SIC industry code, the same beta and similar return variances in the year preceding the split. He finds that the implied volatilities of the split firm and the control firm both increase around the announcement date, but the change in implied volatility for the split firm is not significantly different from its matching firm. Thus, there are other factors that cause the increase in the implied volatility of a call option on a split stock other than the market anticipating a post-split volatility increase. Moreover, the implied volatility for the sample firm significantly increases around the ex-split date, while for the control group it decreases. This increase is correlated with the ex-date increase in return variance. Overall, he concludes that the option market did not anticipate post-split increases in return variance, it waits until the ex-split date to fully incorporate the information about the future volatility into the option prices.

Similarly to Sheikh (1989), Klein and Peterson (1988) investigate the behaviour of implied volatility and option returns of splitting stocks during the period around the announcement/effective date. Their findings indicate that the options market is slow to react to the increased volatility of the underlying stock following the effective date. The increase in the implied volatility is not fully reflected around the announcement date. Further, given that the effective date is known well in advance, a substantial change in implied volatility is still present following the effective date.

Recently, Deng and Julio (2005) test the information content and forecasting ability of implied volatility around stock splits with a much bigger sample: 1,314 stock splits over the period 1996 to 2003. Unlike previous studies, they document strong evidence that implied volatility contains relevant information about future volatility. They work on the same intuition as Sheikh (1988). That is, for the pre-split expiring options (near options), the implied volatility might increase due to a temporary market reaction on the announcement date; however, this increase should not be permanent. On the other hand, for the post-split expiring options (distant options), the implied volatility should exhibit a permanent increase on the announcement date.

They examine the implied volatility for both distant and near options for 40 days around the split announcements. Their empirical results are consistent with their predictions. First, they observe a large jump in the average implied volatility for the distant options. This increase continues even after the announcement date. Meanwhile, the average implied volatility of near options only exhibits a temporary increase around the announcement date and declines to the original level subsequent to the announcement date.

Next, they measure the relative changes in implied volatility of distant versus near options around the split announcement. To compute the change in implied volatility, they match each measure on the announcement date with that of two control samples of options on the same stock on a different date. The two matching samples are formed using options with the same lengths of maturities and which have the same level of moneyness. They then perform the Wilcoxon signed rank test of these two measures after adjusting for maturity differences (since near options mature earlier than distant options, the difference in implied volatility might reflect a difference in maturity rather than market expectation).

The statistic from the Wilcoxon signed test is positive and significant around the announcement date, which suggests that the change in implied volatility for the distant option is much larger than that of the near option. In other words, the increase around the announcement date for the distant option is likely to be more “permanent” compared to that of the near option. This supports the earlier finding and is also consistent with their predictions. Overall, they find strong evidence that implied volatility reflects the market’s expectation about future realized volatility, which suggests some degree of market efficiency is present in the option market.

4.3 Data and sample characteristics

The options data for this chapter are collected from the OptionMetrics Ivy database. This dataset covers all exchange listed call and put options on U.S. equities and includes daily closing bid and ask quotes, open interest and volume for our sample period from January 1998 to December 2007. OptionMetrics also reports the implied volatility on each option. Since options on individual stocks are American options, the implied volatilities are calculated using a pricing algorithm based on 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. The implied volatility is computed by iteratively running the pricing model with different values of volatility until the price of the option approximates to the midpoint of the option’s best closing bid and best closing ask prices.

We merge the OptionMetrics data with the CRSP files to identify all splitting stocks with written options. To be included in the sample, each option record must have data available around the announcement date. Our final sample consists of 1,300 stock splits for 919 firms. First, we group all option trades according to whether the options are in-the-money, at-the-money or out-of-money as well as according to the options’ time to maturity. This is to ensure that our sample is not dominated by options skewed with respect to moneyness or maturity.

Following Amin, Coval and Seyhun (2004), we create two indicator variables: one expresses how far in- or out-of-the money the option's strike price is while the other expresses the time to maturity of each option. The degree of moneyness for a call option is computed by dividing the daily closing share price with the options' strike price. For a put option, the degree of moneyness is calculated by dividing the option strike price with the daily closing share price. Options where the moneyness fluctuates between 0.95 and 1.00 receive a moneyness indicator of minus one (close out-of-the-money) while those with moneyness from 1.00 to 1.05 receive a moneyness indicator of one (close in-the-money). Options with moneyness from 1.05 to 1.1 are assigned an indicator of two and options with moneyness from 0.9 to 0.95 are given an indicator of minus two and so on. We perform a similar procedure to classify options into different groups of time to maturity. Specifically, options that expire in less than or equal to 10 days receive a maturity indicator of one, options with time to maturity of more than 10 days and less than 20 days receive a maturity indicator of two and so on. Unlike Deng and Julio (2005), where they only examine close at-the-money call options, we investigate the behaviour of both call and put options at different levels of maturity and moneyness. However, we restrict our options to be in- or out-of-the money by no more than 25 percent with time to expiration greater than 10 days and less than 100 days.

4.3.1 Summary of the option liquidity and implied volatility for the full sample

To draw initial inference on how the options market behaves in a period outside the announcement window, we report the average implied volatility, volume and open interest of call/put options across different levels of moneyness and time to maturity for the 20 day period from [-30 to -20] and [+20 to +30] where day zero is the announcement date. We are aware that by doing this, stocks with more options will receive higher weights, but this is only a preliminary analysis that allows us to gain some useful insights on the functioning of the option market.

Panel A and B of table 4.1 report the mean/median implied volatility (IV), volume (VOL), open interest (OI) and percentage bid-ask spread for call options across different levels of moneyness and time to maturity while panel C and D report the same information for put options. The percentage bid-ask spread is calculated as the ask price minus the bid price divided by the mid-point of the bid and ask price.

Table 4.1: Summary statistics on option liquidity and implied volatility for the full sample

This table reports the liquidity and implied volatility for both call and put options at different levels of moneyness and time to maturity for the 20 day period [-30 to -20] and [+20 to +30] where day zero is the announcement date. Panel A and B report the mean/median volume (VOL), open interest (OI) and percentage bid-ask spread (B/A), implied volatility (IV) for the call options while panel C and D report the same information for put options. The level of moneyness for a call option is computed by dividing the closing share price with the option's strike price. For a put option, the level of moneyness is calculated by dividing the option strike price with the daily closing share price. N is the number of the option contracts.

Panel A: Summary statistics for call options at different levels of moneyness

Moneyness index	Moneyness	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
-5	[0.75 to 0.80]	33,397	29	725	0.48	0	75	0.14	0.5511
-4	[0.80 to 0.85]	50,538	32	631	0.46	0	70	0.14	0.4724
-3	[0.85 to 0.90]	67,612	45	651	0.37	0	81	0.12	0.4318
-2	[0.90 to 0.95]	79,998	75	821	0.26	1	107	0.10	0.4006
-1	[0.95 to 1.00]	81,141	105	901	0.14	2	125	0.08	0.3946
1	[1.00 to 1.05]	74,680	82	834	0.08	1	111	0.06	0.4041
2	[1.05 to 1.10]	66,718	42	677	0.06	0	80	0.05	0.4192
3	[1.10 to 1.15]	57,678	25	544	0.06	0	56	0.05	0.4402
4	[1.15 to 1.20]	47,951	18	535	0.05	0	47	0.04	0.4583
5	[1.20 to 1.25]	38,767	14	474	0.04	0	43	0.04	0.4902

Table 4.1: continued

Panel B: Summary statistics for call options at different levels of time to maturity									
Maturity index	Time to maturity	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
1	[10 to 20]	59,140	101	886	0.47	0	139	0.11	0.7349
2	[21 to 30]	46,320	95	798	0.39	0	110	0.09	0.6711
3	[31 to 40]	64,411	82	748	0.3	0	82	0.08	0.6522
4	[41 to 50]	52,611	50	608	0.23	0	54	0.07	0.6284
5	[51 to 60]	58,355	38	500	0.21	0	33	0.07	0.5908
6	[61 to 70]	28,646	27	554	0.18	0	66	0.06	0.6083
7	[71 to 80]	28,168	22	605	0.15	0	92	0.06	0.6364
8	[81 to 90]	31,012	17	539	0.15	0	80	0.06	0.6179
9	[91 to 100]	21,239	29	616	0.15	0	97	0.06	0.5869

Panel C: Summary statistics for put options at different levels of moneyness									
Moneyness index	Moneyness	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
-5	[0.75 to 0.80]	55,188	16	628	0.55	0	64	0.20	0.5281
-4	[0.80 to 0.85]	65,795	23	603	0.46	0	60	0.16	0.4946
-3	[0.85 to 0.90]	73,652	32	641	0.37	0	55	0.13	0.4595
-2	[0.90 to 0.95]	78,744	47	611	0.25	0	57	0.11	0.4306
-1	[0.95 to 1.00]	77,033	62	569	0.15	0	48	0.08	0.4106
1	[1.00 to 1.05]	78,678	40	394	0.09	0	27	0.07	0.4049
2	[1.05 to 1.10]	68,297	18	285	0.07	0	11	0.06	0.4082
3	[1.10 to 1.15]	54,799	8	183	0.06	0	5	0.05	0.4362
4	[1.15 to 1.20]	40,111	7	182	0.05	0	2	0.04	0.4677
5	[1.20 to 1.25]	28,754	4	185	0.04	0	1	0.04	0.5127

Panel D: Summary statistics for put options at different levels of time to maturity									
Maturity index	Time to maturity	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
1	[10 to 20]	63,812	56	600	0.62	0	61	0.17	0.7549
2	[21 to 30]	47,934	58	556	0.52	0	50	0.13	0.6965
3	[31 to 40]	67,532	47	531	0.44	0	34	0.12	0.6816
4	[41 to 50]	56,116	28	459	0.43	0	20	0.11	0.6653
5	[51 to 60]	61,338	19	381	0.39	0	11	0.1	0.6240
6	[61 to 70]	30,830	15	429	0.42	0	30	0.11	0.6507
7	[71 to 80]	29,976	12	446	0.42	0	50	0.11	0.6646
8	[81 to 90]	32,799	10	372	0.38	0	40	0.1	0.6412
9	[91 to 100]	22,245	12	418	0.34	0	48	0.1	0.6118

Here, we observe evidence of a volatility smile for both call and put options. A volatility smile refers to the U-shaped implied volatility estimate as a function of the exercise price. Previous literature suggests that standard option pricing models systematically misprice options with respect to moneyness and maturity (Whaley, 1982, Stein, 1989 and Bakshi, Cao and Chen, 1997). Specifically, short-term options are typically underpriced by Black-Scholes (1973) relative to long-term options and deep in-the-money and deep out-of-the money option are underpriced relative to at-the-money options. This leads to both in-/out-of-the money calls and puts having higher implied volatilities than at-the-money calls and puts, while short maturity options tend to have higher implied volatilities than long maturity options. This pattern is confirmed in table 4.1.

Consistent with Chan, Chung and Johnson (1993), at-the-money call options tend to have higher average volume and open interest than deep in-/out-of-the-money call options, which indicates that these options are the most actively traded options. However, this pattern is not strongly observed for put options. Although the average volume and open interest tend to be lowest for in-the-money put options, it is not clear that at-the-money put options exhibit higher average volume and open interest than out-of-the-money put options. Specifically, while the average volume for at-the-money put options tends to be higher than out-of-the-money put options, the average open interest is actually lower. In addition, the mean/median trading volume and interest are higher for short maturity options. This pattern is consistently observed for both calls and puts.

As for the percentage bid-ask spreads, our last measure of liquidity in the option market, out-of-the-money and short-term options exhibit the highest average bid-ask spreads. Thus, due to the degree of leverage that these options offer[5], the market makers impose a higher trading cost in order to discourage investors from profiting in

[5] Out-of-the-money and short-term-options are relatively cheaper compared to all other types of options since out-of-the-money options have lower intrinsic value while short-term options have lower time value.

such options. For a given level of maturity and moneyness, the average volume and open interest of both call and put options is much higher than their median. In fact, except for at-the-money call options, the median volume for all options across different levels of moneyness and time to maturity is close to zero. This suggests that the trading activity in the option market is heavily concentrated in only a few stocks. Meanwhile, the median percentage bid-ask spreads are much lower than the mean, which indicates that the average trading cost in some options is quite extreme. Finally, the average volume and open interest of call options are generally higher than for put options. Thus, call options are relatively more liquid compared to put options.

4.3.2 Summary of the option liquidity and implied volatility across firms with different market capitalisations

The result so far allows us to infer that the liquidity in the option market is low and the cost of trading in some options is very high. Since our aim is to analyse the option investors' perceptions regarding whether positive excess returns exist following the split announcements, there is a need to divide our sample into stocks that have a high level of option liquidity versus those that have a low level of option liquidity. This is because options that are more liquid not only have higher trading activity, they also have lower trading costs. Thus, these options provide investors the ideal means to act upon their private information. In other words, if the split announcement is information that is valued by the option investors, then this should be reflected in the most liquid options. If there is a change in the option implied volatility when the liquidity level is low, then it is likely that this change reflects the expectations of the market makers rather than the option investors.

Although the option trading volume, open interest and percentage bid-ask spreads provide us some indications of the option's liquidity, each of these three measures alone does not completely describe the level of liquidity in the option market. For example, options that have low trading volume but high open interest and low bid-ask spreads may be classified as liquid options while options that have low bid-ask spreads but low trading volume and open interest may be classified as illiquid options. Thus, we need one proxy that actually represents all of these three aspects of the option liquidity level. In this chapter, we use the firm's market capitalisation.

Our reasons are as follows: first, it is possible that the firm's market capitalisation captures factors other than the option's liquidity. For example, a firm's market capitalisation is often used to evaluate the liquidity of the underlying stocks and large firms tend to have a higher number of analyst followings compared to small firms. Together, these factors depict the information environment of both the stocks and the options. Thus, we are able to compare the behaviour of the option market across different levels of informational efficiency in addition to liquidity. Second, if the firm's market capitalisation is a sensible measure of option liquidity, then it actually shows investors where most of the option liquidity exists. Finally, by using the firm's market capitalisation as a proxy for option liquidity, this allows us to assess the importance of our results. Specifically, stocks that belong to the S&P500 index (large cap stocks) represent about 75% of the U.S. market capitalisation, therefore findings on this particular group of stocks might be regarded as "more important" compared to findings observed from other groups.

We divide the full sample into options on firms that belong to the S&P500 index (large cap stocks), S&P400 index (mid cap stocks), S&P600 index (small cap stocks) and "other" stocks (firms that are not part of these three indices). Together, the first three groups make up the S&P1500 index, which comprises 85 percent of the total U.S. market capitalisation while the last group covers the remaining 15 percent. In an unreported result, the average market capitalisation on stocks that belong to the "other" group is higher than that for the S&P600 index while the median is actually lower. This suggests that the "other" group not only contains a number of micro stocks that have smaller size than stocks that belong to the S&P600 index; this group also has some large over-the-counter stocks that are not part of the S&P1500 index.

Panel A of table 4.2 reports the mean/median volume, open interest, percentage bid-ask spreads and the average implied volatility for call options across different size groups while panel B reports the same information for put options. To conserve space, we classify the option moneyness into three groups: out-of-the-money options (moneyness ranges from 0.75 to 0.90), at-the-money options (moneyness ranges from 0.9 to 1.1) and in-the-money options (moneyness ranges from 1.1 to 1.25). Long maturity options are options that expire in more than 50 days while short maturity options expire in less than 50 days. We examine the option liquidity for each of the size groups for the 20 day period from [-30 to -20] and [+20 to +30] where day zero is the announcement date.

Table 4.2: Summary statistics on option liquidity and implied volatility across firms with different market capitalisations

This table reports the liquidity and implied volatility for call and put options on stocks that belong to the S&P500 index (large cap stocks), S&P400 index (mid cap stocks), S&P600 index (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 percentage bid-ask spread (B/A) and the average implied volatility for call options during the period [-30 to -20] and [20 to 30] where day zero is the announcement date. Panel B reports the same information for put options. To conserve space, we classify the option's moneyness into three groups: out-of-the-money options (moneyness ranges between 0.75 to 0.9), at-the-money options (moneyness ranges between 0.9 to 1.1) and in-the-money options (moneyness ranges between 1.1 to 1.25). Long maturity options are options that expire in more than 50 days while short maturity options expire in less than 50 days.

Panel A: Summary statistics for call options on stocks with different market capitalisations

Index		Long maturity call options								Short maturity call options							
	Moneyness	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
S&P500	[0.75 to 0.90]	8,122	68	1453	0.52	0	242	0.22	0.4058	10,998	121	1632	0.99	0	304	0.67	0.4631
	[0.90 to 1.10]	17,771	116	1540	0.09	10	372	0.06	0.3745	28,498	321	2371	0.20	35	656	0.08	0.3755
	[1.10 to 1.25]	8,643	24	979	0.04	0	186	0.03	0.4146	11,090	68	1435	0.04	0	212	0.03	0.4727
S&P400	[0.75 to 0.90]	5,386	20	367	0.49	0	63	0.20	0.5084	8,384	36	478	0.99	0	88	0.67	0.5807
	[0.90 to 1.10]	11,486	31	443	0.12	0	102	0.08	0.4493	17,853	77	595	0.25	5	149	0.11	0.4632
	[1.10 to 1.25]	5,706	6	271	0.06	0	54	0.05	0.4914	7,450	22	363	0.06	0	52	0.05	0.5585
S&P600	[0.75 to 0.90]	5,543	12	214	0.54	0	26	0.29	0.4922	7,644	18	178	1.15	0	20	1.00	0.5573
	[0.90 to 1.10]	10,895	14	220	0.15	0	37	0.11	0.4585	16,955	34	248	0.28	0	57	0.14	0.4580
	[1.10 to 1.25]	5,551	5	155	0.08	0	20	0.07	0.4917	6,928	9	145	0.08	0	15	0.07	0.5452
Other	[0.75 to 0.90]	11,876	25	357	0.30	0	47	0.13	0.6732	17,760	52	413	0.62	0	88	0.26	0.7586
	[0.90 to 1.10]	20,976	40	440	0.10	0	58	0.07	0.6165	32,725	99	623	0.17	9	112	0.09	0.6484
	[1.10 to 1.25]	10,975	15	328	0.06	0	33	0.05	0.6523	15,186	30	393	0.06	0	45	0.05	0.7317

Table 4.2: continued

Panel B: Summary statistics for put options on stocks with different market capitalisations																	
Index		Long maturity put options								Short maturity put options							
S&P500	Moneyness	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV	N	Mean VOL	Mean OI	Mean B/A	Median VOL	Median OI	Median B/A	Mean IV
	[0.75 to 0.90]	11,478	42	1326	0.44	0	315	0.22	0.4324	15,924	92	1801	0.89	0	432	0.67	0.5065
	[0.90 to 1.10]	17,662	55	820	0.09	0	121	0.07	0.3804	28,270	179	1399	0.18	10	259	0.08	0.3861
	[1.10 to 1.25]	6,448	9	478	0.04	0	15	0.03	0.4214	8,111	28	424	0.04	0	21	0.03	0.4837
S&P400	[0.75 to 0.90]	7,678	14	386	0.54	0	60	0.24	0.5046	11,109	21	406	1.00	0	66	0.67	0.5961
	[0.90 to 1.10]	11,416	14	251	0.13	0	20	0.09	0.4563	17,729	51	396	0.23	0	53	0.11	0.4721
	[1.10 to 1.25]	4,588	3	82	0.05	0	0	0.05	0.5088	6,408	12	177	0.06	0	5	0.05	0.5781
S&P600	[0.75 to 0.90]	7,295	6	173	0.62	0	20	0.35	0.5147	10,404	9	162	1.17	0	20	1.11	0.5952
	[0.90 to 1.10]	10,825	7	102	0.15	0	5	0.12	0.4651	16,912	20	163	0.27	0	15	0.14	0.4669
	[1.10 to 1.25]	4,743	2	55	0.07	0	0	0.07	0.4923	5,698	5	48	0.08	0	0	0.07	0.5461
Other	[0.75 to 0.90]	14,660	14	360	0.32	0	31	0.15	0.6735	21,419	37	436	0.67	0	50	0.32	0.7613
	[0.90 to 1.10]	20,764	17	239	0.10	0	10	0.07	0.6288	32,438	57	371	0.17	0	37	0.09	0.6618
	[1.10 to 1.25]	9,917	3	86	0.06	0	0	0.05	0.6739	13,927	10	123	0.06	0	3	0.05	0.7624

First, we observe evidence of an implied volatility smile across all the four size groups for both call and put options. For at-the-money call options, regardless of the time to maturity, options on stocks that belong to the S&P500 usually exhibit a higher mean/median trading volume, open interest and a lower bid-ask spread. This suggests that options on the large cap stocks are more actively traded, which results in lower transaction costs. With the remaining three size groups, it is also evident that option liquidity is increasing with the firm's market capitalisation. Specifically, while the liquidity level for options on firms that belong to the mid cap group (S&P400) is similar to options on firms that belong to the "other" group, options on the small cap stocks (S&P 600 index) exhibit the lowest level of liquidity across the four size groups. Consistent with the findings observed earlier, the median option volume and open interest are much lower compared to their means. This once again implies that the trading activity in the options is heavily concentrated in a small group of stocks. Outside this group, there is no major variation in the option liquidity level across different firms.

The liquidity of out-of-the money call options is much lower compared to at-the-money call options. Options on stocks that belong to the S&P500 index tend to exhibit the highest average volume and open interest compared to options on stocks that belong to the other three size groups. What is quite interesting is that the liquidity of the options on "other" stocks tends to be higher than the options on stocks that belong to the S&P400 and S&P600 index. Specifically, the average volume and open interest for options on "other" stocks is consistently higher than options on the mid cap and small cap stocks while its bid-ask spread is much lower. Unlike at-the-money call options, stocks that belong to the S&P500 index no longer have the lowest bid-ask spreads. The group that experiences the smallest percentage bid-ask spread is the "other" stocks. As mentioned earlier, this group comprises a number of large stocks, and although these stocks are not part of the S&P1500 index, their liquidity level is quite high. The median volume and open interest of options on firms across all the four size groups are much smaller in magnitude compared to their means. In fact, the median trading volume is close to zero for the majority of the sample options. Together, this indicates that the liquidity of the out-of-the-money call options is generally low.

The mean/median volume and open interest for in-the-money call options are quite comparable with out-of-the-money call options. The only difference is that stocks that are in the S&P500 index have the lowest bid-ask spreads while this number is very similar across the other three size groups. Moreover, the average bid-ask spread of in-the-money call options is much lower than out-of-the-money call options. This is not surprising since out-of-the-money options offer the highest degree of leverage. Thus, the market makers impose a high bid-ask spread in order to discourage investors from profiting in such options.

Next, we shift our attention to put options. The liquidity of at-the-money put options shows a very similar pattern with at-the-money-call options. Options on firms that belong to the S&P500 tend to have the highest average trading volume, open interest and lowest bid-ask spread compared to options on firms that are part of the other three size groups. Although the liquidity of put options on firms that are part of the S&P400 index is generally higher than the "other" group, this difference is not substantial. Meanwhile, stocks that belong to the S&P600 index exhibit the lowest liquidity level. The median trading volume and open interest for at-the-money-put options is much lower than their means. Only options on the large cap stocks (S&P500) experience a non-zero median trading volume. This indicates that the trading activity in the options market is very thin and this is evident for both call and put options.

The behaviour of the liquidity for out-of-the-money put options is quite interesting. Although the mean/median trading volume for at-the-money put options is higher compared to out-of-the-money put options, its open interest is generally lower across the four size groups. However, the percentage bid-ask spreads for at-the-money put options is consistently much lower than out-of-the-money put options. Similar to out-of-the-money call options, while options on the large cap stocks are more actively traded (higher mean/median trading volume and open interest), the group that experiences the lowest bid-ask spreads is the "other" stocks. Nevertheless, the percentage bid-ask spread for out-of-the-money put options across the four size groups is generally high.

Finally, we focus on in-the-money put options. The trading activity for in-the-money put options is actually much lower than both at-the-money and out-of-the-money put options. The mean volume and open interest for this type of option is much lower than the other two. However, the magnitude of the average bid-ask spread for in-the-money put options is generally smaller than at-the-money and out-of-the money put options. This suggests that similar to in-the-money call options, in-the-money put options are the least attractive. Thus, this does not generate enough interest from both the investors (volume and open interest is low) as well as the market makers (the bid-ask spread is also low) to participate in such options.

In summary, the firm's market capitalisation is a reasonable proxy for the level of liquidity in the option market. Options on stocks that belong to the S&P500 index are the most actively traded, the average trading cost on these options are generally lower compared to options on stocks that belong to the other three size groups. Although the option's liquidity for stocks that belong to the "other" group is occasionally higher than stocks that belong to the S&P400 index, this should not undermine the ability of firm size to capture the liquidity of the option market. This is because the "other" group contains a number of large optionable stocks that are quite liquid.

4.3.3 Descriptive statistics of the option implied volatility spread

Next, we examine the implied volatility spread between call and put options, the implied volatility spread is calculated as follows:

$$VS_{it} = IV_{it}^{calls} - IV_{it}^{puts}, \tag{4.1}$$

where IV_{it}^{calls} refers to the implied volatility of call option i at time t while IV_{it}^{puts} refers to the implied volatility of put option i at time t. We calculate the volatility spread in two different ways: first, we match options according to maturity and moneyness. Since the IVs of both call and put options vary with the time to expiration and moneyness, failing to control for these two factors could potentially bias our results. Second, we calculate the volatility spread between call options and put options with the same strike price and maturity. With this approach, the option pairs will not have the same level of moneyness (except for at-the-money options) as the deep-out-of the-money call has the same strike price as a deep-in-the-money put.

However, this method allows us to investigate the put-call parity condition since put-call parity specifies that the implied volatility of a call option should be equal to the implied volatility of a put option with the same maturity and strike price. Table 4.3 contains the descriptive statistics on the volatility spreads. Panel A and B reports the average volatility spreads for options matched according to maturity and moneyness while panel C and D reports the average volatility spreads for options matched according to maturity and strike price.

Table 4.3: Summary statistics on the option volatility spreads

This table reports the summary statistics on the option volatility spreads across different levels of moneyness and time to maturity for the period [-30 to -20] and [+20 to +30] where day zero is the announcement date. Panel A and B report the average volatility spreads (VS) between call and put options matched according to maturity and moneyness while panel C and D report the average volatility spreads between call and put options matched according to maturity and strike price.

Panel A: VS on options matched according to maturity and moneyness and sorted by moneyness

Moneyness index	Moneyness	N	Average VS
-5	[0.75 to 0.80]	8,868	-0.0691
-4	[0.80 to 0.85]	14,587	-0.0590
-3	[0.85 to 0.90]	23,050	-0.0472
-2	[0.90 to 0.95]	29,500	-0.0337
-1	[0.95 to 1.00]	23,079	-0.0189
1	[1.00 to 1.05]	21,385	-0.0005
2	[1.05 to 1.10]	21,776	0.0108
3	[1.10 to 1.15]	13,854	0.0185
4	[1.15 to 1.20]	8,467	0.0223
5	[1.20 to 1.25]	5,299	0.0220

Panel B: VS on options matched according to maturity and moneyness and sorted by maturity

Maturity index	Time to maturity	N	Average VS
1	[10 to 20]	31,892	-0.0215
2	[21 to 30]	22,997	-0.0196
3	[31 to 40]	31,516	-0.0173
4	[41 to 50]	25,392	-0.0166
5	[51 to 60]	27,152	-0.0158
6	[61 to 70]	13,178	-0.0156
7	[71 to 80]	12,329	-0.0161
8	[81 to 90]	13,181	-0.0158
9	[91 to 100]	9,009	-0.0167

Table 4.3: continued

Panel C: VS on options matched according to maturity and strike price and sorted by moneyness			
Moneyness index	Moneyness	N	Average VS
-5	[0.75 to 0.80]	51,489	-0.0183
-4	[0.80 to 0.85]	80,683	-0.0144
-3	[0.85 to 0.90]	11,1727	-0.0109
-2	[0.90 to 0.95]	134,667	-0.0094
-1	[0.95 to 1.00]	139,634	-0.0088
1	[1.00 to 1.05]	128,760	-0.0090
2	[1.05 to 1.10]	116,314	-0.0100
3	[1.10 to 1.15]	100,393	-0.0112
4	[1.15 to 1.20]	83,886	-0.0120
5	[1.20 to 1.25]	68,116	-0.0131

Panel D: VS on options matched according to maturity and strike price and sorted by maturity			
Maturity index	Time to maturity	N	Average VS
1	[10 to 20]	52,356	-0.0147
2	[21 to 30]	42,185	-0.0162
3	[31 to 40]	60,726	-0.0147
4	[41 to 50]	50,623	-0.0146
5	[51 to 60]	56,185	-0.0123
6	[61 to 70]	27,853	-0.0119
7	[71 to 80]	27,483	-0.0104
8	[81 to 90]	30,282	-0.0138
9	[91 to 100]	20,810	-0.0175

Under the first matching approach, the average volatility spread varies with the level of moneyness. The volatility spread is negative for out-of-the money options and positive for in-the-money options. This is expected as previous option pricing studies have shown that deep in-the-money calls and deep out-of-the-money puts have the highest estimated implied volatilities. Thus, matching out-of-the money call options with out-of-the-money put options will give rise to a negative volatility spread estimate, since out-of-the-money put options are more underpriced by the Black-Scholes model than out-of-the-money call options. The reverse holds when we match in-the-money call options with in-the-money put options. Meanwhile, the volatility spread tends to be negative across different times to maturity. This negative volatility spread pattern is even stronger in panel C and D where options are matched according to maturity and strike price. That is, out-of-the-money calls are matched against in-the-money puts (similar level of underpricing). The fact that the average volatility spread is negative once again is not surprising. Rather, it confirms the finding in Ofek, Richardson and Whitelaw (2004) that deviations from put-call parity are more likely to occur in the direction of puts being relatively more expensive than corresponding calls. The reason for this is quite intuitive. To partially hedge a short position in the call options, investors need to long the stocks, but to partially hedge a short position in the put options, investors have to short the stocks and shorting the stocks is relatively more difficult than longing them as some stocks cannot be shorted. This binding short sale constraint suggests that put options might be more expensive compared to call options, which leads to higher put implied volatilities relative to call implied volatilities. This is not evidence of market inefficiency, rather it is an important feature of the market microstructure.

4.4 Methodology

We employ two methodologies to investigate the impact of the split announcement on the option market. The first method examines the behaviour of the implied volatility for both call and put options separately while the second method analyses the implied volatility spread between call and put options.

4.4.1 Implied volatility test

Given that a stock split induces a favourable response by the market, previous studies have shown that the abnormal returns following the announcement date tend to persist in the long-run (Ikenberry, Rankine and Stice, 1996, Desai and Jain, 1997 and Ikenberry and Ramnath, 2002). If investors believe that there are positive excess returns to be earned, then one strategy that they can utilise is to either purchase a call option or sell a put option. This buying and selling pressure will in turn increase the price of a call option and decrease the price of a put option. However, investigating changes in option prices as a result of the split may be misleading due to two reasons: First, changes in the option price may reflect a change in the price of the underlying stock. Second, the option price is a function of the time to maturity; specifically, the option price is time decaying. A better approach is to study the behaviour of the option implied volatility around the split announcement date.

Implied volatility is now an accepted paradigm for empirical tests of option valuation (Jarrow and Wiggins, 1989 and Figlewski and Webb, 1993). Holding everything else constant, options with high implied volatilities reflect a higher demand from investors. Thus, in our first test, we calculate the average daily implied volatility changes for both call and put options over the (-5, +5) day period around the split announcements, where the change in implied volatility is given by:

$$\Delta IV_{it} = IV_{it} - IV_{it-1} \ . \tag{4.2}$$

To make sure that the change in IV is not purely a temporal difference in the implied volatilities due to time to maturity, we calculate the abnormal change in IV where ΔIV is adjusted with the expected change in IV. Specifically, we compare the change in implied volatility on the announcement days of the sample option with changes in implied volatility of a similar option in terms of time to maturity and moneyness on non-announcement days. Note that these two options are on the same underlying stock. That is, we select a matching option of the same stock during the estimation period, which has the same time to expiry and is the most similar in moneyness with the sample option. To maximise the number of observations in our sample, we define the estimation period as [-200, -20] and [+20, +200] where day zero is the announcement date[6]. The matching procedure is performed on the announcement date. If an option has more than one match, then we select the matching option that is most similar in volume and open interest as the sample option. The abnormal change in the implied volatility around the announcement period is calculated as follows:

$$Ab\Delta IV_{it} = \Delta IV_{it} - E(\Delta IV_{it}), \tag{4.3}$$

where $Ab\Delta IV_{it}$ is the abnormal change in the implied volatility for option *i* at time *t*, ΔIV_{it} is the change in the implied volatility of the sample option and $E(\Delta IV_{it})$ is the expected change in the implied volatility and is proxied by the change of the implied volatility of a matching option that has a similar level of moneyness and time to maturity. To test the hypothesis that the mean abnormal change in implied volatility is equal to zero for a sample of n firms, we employ a parametric t-statistic:

$$t_{Ab\Delta IV} = \overline{Ab\Delta IV_{it}} / (\sigma(Ab\Delta IV_{it}) / \sqrt{n}). \tag{4.4}$$

Most previous studies often focus their attention on at-the-money-options, as these are the most liquid options. Our analysis on the other hand covers out-of-the-money options, at-the-money options as well as in-the-money options. Our reasoning is that while at-the-money options are the most liquid options, out-of-the-money options offer the highest degree of leverage and hence may be the most speculative options.

We define at-the-money options as follows: for each stock, we choose an option whose exercise price brackets the stock price on the announcement date. Since it is not often for the stock price to equal the exercise price, at-the-money options might be slightly out- or in-the-money. However, we restrict these options not to be in- or out-of-the-money by more than 10 percent. Next, we select all options that are out-of-

[6] To ensure that our results are not driven by the choice of the estimation period, we repeat our test where the matching options are selected from the pre-announcement period [-200, -20] only. The findings are very similar.

the-money by more than 10 percent. Within this group, we choose the ones that have the lowest level of moneyness. Similarly, in-the-money options are those that have the highest level of moneyness given that these options are in-the-money by more than 10 percent. In this way, at a given level of moneyness, each splitting stock is represented by only one option contract.

4.4.2 Volatility spread test

There is a possibility that changes in the implied volatility around the announcement period may have little to do with the idea of investors trying to profit in the option market. The option implied volatility may increase due to two reasons: first, the market makers may simply adjust the option prices to incorporate the information content of the split announcement. Second, an increase in the implied volatility may be the result of an increase in the actual volatility of the splitting companies following the effective date, since the option implied volatility is the expected stock volatility over the life of the option (Ohlson and Penman, 1985). Specifically, changes in the implied volatility may only suggest that the market makers are aware of the tendency for return volatility to increase following the effective date and incorporate their expectations in the option implied volatility. If this is the case, then we expect a surge in the implied volatility around the announcement date for both call and put options, since they both measure the volatility of the underlying asset (put-call parity). On the other hand, if investors buy the call option and sell the put option with the purpose of exploiting the abnormal returns, then this should raise the implied volatility of the call option and lower the implied volatility of the put option. Thus, we should observe a positive spread in the implied volatility between the call option and the put option[7]. This leads us to our second method of evaluating the impact of the split announcement on the option market: the analysis of the volatility spread.

This is not the first time a test of the volatility spread has been used to evaluate the relative buying pressure between call and put options. Rather, it is a popular method in the option literature to examine the linkage between the stock market and the option market. Amin, Coval, Seyhun (2004) find that option prices are affected by past stock returns. Using the Standard and Poor's 100 index options (OEX options), the authors document that OEX calls are significantly overvalued relative to OEX puts (positive volatility spread) after large stock price increases and are significantly negative (negative volatility spread) after large stock price decreases. Seyhun and Wang (2006) extend Amin, Coval and Seyhun's (2004) study to include equity options and find that past stock returns will exert different influences on option prices depending on the autocorrelation structure of stock returns. Cremers and Weinbaum (2010) show that the magnitude and direction of the volatility spread between call and put options carry information about the future stock price and a portfolio that is long stocks with relatively expensive calls and short stocks with relatively expensive puts earns a positive abnormal return after controlling for size, book-to-market and momentum. While these three studies address different issues relating to the option market, there is one common theme. Together, they show that the option market and the stock market do not operate in isolation. There is a strong connection between these two markets with the option market leading the stock market or vice versa. In

[7] Investors do not have to buy a call option and sell a put option simultaneously to generate a volatility spread. If there is more buying pressure in call options compared to put options, then the implied volatility of call options should be higher relative to the implied volatility of put options.

this chapter, we analyse the volatility spread between call and put options because we want to tackle the same problem. If informed investors believe that there are positive excess returns to be earned following the announcement date in the underlying stock market, then this should be reflected in the option market.

The volatility spread is calculated as specified in equation (1). What we observe from section 4.3.3 is that without the effect of the announcement, there is a divergence in the implied volatility inverted from call options compared to put options depending on the level of moneyness and time to maturity. As explained earlier, this does not reflect whether there is stronger buying pressure in call options relative to put options or vice versa. However, it raises the need to control for the "normal" volatility spread given a certain level moneyness and time to maturity. In this way, we can directly measure the abnormal implied volatility spread that is due to the event itself. Thus, we calculate the abnormal change in the implied volatility spread as:

$$Ab\Delta VS_{it} = \Delta VS_{it} - E(\Delta VS_{it}), \tag{4.5}$$

where the $Ab\Delta VS_{it}$ is the abnormal change in the volatility spread between each call and put option pair i at time t, ΔVS_{it} is the change the volatility spread and the $E(\Delta VS_{it})$ is the expected change in the volatility spread of the matching call-put option pair that has a similar level of moneyness and time to maturity as the sample call-put option pair.

4.5 Results

In this section, we present our analysis in two parts: first, we focus our attention on the option implied volatility. We compare the behaviour of the implied volatility for call and put options that expire before the effective date (short maturity options) with those that expire after the effective date (long maturity options). Previous research argues that if there is an increase in the stock volatility following the effective date, then the options that expire after the effective date (long maturity options) should exhibit a permanent increase in implied volatility. Meanwhile, the options that expire before the effective date (short maturity options) should only experience a temporary increase in the implied volatility to reflect the arrival of new information. That is, for the short maturity options, although there is an increase in the implied volatility on the announcement date, after this date, the implied volatility should return to its pre-announcement level.

Next, we sort the sample options into groups based on the market capitalisations of the underlying stocks and repeat the above tests. Specifically, we examine the behaviour of the implied volatility for options on firms that belong to the S&P500 index (large capitalisation stocks), S&P400 index (mid capitalisation stocks), S&P600 index (small capitalisation stocks) and the "other" stocks (stocks that are not part of the three indices). Our intention is not to examine whether the behaviour of the option implied volatility varies with the firms' market capitalisation, rather firm size provides us a means to proxy for the level of liquidity in the option market. If the option is actively traded, then there is a higher chance that the increase in the option implied volatility is a result of the trading activity of the option investors rather than the market makers simply adjusting the option price to incorporate the new information. In other words, the behaviour of the option implied volatility at varying liquidity levels allows us to infer whether the option investors or the market makers are responsible for any change(s) in the option implied volatility around the split announcements.

Second, we examine the volatility spread between the call and put options. This test enables us to study the perception(s) of the option investors regarding the existence of post-announcement excess returns. If the option investors believe that there are no excess returns to be earned following the split announcements, then their trades simply reflect an expectation of a future increase in the stock volatility. In this case, we should observe a rise in the implied volatility for both call and put options. On the other hand, if the option investors believe that they can profit from the split announcements, then this should create a positive spread in the implied volatility between call and put options. That is, more buying pressure in call options compared to put options causes the implied volatility of call options to be higher relative to the implied volatility of put options. This pattern should be observed even in the presence of an increase in the volatility of the underlying stocks. Finally, we repeat the analysis of the volatility spread for options on stocks with different market capitalisations. Our aim is to evaluate whether the implied volatility behaviour is robust across firms with various levels of option liquidity. Moreover, this also allows us to examine whether the perception of the option investors changes with the firm's market capitalisation. For example, if we find evidence of a positive volatility spread for options on firm that belong to the large cap group (S&P500 index) and not for the other three size groups, then this suggests that from the view of the option investors, the post-split announcement excess returns mainly exist in the large cap stocks.

4.5.1 Implied volatility of call options around the announcement date

Panel A of table 4.4 reports the level of moneyness, time to maturity, change and abnormal change in the implied volatility for at-the-money call options while panel B and panel C report the same information for out-of-the-money and in-the-money call options, respectively.

Table 4.4: Implied volatility of call options around the announcement date

This table reports the behaviour of the implied volatility for call options around the announcement date. Panel A reports the level of moneyness (Moneyness), time to maturity (Maturity), change (ΔIV) and abnormal change (AbΔIV) in the implied volatility for at-the-money call options while panel B and C report the same information for out-of-the-money and in-the- money call options. Long maturity call options are call options that expire after the effective date while short maturity call options are call options that expire before the effective date. Our event window is [-5, +5] where day zero is the announcement date. Numbers in parentheses are the t-statistic of the means.

Panel A: Implied volatility for at-the-money call options

	Long maturity at-the-money call option					Short maturity at-the-money call option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	878	0.997	64	0.0017	0.0024	849	0.998	32	0.0000	0.0002
				(2.06)	*(1.83)*				*(0.00)*	*(0.14)*
-4	898	0.997	63	0.0004	0.0002	855	0.997	31	-0.0002	-0.0009
				(0.48)	*(0.15)*				*(-0.18)*	*(-0.49)*
-3	911	0.998	61	0.0001	-0.0014	865	0.997	29	-0.0015	-0.0022
				(0.15)	*(-0.92)*				*(-1.20)*	*(-1.11)*
-2	931	0.999	59	0.0017	0.0023	874	0.999	27	0.0034	0.0038
				(2.35)	*(1.77)*				*(2.58)*	*(1.91)*
-1	947	0.999	57	0.0011	0.0029	875	1.000	26	0.0033	0.0040
				(1.41)	*(2.13)*				*(2.65)*	*(1.98)*
0	969	0.999	55	0.0108	0.0100	884	0.999	25	0.0086	0.0104
				(8.17)	*(5.60)*				*(4.61)*	*(4.14)*
1	1,027	0.999	53	0.0043	0.0065	901	1.000	24	-0.0048	-0.0072
				(2.94)	*(3.10)*				*(-2.21)*	*(-2.56)*
2	1,017	1.000	51	-0.0005	-0.0011	892	1.000	23	-0.0022	-0.0062
				(-0.50)	*(-0.79)*				*(-1.25)*	*(-2.24)*
3	1,013	1.001	51	-0.0002	0.0004	867	1.000	21	-0.0004	-0.0053
				(-0.20)	*(0.30)*				*(-0.30)*	*(-2.04)*
4	1,010	0.999	49	0.0008	-0.0005	857	0.998	20	-0.0003	-0.0072
				(0.95)	*(-0.34)*				*(-0.20)*	*(-2.31)*
5	996	1.002	48	-0.0002	-0.0011	826	1.000	19	0.0048	-0.0043
				(-0.18)	*(-0.78)*				*(2.59)*	*(-1.27)*

Table 4.4: continued

Panel B: Implied volatility for out-of-the-money call options										
	Long maturity out-of-the-money call option					Short maturity out-of-the-money call option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	477	0.836	66	0.0020	0.0012	457	0.839	33	0.0067	0.0016
				(2.09)	*(0.74)*				*(4.53)*	*(0.59)*
-4	505	0.838	65	0.0008	-0.0015	460	0.839	32	0.0023	0.0005
				(0.73)	*(-0.84)*				*(1.34)*	*(0.19)*
-3	508	0.834	64	0.0010	0.0005	474	0.839	31	0.0035	-0.0011
				(1.03)	*(0.32)*				*(1.76)*	*(-0.36)*
-2	536	0.836	62	0.0010	0.0003	479	0.838	29	0.0050	-0.0036
				(1.00)	*(0.19)*				*(2.56)*	*(-1.19)*
-1	576	0.834	60	0.0023	0.0005	506	0.839	28	0.0102	0.0042
				(2.27)	*(0.37)*				*(5.12)*	*(1.29)*
0	584	0.833	59	0.0061	0.0046	486	0.834	27	0.0061	-0.0055
				(4.30)	*(2.56)*				*(2.39)*	*(-1.64)*
1	579	0.833	58	0.0024	-0.0030	460	0.839	26	0.0068	-0.0021
				(1.38)	*(-1.20)*				*(1.97)*	*(-0.46)*
2	563	0.832	56	0.0022	-0.0009	433	0.837	24	0.0108	-0.0025
				(1.79)	*(-0.43)*				*(4.00)*	*(-0.57)*
3	566	0.832	54	0.0030	-0.0003	422	0.838	24	0.0146	0.0036
				(2.04)	*(-0.13)*				*(5.41)*	*(0.73)*
4	563	0.833	53	0.0015	-0.0018	400	0.837	23	0.0194	-0.0010
				(1.27)	*(-0.91)*				*(5.50)*	*(-0.22)*
5	574	0.834	52	0.0010	-0.0023	375	0.837	22	0.0224	0.0070
				(0.67)	*(-1.23)*				*(5.78)*	*(1.40)*

Panel C: Implied volatility for in-the-money call options										
	Long maturity in-the-money call option					Short maturity in-the-money call option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	584	1.173	71	0.0019	0.0003	417	1.168	36	-0.0021	-0.0023
				(1.62)	*(0.15)*				*(-0.83)*	*(-0.56)*
-4	622	1.173	69	0.0007	0.0019	470	1.167	35	0.0000	-0.0081
				(0.51)	*(0.84)*				*(-0.01)*	*(-2.16)*
-3	664	1.175	68	-0.0008	-0.0004	475	1.168	33	-0.0020	-0.0061
				(-0.52)	*(-0.16)*				*(-0.77)*	*(-1.50)*
-2	715	1.175	65	0.0051	0.0025	520	1.167	31	0.0080	0.0095
				(3.76)	*(1.26)*				*(3.02)*	*(2.39)*
-1	751	1.177	64	0.0019	0.0021	547	1.167	30	0.0053	0.0017
				(1.53)	*(1.12)*				*(1.93)*	*(0.35)*
0	876	1.190	61	0.0061	0.0046	664	1.182	27	0.0148	0.0044
				(3.41)	*(1.93)*				*(4.15)*	*(0.90)*
1	863	1.180	59	0.0039	0.0019	588	1.174	28	-0.0015	-0.0082
				(2.15)	*(0.67)*				*(-0.42)*	*(-1.58)*
2	832	1.182	58	0.0007	-0.0012	545	1.173	27	0.0033	-0.0106
				(0.42)	*(-0.46)*				*(0.81)*	*(-1.87)*
3	805	1.181	57	0.0010	-0.0018	507	1.173	26	0.0155	0.0036
				(0.67)	*(-0.68)*				*(3.84)*	*(0.52)*
4	794	1.179	56	0.0018	-0.0014	457	1.172	25	0.0121	-0.0034
				(1.30)	*(-0.56)*				*(2.62)*	*(-0.53)*
5	799	1.177	54	0.0012	0.0010	466	1.170	24	0.0115	0.0026
				(0.82)	*(0.51)*				*(2.02)*	*(0.35)*

First, what we notice from table 4.4 is that our methodology does a reasonable job in differentiating at-the-money, out-of-the-money and in-the-money-call options. The level of moneyness for at-the-money call options is close to one while the levels of moneyness for out-/in-the-money call options are about 0.83 (17 percent out-of-the-money) and 1.16 (16 percent in-the-money), respectively.

For at-the-money call options, the long maturity options exhibit a significant jump of 1.08% on the announcement date (t-statistic is 8.17). After adjusting for the "normal" difference in the implied volatility given the option's level of moneyness and time to maturity, the change in the option implied volatility is still positive and significant. The average abnormal change in the implied volatility amounts to 1% (t-statistic is 5.60). In fact, the abnormal change in the implied volatility for the long maturity at-the-money options is positive and significant in days -1, 0 and +1. Following day +1, the average abnormal change in the implied volatility is close to zero. The behaviour of the short maturity at-the-money call options on the other hand is quite interesting. While there is an increase in the implied volatility on day -1 and day zero (the announcement date), the abnormal change in the implied volatility is actually significantly negative after that. Specifically, the abnormal change in the implied volatility for the short maturity at-the-money call option is 0.4% (t-statistic is 1.98) and 1.04% (t-statistic is 4.14) on day -1 and day zero, respectively. Following the announcement date, the abnormal change in the implied volatility amounts to -0.72% (t-statistic equals -2.56), -0.62% (t-statistic equals -2.24) and -0.53% (t-statistic equals -2.31) on day +1, +2 and +3, respectively. This is perfectly consistent with the notion that the increase in the implied volatility for options that expire before the effective date is temporary, and that following the announcement date, the implied volatility returns to its pre-announcement level.

For out-of-the money call options, once again, the behaviour of the implied volatility for the short and long maturity options is quite different. While there is a significant increase in the implied volatility for the long maturity options on the announcement date, for the short maturity options, this figure is not statistically different from zero in any days during the event window. Specifically, the average abnormal change in the implied volatility for the long maturity options is 0.46% (t-statistic equals 2.56) on the announcement date. On the other hand, although there is a significant positive change in the implied volatility for the short maturity options on the announcement date (ΔIV is 0.61%, t-statistic is 2.31), after adjusting for the "normal" change in the implied volatility given the options level of moneyness and time to maturity, the abnormal change in the implied volatility is actually negative, -0.55% and insignificant (t-statistic is -1.64).

Unlike at-the-money and out-of-the-money call options, the evidence of an increase in the implied volatility is generally weaker for in-the-money call options. The abnormal change in the implied volatility for the long maturity options is positive and it amounts to 0.46% with a t-statistic equal to 1.93 (significant at 5.8%). Meanwhile, for the short maturity options, the abnormal change in the implied volatility is significantly negative on day -4 (AbΔIV is -0.81%, t-statistic is -2.16) while it is significantly positive on day -2 (AbΔIV is +0.95%, t-statistic is 2.39). After this date, the abnormal change in the implied volatility for these options is close to zero.

Our findings so far allow us to infer that Ohlson and Penman's (1985) contention of an increase in the actual volatility for the underlying stock is likely to be valid and this effect has been incorporated in the option market in a prompt manner. Specifically, while we observe a surge in the implied volatility for both of the long and short maturity at-the-money call options, there is no sign of a reduction in the implied volatility for the long maturity options following the announcement date. On the other hand, for the short maturity at-the-money call options, the increase in the implied volatility only takes place on the announcement date. Following this date, the implied volatility returns to its pre-announcement level. Although this pattern is not repeated in out-of-the-money and in-the-money call options, the long maturity call options experience a rise in the implied volatility on the announcement date while the short maturity options do not. This, once again, is confirming evidence that implied volatility inverted from the calls is a good proxy for the expected volatility of the underlying stock over the life of the options. Given that there is a permanent increase in the stock volatility following the effective date, this effect has been correctly incorporated in the implied volatility of the long maturity call options.

4.5.2 Implied volatility of put options around the announcement date

Table 4.5 panel A presents the level of moneyness, time to maturity, average daily change and abnormal change in the implied volatility for at-the-money put options. Panel B and panel C present the same information for out-of-the-money and in-the-money put options.

Table 4.5: Implied volatility of put options around the announcement date

This table reports the behaviour of the implied volatility for put options around the announcement date. Panel A reports the level of moneyness (Moneyness), time to maturity (Maturity), change (ΔIV) and abnormal change (AbΔIV) in the implied volatility of at-the-money put options while panel B and C report the same information for out-of-the-money and in-the-money put options. Long maturity put options are put options that expire after the effective date while short maturity put options are put options that expire before the effective date. Our event window is [-5, +5] where day zero is the announcement date. Numbers in parentheses are the t-test statistic of the means.

Panel A: Implied volatility for at-the-money put options

	Long maturity at-the-money put option					Short maturity at-the-money put option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	924	1.000	65	0.0000	0.0001	870	0.998	32	-0.0003	-0.0032
				(0.04)	*(0.14)*				*(-0.30)*	*(-1.43)*
-4	931	1.000	63	0.0006	0.0014	874	0.999	30	-0.0002	0.0021
				(0.83)	*(1.29)*				*(-0.21)*	*(0.85)*
-3	955	1.000	61	-0.0001	-0.0013	877	1.001	29	-0.0017	-0.0012
				(-0.19)	*(-1.21)*				*(-1.39)*	*(-0.71)*
-2	973	0.999	59	0.0009	0.0023	898	0.998	28	0.0025	0.0033
				(1.45)	*(2.11)*				*(2.31)*	*(1.94)*
-1	990	1.000	57	0.0005	0.0003	893	0.998	26	0.0022	0.0030
				(0.75)	*(0.27)*				*(2.01)*	*(1.81)*
0	1,025	0.999	56	0.0078	0.0090	892	0.998	25	0.0083	0.0096
				(6.32)	*(5.84)*				*(5.18)*	*(4.57)*
1	1,069	0.999	54	0.0012	-0.0014	907	0.998	24	-0.0060	-0.0072
				(1.02)	*(-0.69)*				*(-3.14)*	*(-2.60)*
2	1,058	0.998	52	0.0003	0.0013	901	0.998	22	-0.0017	-0.0053
				(0.33)	*(0.75)*				*(-1.03)*	*(-2.22)*
3	1,045	0.997	51	0.0007	0.0002	879	0.996	21	0.0009	-0.0041
				(0.86)	*(0.17)*				*(0.64)*	*(-1.81)*
4	1,040	0.999	49	0.0000	-0.0014	873	0.996	20	0.0025	-0.0061
				(-0.04)	*(-0.89)*				*(1.75)*	*(-1.45)*
5	1,031	0.996	48	0.0004	-0.0010	855	0.994	19	0.0015	-0.0078
				(0.48)	*(-0.59)*				*(0.94)*	*(-2.65)*

Panel B: Implied volatility for out-of-the-money put options

	Long maturity out-of-the-money put option					Short maturity out-of-the-money put option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	477	0.836	66	0.0020	0.0012	692	0.826	34	0.0048	-0.0008
				(2.09)	*(0.74)*				*(3.88)*	*(-0.44)*
-4	505	0.838	65	0.0008	-0.0015	708	0.823	33	0.0066	0.0012
				(0.73)	*(-0.84)*				*(4.46)*	*(0.62)*
-3	508	0.834	64	0.0010	0.0005	727	0.820	31	0.0061	-0.0019
				(1.03)	*(0.32)*				*(3.87)*	*(-0.95)*
-2	536	0.836	62	0.0010	0.0003	737	0.819	30	0.0124	0.0016
				(1.00)	*(0.19)*				*(7.55)*	*(0.61)*
-1	576	0.834	60	0.0023	0.0005	760	0.817	28	0.0108	-0.0017
				(2.27)	*(0.37)*				*(7.31)*	*(-0.58)*
0	584	0.833	59	0.0061	0.0046	801	0.806	26	0.0264	0.0109
				(4.30)	*(2.56)*				*(12.89)*	*(4.25)*
1	579	0.833	58	0.0024	-0.0030	792	0.811	26	0.0109	-0.0009
				(1.38)	*(-1.20)*				*(4.73)*	*(-0.30)*
2	563	0.832	56	0.0022	-0.0009	774	0.813	24	0.0198	-0.0012
				(1.79)	*(-0.43)*				*(8.88)*	*(-0.40)*
3	566	0.832	54	0.0030	-0.0003	728	0.815	23	0.0256	0.0071
				(2.04)	*(-0.13)*				*(9.99)*	*(2.14)*
4	563	0.833	53	0.0015	-0.0018	688	0.816	23	0.0202	-0.0001
				(1.27)	*(-0.91)*				*(7.86)*	*(-0.02)*
5	574	0.834	52	0.0010	-0.0023	656	0.820	22	0.0226	-0.0021
				(0.67)	*(-1.23)*				*(8.13)*	*(-0.63)*

Table 4.5: continued

Panel C: Implied volatility for in-the-money put options										
	Long maturity in-the-money put option					Short maturity in-the-money put option				
Day	N	Moneyness	Maturity	ΔIV	AbΔIV	N	Moneyness	Maturity	ΔIV	AbΔIV
-5	440	1.163	67	-0.0029	-0.0044	334	1.155	34	-0.0021	-0.0010
				(-1.95)	*(-2.04)*				*(-0.85)*	*(-0.29)*
-4	462	1.163	67	0.0024	-0.0011	349	1.158	33	-0.0034	-0.0041
				(1.58)	*(-0.32)*				*(-1.22)*	*(-0.97)*
-3	486	1.163	65	-0.0010	0.0034	370	1.158	32	-0.0032	-0.0026
				(-0.77)	*(0.91)*				*(-1.27)*	*(-0.60)*
-2	538	1.161	63	0.0018	0.0008	375	1.158	31	0.0056	0.0013
				(1.51)	*(0.41)*				*(2.26)*	*(0.36)*
-1	579	1.163	62	-0.0016	-0.0014	396	1.159	30	0.0001	-0.0041
				(-1.23)	*(-0.64)*				*(0.03)*	*(-0.86)*
0	633	1.170	60	0.0058	0.0048	446	1.167	27	0.0100	0.0025
				(3.62)	*(2.17)*				*(3.18)*	*(0.56)*
1	601	1.163	59	0.0010	-0.0003	359	1.156	28	0.0034	-0.0019
				(0.54)	*(-0.12)*				*(0.79)*	*(-0.35)*
2	578	1.164	58	0.0040	0.0020	334	1.159	27	0.0121	0.0014
				(2.53)	*(0.88)*				*(3.09)*	*(0.24)*
3	570	1.165	56	0.0051	0.0029	339	1.159	25	0.0029	-0.0087
				(3.15)	*(1.08)*				*(0.80)*	*(-1.40)*
4	570	1.166	54	-0.0013	-0.0071	314	1.161	24	0.0120	-0.0005
				(-0.89)	*(-2.75)*				*(2.46)*	*(-0.08)*
5	538	1.167	53	0.0017	0.0032	277	1.165	23	0.0283	0.0137
				(1.02)	*(1.34)*				*(4.56)*	*(2.16)*

The behaviour of the implied volatility for at-the-money put options shares a similar pattern with at-the-money call options. For the long maturity options, the implied volatility starts to rise on day -2 and shows another increase on the announcement date. In particular, the abnormal change in the implied volatility amounts to 0.23% (t-statistic is 2.11) on day -2 and 0.9% (t-statistic equals 5.84) on day zero. Following the announcement date, the abnormal change in the implied volatility for this option is close to zero. That is, we see no sign of the implied volatility reverting to its pre-announcement level. For the short maturity at-the-money put options, we also observe a positive abnormal change in the implied volatility on day -2 (AbΔIV is 0.33%, t-statistic is 1.94) and day zero (AbΔIV is 0.96%, t-statistic equals 4.52). However, following the announcement date, the abnormal change in the implied volatility is significantly negative. The abnormal change in the implied volatility is -0.72% (t-statistic is -2.60), -0.53% (t-statistic is -2.22) and -0.78% (t-statistic equals to -2.65) on day +1, +2 and +5. This indicates that similar to at-the-money call options, while the long maturity at-the-money put options exhibit a permanent increase in the implied volatility on the announcement date, the increase in the implied volatility for the short maturity options is only a temporary effect.

Out-of-the-money put options on the other hand experience a positive change in the abnormal implied volatility for both of the long and short maturity options. For the long maturity options, the abnormal change in the implied volatility amounts to 0.46% (t-statistic equals 2.56) on the announcement date. Following this date, the abnormal change in the implied volatility is close to zero. For the short maturity options, the magnitude of the abnormal change in the implied volatility is much higher than the long maturity options, and it amounts to 1.09% (t-statistic is 4.25) on the announcement date. Unlike at-the-money puts, we do not observe any major reduction in the implied volatility following this date. In fact, the short maturity options experience another increase in implied volatility of 0.71% (t-statistic equals 2.14) three days following the announcement date. This result allows us to infer that although Ohlson and Penman's (1985) effect implies a difference in the behaviour of the implied volatility for the long and short maturity put options, out-of-the-money short maturity put options are the cheapest means to protect investors from a large decrease in share price. Therefore, the fact that the abnormal change in the implied volatility actually increases instead of decreases following the announcement date is perhaps a result of a rising demand from the option investors to partially hedge themselves from a short-term fall in the price of the underlying stock.

For in-the-money put options, while there is a significant positive change in the implied volatility on the announcement date (AbΔIV is 0.48%, t-statistic is 2.17), the abnormal change in the implied volatility is significantly negative on day +4 (AbΔIV is -0.71%, t-statistic is -2.75). For the short maturity options, although we do not observe any major changes in the implied volatility on the announcement date, the abnormal change in the implied volatility is positive and significant in the last day of the event window (day +5). Since day +5 is considerably far from the announcement date, we are cautious in concluding that this increase is a result of the split announcements. Thus, for both in-the-money call and put options, the evidence of an increase in the implied volatility is much weaker. Our result so far enables us to infer that while the split announcements may influence at-the-money and out-of-the-money options differently, it certainly does not have a major impact on in-the-money options. This is because from the view of the option investors as well as the market makers, at-the-money options and out-of-the-money options are relatively more attractive than in-the-money options. At-the-money options are the most liquid options while out-of-the-money options offer investors the highest degree of leverage.

4.5.3 Sub-sample analysis

In this section, we examine the behaviour of the option implied volatility for firms with different market capitalisations. Specifically, we focus our attention on the options on firms that belong to the S&P500 index (large capitalisation stocks), S&P400 index (mid capitalisation stocks), S&P600 (small capitalisation stocks) and “other” stocks (stocks that are not part of any of these three indexes). Since the firm’s market capitalisation is a reasonable proxy for the option liquidity, this allows us to examine the behaviour of the option implied volatility at varying levels of liquidity. If the option is actively traded, then there is a higher chance that the increase in the option implied volatility is the result of investors trying to profit in the option market rather than the market makers simply adjusting the option price to incorporate the new information.

4.5.3.1 Implied volatility of call options on stocks with different market capitalisations

Panel A of table 4.6 presents the mean/median trading volume, open interest, average change and abnormal change in the implied volatility of the at-the-money call options on stocks that belong to the S&P500, S&P400, S&P600 index and the "other" stocks separately. Panel B and panel C present the same information for out-of-the-money and in-the-money call options. To conserve space, we only report the average daily change and the abnormal change in the implied volatility over the [-2, +2] day window where day zero is the announcement date[8].

[8] Findings over the [-5, 5] day period share a similar pattern of the result observed earlier. That is, the abnormal change in the implied volatility outside the [-2, 2] window is not statistically different from zero.

Table 4.6: Implied volatility of call options on stocks with different market capitalisations

This table reports the behaviour of the implied volatility for call options on stocks with different market capitalisations. Panel A reports the mean/median volume (VOL), open interest (OI) and percentage bid-ask spread (B/A) as well as the change and abnormal change in the implied volatility for at-the-money call options on stocks that belong to the S&P500 (large cap stock), S&P400 (mid cap stock) and S&P600 (small cap stock) index and the "other" group (stocks that do not belong to the three indices) separately. Panel B and C report the same information for out-of-the-money and in-the-money call options. Our event window is [-2, +2] where day zero is the announcement date. Long maturity call options are call options that expire after the effective date while short maturity call options are call options that expire before the effective date.

Panel A: Implied volatility for at-the-money call options on stocks with different market capitalisations

		IV for long maturity at-the-money call options							IV for short maturity at-the-money call options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	223	188	1666	32	464	0.0010	0.0032	241	419	2273	74	713	0.0031	0.0028
							(0.89)	*(1.50)*						*(1.77)*	*(1.02)*
S&P500	-1	217	269	1817	32	527	0.0002	-0.0007	241	510	2295	80	888	0.0003	-0.0008
							(0.18)	*(-0.43)*						*(0.20)*	*(-0.31)*
S&P500	0	228	398	1742	72	474	0.0056	0.0076	244	785	2352	233	1000	0.0047	0.0076
							(2.59)	*(2.27)*						*(1.85)*	*(2.28)*
S&P500	1	240	570	1827	106	556	-0.0012	-0.0008	249	751	2519	180	1099	-0.0070	-0.0083
							(-0.55)	*(-0.35)*						*(-1.78)*	*(-1.87)*
S&P500	2	239	430	1935	68	648	-0.0012	-0.0009	247	535	2562	129	1170	-0.0065	-0.0134
							(-0.72)	*(-0.46)*						*(-2.49)*	*(-3.40)*
S&P400	-2	192	63	494	4	181	-0.0012	-0.0057	193	72	530	11	124	-0.0005	-0.0045
							(-0.99)	*(-2.23)*						*(-0.25)*	*(-1.23)*
S&P400	-1	197	81	461	7	192	0.0028	0.0043	190	71	492	15	172	0.0058	0.0114
							(1.65)	*(1.86)*						*(2.46)*	*(2.53)*
S&P400	0	204	121	502	22	200	0.0076	0.0098	193	187	515	38	187	0.0068	0.0048
							(3.81)	*(4.26)*						*(2.73)*	*(1.28)*
S&P400	1	219	113	485	24	185	0.0006	0.0011	195	156	507	31	191	-0.0050	-0.0074
							(0.22)	*(0.33)*						*(-1.37)*	*(-1.59)*
S&P400	2	215	68	523	14	210	-0.0025	-0.0028	193	100	588	20	217	-0.0010	0.0007
							(-1.81)	*(-1.30)*						*(-0.39)*	*(0.16)*

Panel A: continued

		IV for long maturity at-the-money call options							IV for short maturity at-the-money call options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P600	-2	244	23	231	1	60	0.0028	0.0089	203	48	261	2	89	0.0035	0.0031
							(1.76)	*(3.46)*						*(1.20)*	*(0.74)*
S&P600	-1	250	37	245	1	70	0.0012	0.0041	207	48	274	5	112	0.0035	-0.0007
							(0.82)	*(1.47)*						*(1.23)*	*(-0.17)*
S&P600	0	251	43	240	12	72	0.0101	0.0057	208	84	279	22	109	0.0070	0.0077
							(4.10)	*(1.65)*						*(1.99)*	*(1.68)*
S&P600	1	263	60	226	15	81	0.0081	0.0111	210	92	308	17	130	0.0027	0.0019
							(3.72)	*(3.51)*						*(0.72)*	*(0.34)*
S&P600	2	262	64	247	11	96	0.0010	0.0012	209	67	290	10	145	-0.0025	-0.0072
							(0.53)	*(0.41)*						*(-0.71)*	*(-1.48)*
Other	-2	336	55	407	1	91	0.0031	0.0011	300	148	684	10	126	0.0053	0.0071
							(2.17)	*(0.45)*						*(1.96)*	*(1.68)*
Other	-1	349	62	374	3	68	0.0009	0.0037	300	179	648	11	127	0.0038	0.0057
							(0.66)	*(1.41)*						*(1.57)*	*(1.50)*
Other	0	351	117	437	17	74	0.0153	0.0130	304	240	675	37	125	0.0124	0.0166
							(5.63)	*(3.67)*						*(2.90)*	*(2.92)*
Other	1	376	116	440	25	101	0.0075	0.0112	312	224	671	44	146	-0.0067	-0.0110
							(2.42)	*(2.36)*						*(-1.54)*	*(-1.99)*
Other	2	372	87	476	12	116	-0.0004	-0.0017	308	231	739	20	149	0.0004	-0.0028
							(-0.24)	*(-0.64)*						*(0.10)*	*(-0.44)*

Table 4.6: continued

Panel B: Implied volatility for out-of-the-money call options on stocks with different market capitalisations															
		IV for long maturity out-of-the-money call options							IV for short maturity out-of-the-money call options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	133	102	958	0	169	0.0019	0.0002	154	101	788	0	109	0.0016	-0.0070
							(1.31)	*(0.09)*						*(0.60)*	*(-1.76)*
S&P500	-1	142	45	623	0	129	0.0003	0.0007	157	64	707	0	116	0.0037	-0.0014
							(0.18)	*(0.29)*						*(1.74)*	*(-0.32)*
S&P500	0	146	87	568	0	141	0.0019	0.0038	148	131	748	0	105	0.0054	-0.0021
							(0.77)	*(1.37)*						*(1.42)*	*(-0.41)*
S&P500	1	145	143	861	5	181	0.0001	-0.0033	136	99	792	0	142	-0.0038	-0.0098
							(0.05)	*(-1.18)*						*(-0.67)*	*(-1.22)*
S&P500	2	138	161	917	0	175	0.0009	-0.0014	126	115	848	0	120	0.0060	0.0010
							(0.52)	*(-0.60)*						*(1.47)*	*(0.18)*
S&P400	-2	121	11	326	0	60	0.0012	-0.0005	100	28	169	0	17	0.0049	0.0027
							(0.66)	*(-0.18)*						*(1.48)*	*(0.57)*
S&P400	-1	122	11	337	0	61	0.0022	-0.0040	101	34	208	0	22	0.0089	0.0021
							(0.92)	*(-1.17)*						*(2.44)*	*(0.40)*
S&P400	0	129	31	412	0	59	0.0062	0.0034	103	13	195	0	22	0.0061	-0.0102
							(2.53)	*(1.01)*						*(1.38)*	*(-1.46)*
S&P400	1	130	66	480	0	78	-0.0021	-0.0073	103	32	237	0	28	0.0098	0.0021
							(-0.69)	*(-2.01)*						*(1.78)*	*(0.23)*
S&P400	2	127	18	476	0	81	0.0026	0.0024	102	14	185	0	50	0.0104	-0.0004
							(1.42)	*(0.69)*						*(2.39)*	*(-0.06)*
S&P600	-2	127	26	102	0	17	0.0029	0.0054	97	9	97	0	12	0.0115	-0.0043
							(1.03)	*(1.31)*						*(1.97)*	*(-0.47)*
S&P600	-1	138	13	122	0	24	0.0057	0.0043	108	7	92	0	10	0.0205	0.0134
							(2.41)	*(1.48)*						*(4.04)*	*(1.38)*
S&P600	0	133	18	116	0	25	0.0044	0.0010	99	30	102	0	16	0.0027	-0.0072
							(1.43)	*(0.25)*						*(0.39)*	*(-0.88)*
S&P600	1	140	17	118	0	26	0.0049	-0.0029	99	19	108	0	20	0.0201	0.0050
							(2.16)	*(-0.48)*						*(2.73)*	*(0.56)*
S&P600	2	141	21	147	0	39	0.0066	0.0011	95	9	118	0	17	0.0192	0.0006
							(2.28)	*(0.19)*						*(2.43)*	*(0.05)*
Other	-2	192	16	328	0	31	-0.0003	-0.0010	169	36	261	0	29	0.0039	-0.0045
							(-0.13)	*(-0.33)*						*(1.10)*	*(-0.84)*
Other	-1	212	25	304	0	30	0.0014	0.0010	181	45	250	0	34	0.0089	0.0042
							(0.91)	*(0.41)*						*(2.28)*	*(0.77)*
Other	0	212	41	334	0	46	0.0098	0.0068	168	44	252	0	45	0.0059	-0.0065
							(3.79)	*(2.01)*						*(1.27)*	*(-1.09)*
Other	1	209	50	405	1	61	0.0047	-0.0008	158	87	353	0	53	0.0091	0.0011
							(1.20)	*(-0.15)*						*(1.36)*	*(0.13)*
Other	2	199	37	427	2	56	-0.0002	-0.0040	145	55	344	0	53	0.0099	-0.0101
							(-0.08)	*(-1.11)*						*(2.10)*	*(-1.08)*

Table 4.6: continued

Panel C: Implied volatility for in-the-money call options on stocks with different market capitalisations

		IV for long maturity in-the-money call options							IV for short maturity in-the-money call options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	186	20	732	0	205	0.0030	0.0005	150	27	845	0	149	0.0017	0.0029
							(1.39)	*(0.13)*						*(0.34)*	*(0.45)*
S&P500	-1	190	32	737	0	228	0.0009	0.0000	151	47	881	0	188	0.0043	-0.0027
							(0.41)	*(0.00)*						*(1.09)*	*(-0.47)*
S&P500	0	212	34	808	0	204	0.0012	-0.0022	175	39	664	1	158	0.0111	-0.0005
							(0.35)	*(-0.55)*						*(1.90)*	*(-0.07)*
S&P500	1	211	57	754	2	177	0.0027	-0.0051	169	144	871	2	229	-0.0081	-0.0106
							(0.73)	*(-0.68)*						*(-1.23)*	*(-1.53)*
S&P500	2	204	23	784	0	226	-0.0011	-0.0023	165	32	823	2	230	-0.0024	-0.0061
							(-0.35)	*(-0.32)*						*(-0.45)*	*(-0.84)*
S&P400	-2	151	7	331	0	116	-0.0002	-0.0025	117	11	314	0	61	0.0076	-0.0018
							(-0.06)	*(-0.73)*						*(1.55)*	*(-0.23)*
S&P400	-1	158	20	312	0	101	0.0057	0.0029	120	22	371	0	66	0.0157	0.0075
							(2.01)	*(0.81)*						*(2.83)*	*(1.01)*
S&P400	0	177	27	285	0	82	0.0064	0.0066	141	35	351	0	61	0.0143	0.0024
							(2.00)	*(1.56)*						*(2.58)*	*(0.26)*
S&P400	1	183	22	271	0	113	0.0010	-0.0060	114	35	461	2	82	-0.0054	-0.0105
							(0.27)	*(-1.14)*						*(-0.80)*	*(-1.10)*
S&P400	2	170	20	320	0	110	-0.0035	0.0012	107	43	384	0	73	0.0030	-0.0179
							(-1.19)	*(0.29)*						*(0.45)*	*(-1.39)*
S&P600	-2	180	8	203	0	39	0.0114	0.0122	103	13	142	0	27	0.0142	0.0194
							(3.96)	*(2.88)*						*(2.96)*	*(2.22)*
S&P600	-1	185	7	226	0	43	-0.0008	-0.0009	118	11	125	0	31	0.0032	0.0135
							(-0.33)	*(-0.22)*						*(0.55)*	*(0.85)*
S&P600	0	225	9	195	0	34	0.0057	0.0038	147	11	132	0	28	0.0127	0.0055
							(1.88)	*(0.75)*						*(2.02)*	*(0.57)*
S&P600	1	211	14	155	0	34	0.0042	0.0061	122	23	161	0	30	0.0219	0.0016
							(1.44)	*(1.47)*						*(3.07)*	*(0.15)*
S&P600	2	212	13	182	0	40	0.0069	0.0023	108	68	234	0	36	-0.0028	-0.0194
							(2.36)	*(0.54)*						*(-0.38)*	*(-1.85)*
Other	-2	249	8	307	0	52	0.0050	0.0000	190	26	317	0	52	0.0085	0.0153
							(1.93)	*(0.00)*						*(1.74)*	*(2.07)*
Other	-1	269	16	304	0	50	0.0021	0.0056	198	33	323	0	68	0.0011	-0.0100
							(0.97)	*(1.64)*						*(0.22)*	*(-1.43)*
Other	0	324	16	272	0	43	0.0090	0.0081	250	41	282	0	55	0.0174	0.0093
							(2.63)	*(1.89)*						*(2.40)*	*(1.01)*
Other	1	323	25	318	0	49	0.0055	0.0069	224	35	383	1	59	-0.0071	-0.0074
							(1.67)	*1.60*						*(-1.22)*	*(-0.73)*
Other	2	307	27	342	0	55	0.0011	-0.0021	201	63	379	0	72	0.0105	-0.0071
							(0.40)	*(-0.53)*						*(1.20)*	*(-0.63)*

What we first notice from table 4.6 is that the mean/median trading volume and open interest for the at-the-money call options is considerably higher during the announcement period compared to the non-announcement period. Specifically, while most of the at-the-money call options exhibit a median trading volume of zero during the non-announcement period, this figure is positive throughout the announcement window. Moreover, the announcement volume is twice as large compared to the non-announcement volume. This pattern is observed across the four size groups for both long and short maturity options. Thus, our sub-sample result suggests an increase in trading activity in the option market due to the split announcements.

For stocks that belong to the S&P500 index, both of the long and short maturity at-the-money call options exhibit an increase of 0.76%, significant at 5%, on the announcement date. However, following this date, while the abnormal change in the implied volatility of the long maturity options is not statistically different from zero, the implied volatility of the short maturity at-the-money call options experiences a major reduction of 1.34% on day +2. This pattern is very similar to the behaviour of the implied volatility for the at-the-money call options in the full sample. Thus, for the most liquid options, our result implies that Ohlson and Penman's (1985) contention of an increase in the stock volatility following the effective date is likely to be valid and this effect has induced the long and short at-the-money call options to behave differently during the event window.

For stocks that belong to the S&P400 index, we observe a positive abnormal change in the implied volatility for the long maturity at-the-money call options of 0.98% (t-statistic is 4.26) on the announcement date. The implied volatility for the short maturity at-the-money call options on the same stocks experiences a surge of 1.14% (t-statistic is 2.53) two days prior to the announcement date and shows no sign of further increase following this date. More importantly, not only does the implied volatility for the long maturity options not drop following the announcement date, there is also no major reduction in the implied volatility of the short maturity options. This is in contrast to the behaviour of the implied volatility for the at-the-money call options on the large cap stocks.

With the small cap stocks (S&P600 index), while there is an increase in the implied volatility on day -2 ($Ab\Delta IV$ is 0.89%, t-statistic is 3.46) and day +1 ($Ab\Delta IV$ is 1.11%, t-statistic is 3.51) for the long maturity options, the abnormal change in the implied volatility for the short maturity options does not differ from zero. On the other hand, the behaviour of the implied volatility for the at-the-money call options on the "other" group shares a similar pattern with the large cap stocks (S&P500 index). Specifically, on the announcement date, the abnormal change in the implied volatility amounts to 1.30% (t-statistic is 3.67) and 1.66% (t-statistic is 2.92) for the long and short maturity options, respectively. However, while the long maturity option shows a further increase of 1.12% (t-statistic is 2.36) on day +1, the short maturity option exhibits a reduction of -1.11% (t-statistic is -1.99) on the same date. Thus, the fact that the implied volatility of the short maturity options tend to revert to its pre-announcement level is not limited to the large cap stocks, rather this pattern is also present in stocks that belong to the "other" group. This is not surprising as the "other" group contains a number of large cap stocks that are quite liquid. Thus, the behavior of the option implied volatility for this group is comparable to the S&P500 index.

Unlike at-the-money call options, for both out-of-the-money and in-the-money call options, we do not observe any increase in the trading activity of the option market as a result of the split announcement. The median trading volume throughout the announcement window is actually zero while the average volume and open interest around the announcement date is very similar to the non-announcement days. This indicates that if the split announcement induces a change in the trading behaviour of the option market, then it is likely to be present in at-the-money options.

The findings in the option implied volatility actually confirms this conjecture. There is no evidence of a change in the implied volatility for out-of-the-money call options on stocks that belong to the S&P500, S&P400 and S&P600 index. The abnormal change in the option implied volatility for stocks that belong to these three indexes is not significantly different from zero on any days during the announcement period. This is consistently observed for both long and short maturity options. Conversely, the implied volatility of the long maturity options on the "other" stocks exhibit an increase of 0.68% (t-statistic is 2.01) on the announcement date. The abnormal change in the implied volatility of the short maturity options on stocks in this size group is generally negative, although insignificant. In section 4.5.1, we find that, on average, there is an increase in the implied volatility for the long maturity out-of-the-money call options on the announcement date. Our sub-sample result so far allows us to infer that most of this increase is due to the "other" group. There is no evidence of a positive change in the implied volatility for this type of option across the other three size groups.

Finally, the average abnormal change of the implied volatility of in-the-money call options is not significantly positive for stocks that belong to the S&P500 and S&P400 index. However, for stocks that belong to the S&P600 index, the implied volatility shows an increase of 1.22% (t-statistic equals 2.88) and 1.94% (t-statistic equals 2.22) two days before the announcement date for the long and short maturity options, respectively. For the "other" stocks, while there is virtually no change in the implied volatility for the long maturity options, the short maturity in-the-money call options experience a significant positive change of 1.53% (t-statistic is 2.07) on day -2.

In summary, only at-the-money call options consistently induce a positive change in the implied volatility across different market capitalisations. While there is evidence of an increase in the implied volatility for such options, the pattern in which the option implied volatility behaves between the long and short maturity options is highly dependent on the market capitalisations of the underlying stock, a reasonable proxy for the option liquidity. This leads us to conclude that liquidity plays a very important role in determining the operation of the option market and how it reacts to new information.

4.5.3.2 Implied volatility of put options on stocks with different market capitalisations

In this section, we study the implied volatility for put options across different market capitalisations over the [-2, +2] event window where day zero is the announcement date. Panel A, B and C of table 4.7 reports the mean/median volume, open interest, change and abnormal change in the implied volatility for at-the-money, out-of-the-money and in-the money put options, respectively.

Table 4.7: Implied volatility of put options on stocks with different market capitalisations

This table reports the behaviour of the implied volatility for put options on stocks with different market capitalisations. Panel A reports the mean/median volume (VOL), open interest (OI) and percentage bid-ask spread (B/A) as well as the change and abnormal change in the implied volatility for at-the-money put options on stocks that belong to the S&P500 (large cap stock), S&P400 (mid cap stock) and S&P600 (small cap stock) index and the "other" group (stocks that do not belong to the three indices) separately. Panel B and C report the same information for out-of-the-money and in-the-money put options. Our event window is [-2, +2] where day zero is the announcement date. Long maturity put options are put options that expire after the effective date while short maturity put options are put options that expire before the effective date.

Panel A: Implied volatility for at-the-money put options on stocks with different market capitalisations

		IV for long maturity at-the-money-put options							IV for short maturity at-the-money put options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	223	92	643	5	126	0.0022	0.0030	244	249	1066	28	332	0.0034	-0.0006
							(2.30)	*(1.94)*						*(2.18)*	*(-0.25)*
S&P500	-1	220	138	702	6	126	-0.0010	-0.0010	245	229	1092	38	373	0.0016	0.0019
							(-1.02)	*(-0.79)*						*(1.24)*	*(0.85)*
S&P500	0	233	212	616	11	126	0.0067	0.0095	244	331	1118	67	357	0.0062	0.0107
							(3.25)	*(3.24)*						*(2.50)*	*(3.29)*
S&P500	1	243	254	622	17	139	-0.0034	-0.0039	248	414	998	60	381	-0.0089	-0.0092
							(-1.85)	*(-1.89)*						*(-2.60)*	*(-2.42)*
S&P500	2	242	195	845	17	142	-0.0011	-0.0013	247	258	1091	43	355	-0.0056	-0.0089
							(-0.81)	*(-0.81)*						*(-1.65)*	*(-2.31)*
S&P400	-2	203	31	251	0	30	-0.0006	0.0016	194	36	235	0	41	0.0008	0.0042
							(-0.61)	*(0.75)*						*(0.43)*	*(1.43)*
S&P400	-1	206	24	268	0	28	0.0017	0.0045	193	64	249	0	42	-0.0010	0.0008
							(1.21)	*(2.17)*						*(-0.49)*	*(0.28)*
S&P400	0	214	46	275	0	30	0.0099	0.0103	195	88	268	5	55	0.0110	0.0103
							(3.16)	*(3.02)*						*(3.29)*	*(2.62)*
S&P400	1	228	75	304	0	38	0.0009	-0.0006	197	94	273	4	52	-0.0044	-0.0001
							(0.47)	*(-0.22)*						*(-1.27)*	*(-0.02)*
S&P400	2	226	39	307	0	47	-0.0013	-0.0026	196	72	315	3	59	0.0012	-0.0032
							(-0.84)	*(-1.27)*						*(0.61)*	*(-0.93)*

Panel A: continued

Index	Day	IV for long maturity at-the-money put options							IV for short maturity at-the-money put options						
		N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P600	-2	262	13	96	0	9	0.0016	0.0042	216	24	114	0	18	0.0020	0.0044
							(1.11)	*(1.79)*						*(1.05)*	*(1.06)*
S&P600	-1	265	14	94	0	10	-0.0006	-0.0013	214	30	118	0	23	0.0047	0.0038
							(-0.45)	*(-0.72)*						*(2.12)*	*(1.13)*
S&P600	0	268	14	97	0	10	0.0058	0.0068	212	47	150	0	21	0.0051	0.0025
							(2.83)	*(2.67)*						*(1.51)*	*(0.59)*
S&P600	1	280	19	117	0	11	0.0016	-0.0005	212	52	143	1	25	-0.0026	-0.0040
							0.88	*(-0.20)*						*(-0.80)*	*(-0.94)*
S&P600	2	276	15	94	0	10	0.0050	0.0049	214	59	122	0	30	0.0031	0.0027
							(2.81)	*(2.23)*						*(0.94)*	*(0.51)*
Other	-2	351	22	230	0	10	0.0009	0.0013	307	71	330	0	25	0.0028	0.0032
							(0.66)	*(0.62)*						*(1.19)*	*(1.09)*
Other	-1	365	49	212	0	10	0.0009	-0.0006	305	109	298	1	34	0.0018	0.0036
							(0.70)	*(-0.31)*						*(0.80)*	*(1.05)*
Other	0	379	70	176	0	10	0.0078	0.0092	306	115	297	2	33	0.0097	0.0119
							(3.66)	*(3.40)*						*(3.28)*	*(2.90)*
Other	1	391	38	191	0	20	0.0043	-0.0002	314	97	286	6	36	-0.0060	-0.0109
							(1.84)	*(-0.04)*						*(-1.61)*	*(-2.22)*
Other	2	388	45	245	0	22	-0.0020	0.0018	309	107	295	4	42	-0.0038	-0.0079
							(-1.11)	*(0.43)*						*(-1.25)*	*(-1.64)*

Table 4.7: continued

Panel B: Implied volatility for out-of the money put options on stocks with different market capitalisations															
		IV for long maturity out-of-the-money put options							IV for short maturity out-of-the-money put options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	133	102	958	0	169	0.0019	0.0002	191	32	1031	0	265	0.0062	-0.0034
							(1.31)	*(0.09)*						*(2.91)*	*(-0.96)*
S&P500	-1	142	45	623	0	129	0.0003	0.0007	192	56	978	0	257	0.0108	-0.0002
							(0.18)	*(0.29)*						*(4.95)*	*(-0.06)*
S&P500	0	146	87	568	0	141	0.0019	0.0038	208	56	1094	0	289	0.0191	0.0051
							(0.77)	*(1.37)*						*(6.11)*	*(1.29)*
S&P500	1	145	143	861	5	181	0.0001	-0.0033	207	87	1071	0	277	0.0027	-0.0042
							(0.05)	*(-1.18)*						*(0.78)*	*(-1.11)*
S&P500	2	138	161	917	0	175	0.0009	-0.0014	206	51	1012	0	261	0.0107	-0.0029
							(0.52)	*(-0.60)*						*(3.16)*	*(-0.71)*
S&P400	-2	121	11	326	0	60	0.0012	-0.0005	162	7	207	0	52	0.0137	-0.0018
							(0.66)	*(-0.18)*						*(4.64)*	*(-0.44)*
S&P400	-1	122	11	337	0	61	0.0022	-0.0040	164	17	218	0	50	0.0082	-0.0011
							(0.92)	*(-1.17)*						*(2.86)*	*(-0.22)*
S&P400	0	129	31	412	0	59	0.0062	0.0034	170	15	224	0	51	0.0276	0.0069
							(2.53)	*(1.01)*						*(6.62)*	*(1.42)*
S&P400	1	130	66	480	0	78	-0.0021	-0.0073	168	20	213	0	60	0.0075	-0.0025
							(-0.69)	*(-2.01)*						*(1.65)*	*(-0.34)*
S&P400	2	127	18	476	0	81	0.0026	0.0024	163	13	220	0	69	0.0194	-0.0071
							(1.42)	*(0.69)*						*(4.77)*	*(-1.15)*
S&P600	-2	127	26	102	0	17	0.0029	0.0054	181	7	132	0	18	0.0162	-0.0021
							(1.03)	*(1.31)*						*(4.42)*	*(-0.28)*
S&P600	-1	138	13	122	0	24	0.0057	0.0043	188	5	126	0	18	0.0133	-0.0033
							(2.41)	*(1.48)*						*(3.95)*	*(-0.42)*
S&P600	0	133	18	116	0	25	0.0044	0.0010	193	7	116	0	16	0.0294	0.0144
							(1.43)	*(0.25)*						*(7.86)*	*(2.77)*
S&P600	1	140	17	118	0	26	0.0049	-0.0029	188	23	125	0	20	0.0263	0.0095
							(2.16)	*(-0.48)*						*(5.97)*	*(1.51)*
S&P600	2	141	21	147	0	39	0.0066	0.0011	185	9	137	0	29	0.0299	0.0028
							(2.28)	*(0.19)*						*(5.44)*	*(0.38)*
Other	-2	192	16	328	0	31	-0.0003	-0.0010	253	32	349	0	45	0.0139	0.0090
							(-0.13)	*(-0.33)*						*(4.04)*	*(2.04)*
Other	-1	212	25	304	0	30	0.0014	0.0010	272	49	346	0	50	0.0106	-0.0025
							(0.91)	*(0.41)*						*(3.94)*	*(-0.54)*
Other	0	212	41	334	0	46	0.0098	0.0068	287	28	318	0	50	0.0290	0.0162
							(3.79)	*(2.01)*						*(7.25)*	*(3.27)*
Other	1	209	50	405	1	61	0.0047	-0.0008	286	35	365	0	50	0.0088	-0.0020
							(1.20)	*(-0.15)*						*(1.96)*	*(-0.33)*
Other	2	199	37	427	2	56	-0.0002	-0.0040	275	44	358	0	53	0.0197	0.0007
							(-0.08)	*(-1.11)*						*(4.98)*	*(0.13)*

Table 4.7: continued

Panel C: Implied volatility for in-the-money put options on stocks with different market capitalisations

		IV for long maturity in-the-money put options							IV for short maturity in-the-money put options						
Index	Day	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV	N	Mean VOL	Mean OI	Median VOL	Median OI	ΔIV	AbΔIV
S&P500	-2	129	3	70	0	6	0.0023	-0.0012	109	47	168	0	11	0.0028	-0.0005
							(1.09)	*(-0.38)*						*(0.59)*	*(-0.09)*
S&P500	-1	138	4	77	0	4	-0.0018	-0.0029	116	7	103	0	6	0.0009	-0.0071
							(-0.93)	*(-0.92)*						*0.21*	*-1.24*
S&P500	0	151	8	69	0	0	0.0053	0.0097	139	7	135	0	7	0.0041	-0.0056
							(1.81)	*(2.34)*						*(0.76)*	*(-0.76)*
S&P500	1	141	39	237	0	8	0.0007	-0.0022	103	15	192	0	10	0.0114	0.0095
							(0.20)	*(-0.50)*						*(1.14)*	*(0.89)*
S&P500	2	135	9	282	0	4	0.0021	0.0002	102	15	122	0	11	0.0070	0.0005
							(0.62)	*(0.04)*						*(1.35)*	*(0.06)*
S&P400	-2	113	1	97	0	0	0.0019	0.0036	68	2	99	0	0	0.0070	0.0013
							(0.79)	*(0.91)*						*(1.66)*	*(0.16)*
S&P400	-1	120	4	108	0	0	-0.0036	-0.0052	79	4	111	0	3	-0.0134	-0.0025
							(-1.25)	*(-1.38)*						*(-2.16)*	*(-0.19)*
S&P400	0	133	3	81	0	0	0.0002	-0.0033	89	6	90	0	1	0.0065	-0.0106
							(0.07)	*(-0.82)*						*(1.03)*	*(-1.06)*
S&P400	1	127	9	102	0	0	0.0011	-0.0010	76	15	147	0	5	0.0025	0.0086
							(0.38)	*(-0.23)*						*(0.35)*	*(0.72)*
S&P400	2	131	1	93	0	1	0.0018	0.0012	70	10	172	0	8	0.0107	-0.0022
							(0.80)	*(0.32)*						*(1.55)*	*(-0.23)*
S&P600	-2	130	1	15	0	0	0.0038	0.0047	78	4	19	0	0	0.0029	0.0004
							(1.37)	*(0.80)*						*(0.56)*	*(0.05)*
S&P600	-1	148	0	12	0	0	-0.0001	0.0022	82	1	31	0	0	0.0087	-0.0033
							(-0.04)	*(0.52)*						*(1.35)*	*(-0.32)*
S&P600	0	161	3	13	0	0	0.0045	-0.0007	93	2	27	0	0	0.0184	0.0140
							(1.26)	*(-0.14)*						*(2.80)*	*(1.50)*
S&P600	1	153	2	13	0	0	0.0010	0.0055	75	3	38	0	0	-0.0037	-0.0192
							(0.34)	*(1.34)*						*(-0.46)*	*(-1.80)*
S&P600	2	143	4	18	0	0	0.0095	0.0024	73	2	41	0	0	0.0210	0.0052
							(2.85)	*(0.52)*						*(2.28)*	*(0.37)*
Other	-2	207	2	92	0	0	0.0014	0.0007	153	5	50	0	0	0.0071	0.0030
							(0.64)	*(0.21)*						*(1.65)*	*(0.49)*
Other	-1	211	2	98	0	0	-0.0025	-0.0026	152	11	56	0	0	-0.0014	-0.0129
							(-1.14)	*(-0.60)*						*(-0.29)*	*(-1.55)*
Other	0	229	7	89	0	0	0.0089	0.0093	159	10	50	0	3	0.0143	0.0150
							(3.39)	*(2.44)*						*(2.52)*	*(1.93)*
Other	1	226	3	108	0	0	0.0029	-0.0007	134	13	268	0	6	0.0026	-0.0023
							(0.74)	*(-0.15)*						*(0.40)*	*(-0.26)*
Other	2	209	1	94	0	0	0.0013	0.0023	116	18	113	0	10	0.0128	0.0055
							(0.46)	*(0.54)*						*(1.58)*	*(0.44)*

Once again, we observe a rise in the trading activity around the announcement date for the at-the-money put options. Except for options on stocks that belong to the S&P600 index, the median trading volume for the at-the-money put options on stocks that belong to the other three size groups is actually positive while this figure is zero on the non-announcement days. The average volume during the announcement period is also much higher compared to the non-announcement period. This trend is observed in both long and short maturity options across all the four size groups.

The behaviour of the implied volatility for the at-the-money put options on firms with different market capitalisations is comparable to that of the at-the-money call options. Specifically, for options on the large cap stocks, the long and short maturity options exhibit an increase of 0.95% (t-statistic is 3.24) and 1.07% (t-statistic is 3.29) on the announcement date, respectively. However, this new level of implied volatility is not sustainable for the short maturity options. The implied volatility for these options is reduced by 0.92% (t-statistic is -2.42) on day +1 and 0.89% (t-statistic is -2.31) on day +2. This pattern is actually repeated for options on the "other" stocks. That is, while there is an increase of 0.92% (t-statistic is 3.40) and 1.19% (t-statistic is 2.90) in the implied volatility for the long and short maturity options on the announcement date, the implied volatility for the short maturity options actually reverts to its pre-announcement level on day +1 (AbΔIV is -1.09%%, t-statistic is -2.22).

For at-the-money put options on stocks that are part of the S&P400 index, both of the long and short maturity options experience a significant positive change of 1.03% in the implied volatility on the announcement date. Surprisingly, for the short maturity options on this group of stocks, we observe no evidence of the implied volatility returning to its pre-announcement level. Following the announcement date, the abnormal change in the implied volatility is close to zero. Finally, while there is a positive change of 0.68% (t-statistic equals 2.67) in the implied volatility for the long maturity options on the small cap stocks, the abnormal change in the implied volatility for the short maturity options is not statistically different from zero in any days during the announcement period.

Similar to out-of-the-money and in-the-money call options, it is doubtful that the split announcements induce a positive change in the trading activity of out-of-the-money and in-the-money put options. The median trading volume throughout the announcement period is zero across the four size groups. Moreover, the average trading volume and open interest during the announcement period is very similar to the non-announcement period. Thus, if there is a change in the trading activity in the option market as a result of the split announcements, then it is unlikely that this trend will be observed in out-of-the-money and in-the-money put options.

Compared to at-the-money put options, the evidence of an increase in the implied volatility is much weaker for out-of-the-money put options. The abnormal change in the implied volatility for options on the large and mid cap stocks is close to zero and only options on the small and "other" stocks exhibit a positive change in the implied volatility around the announcement period. Specifically, for the small cap stocks, the short maturity out-of-the-money put options show an increase of 1.44% (t-statistic equals 2.77) in implied volatility on day zero. However, the abnormal change in the implied volatility for the long maturity options does not differ from zero. For stocks that belong to the "other" group, the long and short maturity out-of-the-money put options experience a positive change of 0.68% (t-statistic equals 2.01) and 1.62% (t-statistic is 3.27) on the announcement date, respectively. In fact, the abnormal change in the implied volatility for the short maturity options on this group of stocks starts to rise two days before the announcement date (AbΔIV is 0.90%, t-statistic is 2.04). In section 4.5.2, the average abnormal change in the implied volatility for both of the long and short maturity out-of-the-money put options of the whole sample is actually positive and significant. Thus, our sub-sample result implies that this increase is likely to be due to a rise in the implied volatility of out-of-the-money put options on the small and "other" stocks. So far, the behaviour of the implied volatility for both call and put options on stocks that belong to the "other" group is quite interesting, on some occasions, it is similar to the S&P500 index while on other occasions, it is comparable to the S&P600 index. The reason is that this group comprises all companies that are not part of the S&P1500 index. Thus, not only does it include the micro stocks where the market capitalisation is somewhat similar or even smaller than the S&P600 index, a number of large firms that do not belong to any of the three indices also reside in this group.

The behaviour of the implied volatility for the in-the-money put option is not robust across the four size groups. Except for the long maturity options on the large cap and "other" stocks where there is an increase of 0.97% (t-statistic equals 2.34) and 0.93% (t-statistic is 2.44) on the announcement date, the abnormal change in the implied volatility for options on stocks that belong to the S&P400 and S&P600 index is not statistically different from zero. Moreover, the short maturity in-the-money put options on the other hand do not experience any increase in the implied volatility across all the four size groups. This is consistent with our findings in section 4.5.2.

In summary, there is evidence of an increase in the implied volatility for both call and put options around the announcement date. Although the behaviour of the option implied volatility varies with the firm's market capitalisation and moneyness, for at-the-money options on firms that belong to the S&P500 index (the most liquid options), the split announcements exert a different influence on options that expire after the effective date compared to those that expire before. Specifically, we observe a permanent increase in the implied volatility for options that expire after the effective date. Meanwhile, for options that expire before the effective date, the increase in the implied volatility is rather short-lived. Following the announcement date, the implied volatility for this type of option reverts to its pre-announcement level. This is perfectly consistent with Ohlson and Penman's (1985) conjecture of an increase in the stock volatility following the effective date. However, we need to distinguish whether the increase in the option implied volatility is a result of investors believing in a rise in the volatility of the underlying stock or if they are actually trading in the options market in anticipation of an increase in the stock price. This leads us to our next test: the analysis of the volatility spread.

4.5.4 Volatility spread

We argue that if the option investors believe that the stock price will increase following the split announcement, then one profitable strategy they could implement is to either buy a call option or sell a put option. This in turn will create a positive spread between the implied volatility of a call and a put option. Meanwhile, if the increase in the option implied volatility simply reflects an increase in the return volatility of the underlying stock, then we should not expect a significant difference in the implied volatility of a call option versus a put option. The behaviour of the option volatility spread is the key evidence that allows us to evaluate the importance of the split announcement on the option market.

Our results so far suggest that most of the trading activity in the options market resides in at-the-money options. This is the only group that shows an increase in trading activity as a result of the split announcements. While out-of-the-money options might appear to be more attractive in terms of leverage, the exceptionally high bid-ask spreads on these options actually discourage investors from trading. Thus, we only examine the volatility spread between at-the-money call options and at-the-money put options in order to separate the effect of investors trading activity on the option price. Moreover, a positive spread in the implied volatility for at-the-money options is also evidence of a deviation in put-call parity.

For each stock, we select the closest at-the-money call and put option given that these options are not out- or in-the-money by more than 10 percent. We then randomly match each call option with a put option on the same underlying stock with the same maturity index. Next, we compute the difference in the level of moneyness between a call and a put option where the level of moneyness for a call option, as defined earlier, is the stock price divided by the strike price and the level of moneyness for a put option is the strike price divided by the stock price. We then select the call and put pair with the minimum moneyness difference. This procedure ensures that each splitting company is represented by only one call and put pair. Table 4.8 presents the change and abnormal change in the volatility spread between at-the-money call and put options during the period [-5, +5] where day zero is the announcement date. We examine the short and long maturity options separately.

Table 4.8: Volatility spread between at-the-money call and put options

This table reports the level of moneyness, time to maturity and average change and abnormal change in the volatility spread (VS) between at the money call and put options during the period [-5, +5] where day zero is the announcement date. For each stock, we select the closest at-the-money call and put option given that these options are not out- or in-the-money by more than 10 percent. We then randomly match each call option with a put option on the same underlying stock with the same maturity index and compute the difference in the level of moneyness between a call and a put option. We select the call and put pair with the minimum moneyness difference. Thus, each splitting company is represented by only one call and put pair. Long maturity options are options that expire after the effective date while short maturity options are options that expire before the effective date.

	VS between long maturity at-the-money call and put options						VS between short maturity at-the-money call and put options					
Day	N	Moneyness call	Moneyness put	Maturity	ΔVS	AbΔVS	N	Moneyness call	Moneyness put	Maturity	ΔVS	AbΔVS
-5	826	0.998	0.999	60	0.0019	0.0039	805	0.998	0.998	35	0.0024	-0.0010
					(1.68)	*(1.22)*					*(1.96)*	*(-0.26)*
-4	853	0.997	0.996	58	0.0008	-0.0088	832	0.997	0.997	34	0.0005	-0.0049
					(0.80)	*(-2.76)*					*(0.35)*	*(-1.14)*
-3	869	0.998	0.997	56	0.0004	-0.0015	841	0.997	0.995	33	0.0008	0.0010
					(0.38)	*(-0.39)*					*(0.59)*	*(0.25)*
-2	890	0.998	0.999	53	0.0006	-0.0075	861	0.999	0.997	31	0.0009	-0.0009
					(0.62)	*(-2.05)*					*(0.61)*	*(-0.20)*
-1	921	0.999	0.997	52	0.0010	-0.0003	856	1.000	0.998	30	0.0023	-0.0054
					(0.98)	*(-0.07)*					*(1.53)*	*(-1.22)*
0	934	0.999	0.998	50	0.0038	-0.0019	861	0.999	0.998	29	0.0017	-0.0011
					(2.74)	*(-0.54)*					*(0.87)*	*(-0.25)*
1	989	0.999	0.997	49	0.0043	0.0086	878	1.000	0.996	28	0.0039	-0.0022
					(3.40)	*(2.05)*					*(1.90)*	*(-0.53)*
2	1,001	1.000	0.996	47	0.0003	-0.0035	881	1.000	0.994	26	-0.0009	-0.0020
					(0.20)	*(-0.95)*					*(-0.40)*	*(-0.42)*
3	1,005	1.001	0.996	46	-0.0006	0.0044	855	1.000	0.995	25	-0.0027	0.0056
					(-0.49)	*(1.37)*					*(-1.38)*	*(1.23)*
4	995	0.999	0.994	45	0.0006	-0.0013	837	0.998	0.993	23	-0.0020	-0.0037
					(0.56)	*(-0.39)*					*(-0.94)*	*(-0.75)*
5	984	1.002	0.997	44	0.0004	0.0028	811	1.000	0.993	23	0.0031	0.0043
					(0.32)	*(0.79)*					*(1.57)*	*(0.80)*

Here, not only is our methodology successful in extracting at-the-money options, the level of moneyness of call options are very comparable to put options and close to one. For the long maturity options, prior to the announcement date, we see no evidence of a positive volatility spread between a call and a put option. In fact, the change in the volatility spread is significantly negative in day -4 and day -2, and it amounts to -0.88% (t-statistic is -2.76) and -0.75% (t-statistic is -2.05) on these two days. While the abnormal change in the volatility spread is not significantly different from zero on the announcement date, we observe a positive spread in the volatility between call and put options on day +1. Specifically, the abnormal change in the volatility spread is 0.86% (t-statistic is 2.05). In section 4.5.1 and 4.5.2, although both the long maturity at-the-money call and put options exhibit an increase in the implied volatility on the announcement date, the implied volatility of the call options continue to show a further increase of 0.65% (t-statistic is 3.10) while the implied volatility of the long maturity at-the-money put options do not. Thus, our result indicates that perhaps the split announcement is information that is valued by the option investors and induces them to increase their buying activity in at-the-money call options. In other words, from the view of the option investors, there are positive abnormal returns to be earned following the announcement.

The behaviour of the short maturity options on other hand is quite different to the long maturity options. Both the change and abnormal change in option volatility are not significantly positive in any days during the announcement period. Given the results in sections 4.5.1 and 4.5.2, we interpret this evidence as follows: while there appears to be an increase in the implied volatility for the short maturity at-the-money call option on the announcement date, this increase is not large enough to create a significant positive volatility spread between a call and a put option since the implied volatility of the put option also increases. Thus, our results so far suggest that if the split announcements induce the option investors to trade, then most of the trading activity resides in the long maturity options.

4.5.5 Volatility spread across different market capitalisations

Table 4.9 reports the change and abnormal change in the volatility spread between the long/short maturity at-the-money call and put options on stocks with different market capitalisations. To conserve space, we only examine the behaviour of the volatility spread for the period [-2, +2] day around the announcement date.

Table 4.9: Volatility spread between at-the-money call and put options across firms with different levels of market capitalisation

This table reports the average change and abnormal change in the volatility spread (VS) between at the money call and put options on stocks that belong to the S&P500 (large cap stocks), S&P400 (mid cap stocks), S&P600 (small cap stocks) index and the "other" group (stocks that do not belong to any of the three indices) during the period [-2, +2] where day zero is the announcement date. Long maturity options are options that expire after the effective date while short maturity options are options that expire before the effective date.

		VS for long maturity at-the-money option			**VS for short maturity at-the-money option**		
Index	Day	N	ΔIV	AbΔIV	N	ΔIV	AbΔIV
S&P500	-2	214	-0.0017	-0.0002	240	0.0010	0.0002
			(-1.12)	*(-0.05)*		*(0.55)*	*(0.02)*
S&P500	-1	216	0.0021	0.0053	236	0.0008	-0.0116
			(1.60)	*(1.08)*		*(0.47)*	*(-1.80)*
S&P500	0	226	0.0012	-0.0083	241	0.0021	-0.0097
			(0.50)	*(-1.47)*		*(0.90)*	*(-1.44)*
S&P500	1	236	0.0030	0.0038	246	0.0037	-0.0071
			(1.25)	*(0.64)*		*(1.20)*	*(-1.10)*
S&P500	2	238	0.0014	-0.0066	247	-0.0008	-0.0117
			(0.59)	*(-1.42)*		*(-0.27)*	*(-1.38)*
S&P400	-2	189	0.0000	-0.0122	191	-0.0003	0.0071
			(0.01)	*(-1.77)*		*(-0.11)*	*(0.89)*
S&P400	-1	192	-0.0009	0.0002	186	0.0071	0.0035
			(-0.36)	*(0.03)*		*(2.17)*	*(0.44)*
S&P400	0	197	0.0027	0.0068	189	-0.0033	-0.0101
			(1.18)	*(1.25)*		*(-1.08)*	*(-1.48)*
S&P400	1	214	0.0038	0.0031	192	0.0030	-0.0001
			(1.58)	*(0.45)*		*(0.93)*	*(-0.01)*
S&P400	2	214	-0.0024	-0.0099	193	-0.0045	0.0016
			(-1.00)	*(-1.55)*		*(-1.28)*	*(0.23)*

Table 4.9: continued

		VS for long maturity at-the-money option			VS for short maturity at-the-money option		
S&P600	-2	233	0.0020	-0.0077	197	0.0009	-0.0088
			(1.16)	*(-1.29)*		*(0.31)*	*(-1.18)*
S&P600	-1	245	0.0012	-0.0032	205	0.0004	-0.0195
			(0.53)	*(-0.52)*		*(0.11)*	*(-2.06)*
S&P600	0	244	0.0046	-0.0083	203	0.0027	0.0039
			(1.72)	*(-1.41)*		*(0.72)*	*(0.46)*
S&P600	1	253	0.0064	0.0157	203	0.0094	0.0002
			(2.64)	*(2.53)*		*(2.44)*	*(0.02)*
S&P600	2	256	-0.0020	-0.0015	206	-0.0044	-0.0076
			(-0.87)	*(-0.28)*		*(-0.92)*	*(-0.95)*
Other	-2	321	0.0011	-0.0099	303	0.0024	0.0019
			(0.59)	*(-1.27)*		*(0.89)*	*(0.20)*
Other	-1	335	0.0021	-0.0009	294	0.0027	0.0047
			(1.06)	*(-0.12)*		*(0.97)*	*(0.55)*
Other	0	330	0.0050	-0.0009	296	0.0031	0.0095
			(1.84)	*(-0.12)*		*(0.66)*	*(0.98)*
Other	1	358	0.0031	0.0101	306	0.0011	0.0000
			(1.30)	*(1.11)*		*(0.24)*	*(0.00)*
Other	2	366	0.0031	0.0012	304	0.0045	0.0141
			(1.36)	*(0.15)*		*(1.00)*	*(1.41)*

For options on the most liquid stocks (S&P500 index), the abnormal change in the volatility spread is not statistically different from zero in any days during the [-2, +2] window. On the announcement date, the abnormal change in the volatility spread is negative and it amounts to -0.83%, however, it is insignificant (t-statistic equals -1.47). Thus, although there is an increase in the implied volatility for the long maturity at the money call options, this is not enough to create a positive spread in the volatility between call and put options on the same underlying stocks since the long maturity at-the-money put option also experiences an increase in the implied volatility around the announcement period. This pattern is repeated for options on stocks that belong to the S&P400 and the “other” group. In fact, the only time when the abnormal change in the volatility spread is positive and significant is for options on stocks that are part of the S&P600 index. Specifically, the abnormal change in the volatility spread for options on this group of stocks amounts to 1.57% (t-statistic is 2.53) one day after the announcement date. This suggests that the positive change in the volatility spread observed earlier in table 4.8 is the result of options on the small cap stocks (S&P600 index). We attribute the reasons for this increase in the volatility spread as follows: first, stock split announcements are better valued by the option investors when they occur in small firms. That is, the option investors believe there is a higher chance for positive abnormal returns to exist in small firms compared to large firms. Second, what we notice in table 4.6 and 4.7 (panel A) is that although there is an increase in the implied volatility for both at-the-money call and put options during the announcement period, the call options are slower to react to the split announcements. Specifically, while the implied volatility of at-the-money put options exhibit an increase on the announcement date (day zero) and stay at that level thereafter, the implied volatility of at-the-money call options actually do not show any increase in the implied volatility until day +1. Thus, when the implied volatility of at-the-money call options are matched with at-the-money put options on day +1, we observe a positive volatility spread. Given the liquidity in options on the small cap stocks is low and there does not appear to be any major changes in the trading volume for both call and put options on day +1, we conclude that the second reason is likely to be valid. That is, the positive change in the volatility spread for this group of stocks is mainly due to a timing difference in which the market makers respond to the split announcements.

We observe no evidence of a significant positive change in the volatility spread between the short maturity at-the-money call and put options in any days during the announcement window across the four size groups. Specifically, the abnormal change in the volatility spread between call and put options on the announcement date amounts to -0.97% (t-statistic is -1.44), -1.01% (t-statistic is -1.38), 0.2% (t-statistic is

0.02) and 0.95% (t-statistic is 0.98) for options on stocks that are part of the S&P500, S&P400, S&P600 index and the "other" group, respectively. The findings in section 4.5.2 and 4.5.3 suggest that except for options on the large and "other" stocks, there are no major changes in the implied volatility for both call and put options as a result of the split announcements. Thus, it is not surprising that the change in the volatility spread for options on stocks that are part of the S&P400 and S&P600 is close to zero on the announcement date. As for options on the large cap and "other" group, even though there is an increase in the implied volatility for at-the-money call options, the implied volatility for at-the-money put options also increases. These combined effects only result in a small change in the volatility spread between call and put options, which on average, is not significant.

In summary, except for options on stocks that belong to the S&P600 index, we find no evidence of a significant positive change in the volatility spread as a result of the split announcement for both long and short maturity options. While there is an increase in the trading activity for at-the-money options, this does not suggest that investors in the option market anticipate positive abnormal returns to be earned in the stock market. Rather, it mainly reflects their expectations of an increase in the volatility of the underlying stock. While most previous studies document evidence of the market under-reacting to the split announcement and there are positive abnormal returns to be made in the long-run, from the view of the options investors, this anomaly either does not exist or is not exploitable.

4.6 Conclusion

In this chapter, we examine whether informed investors believe that they can make money by trading following stock split announcements. Our focus is on profitability as opposed to predictability. This is because the fact that asset returns are predictable following such announcements does not always guarantee that positive excess returns can be earned. Rather, the ability to capture these returns is dependent on the information that is available to investors at the time the trades were made. Since informed investors tend to migrate to the option market to achieve higher leverage and avoid short-sale constraints, this provides us an opportunity to study whether a strategy of buying companies that announce a stock split is profitable from the view of the option investors who possess an informational advantage compared to uninformed investors.

We find that, in aggregate, call and put options on splitting companies exhibit an increase in the implied volatility around the announcement date. For at-the-money call options, while there is a permanent increase in the implied volatility for options that expire after the effective date, the increase in the implied volatility for options that expire before the effective date either does not exist or is only a temporary effect. This indicates that Ohlson and Penman's (1985) conjecture of an increase in the stock volatility following the effective date is valid and the option market has quickly incorporated this effect into the implied volatility. For out-of-the-money and in-the-money options, an increase in the implied volatility as a result of the split announcement is only found in options on firms that belong to the small and "other" group. In sum, most of the reaction in the option market takes place in at-the-money options. Nevertheless, the key finding in this chapter is that from the view of the option investors, excess returns do not exist following the split announcements. Except for options on firms that belong to the S&P600 index, there is no evidence of a positive volatility spread during the announcement period. In other words, the split announcement does not create excess buying pressure in call options relative to put options. The increase in the option implied volatility mainly reflects an increase in the actual volatility of the underlying stocks. The option investors do not anticipate the stock price to increase following the split announcements.

Cremers and Weinbaum (2010) state that uninformed investors, who are relatively informationally disadvantaged should observe the trading activity of informed investors to infer the private information about the underlying stocks. If this is the case, then the option investors do not recommend a stock split as a "buy". From the view of the option investors, there is not a window of opportunity (both short-run and long-run) to profit from the split announcements. The stock market has correctly interpreted the new information and responds accordingly. While we do not aim to examine whether asset returns are predictable, our evidence seems to contradict the findings of previous research where positive abnormal returns are documented following the splits. Clearly, there is a need to examine the long-run returns to get a full view of the market reaction to stock splits. At a minimum, the result of such a study will allow us to evaluate whether the market indeed under-reacts to this event.

Chapter 5:

Trading on stock split announcements and the ability to earn long-run abnormal returns: caveat emptor

5.1 Introduction

What have we learned about stock splits so far? In chapter 3, we learnt that stock splits are perceived by the market as good news, which induce positive abnormal returns upon the arrival of the new information. Although our findings from chapter 4 indicate that the option investors do not believe that positive excess returns persist following the announcement date, it does not resolve the conflicting evidence that is observed in previous research. Specifically, over the past twenty years, researchers have not reached any definite conclusion on whether asset returns are predictable as a result of the split.

Fama, Fisher, Jensen and Roll (1969) claim that although stock splits are preceded by a period of unusual high returns, in the post-split period, the abnormal returns are unconditionally nonexistent. Depending on whether the splitting firm increases its dividend or not in the future, the authors document an important dichotomy: abnormal returns in the post-split period are conditional on future dividend increases. Ikenberry, Rankine and Stice (1996), Desai and Jain (1997) and Ikenberry and Ramnath (2002) on the other hand all find that on average, splitting companies outperform their peers for at least one-year following the announcement date. They contend that the information content of the split is not fully priced in the short event window. A partial explanation for this inconsistency is offered by Byun and Rozeff (2003) who claim that the above studies do not contradict but rather complement each other since long-run excess returns are sensitive to the time period examined. They observe that the abnormal returns following stock splits are concentrated in the 1975-1996 period and that this is an exceptional period where the magnitude and significance of the long-run excess returns are robust to different statistical analysis techniques. In contrast, there are not any meaningful excess gains for the other time periods studied. Adding to this, Boehme and Danielson (2007) assert that the post-split announcement drift observed by others is of short duration, which they argue is a result of market friction rather than behavioural biases. However, these studies offer no convincing explanation as to why these excess returns vary with the time period examined.

We examine the impact of the split announcement on share prices for the period 1975-2006. While there are some comprehensive studies on the long-run performance after stock splits (Byun and Rozeff, 2003, examine the excess returns on splitting companies from 1927 to 1996, Boehme and Danielsen, 2007, investigate the same argument for the period 1950-2000), we believe that our study will provide some valuable insights to the existing literature. First, we re-examine the period that has been analysed by previous research, as well as including a more recent period where the evidence on the long-run performance of splitting firms is limited. By studying the 1998-2006 period, we test whether previous findings are observed in today's market. More importantly, we will be able to compare the effect of the split announcements during different stages of the business cycle, since the 1975-1997 period is a major bull market (except 1987) while the 1998-2006 period is a neutral market. Second, inspired by Fama et al. (1969), we present the answer to one of the most fundamental questions in an event study: are there excess returns to be earned based on publicly available information or are the returns conditional on ex-post information? In addition, if the long-run abnormal returns are indeed sensitive to the period studied, then what is the characteristic of a particular period that is influencing the performance of the splitting firms?

Stock splits are popular corporate events that happen quite frequently and it is not uncommon for companies to split their stock multiple times in a short period. While there is no convincing theory that explains why companies continue to split their stock, one thing is clear – very few companies will split their stock when their share price has fallen. Thus, when a firm splits multiple times, this indicates that the firm has performed well and a sample that includes a large proportion of firms that split multiple times is more likely to exhibit positive abnormal returns in aggregate. However, the key consideration for investors is whether they can make money by knowing which companies have split before because this information is available when the trading decision is made. If managers convey their private news about the performance of the firm through a stock split, then there are reasonable grounds to expect that companies that have split multiple times in the past will continue to do well in the future. On the other hand, if a stock split is a cosmetic event that does not change the fundamental value of the company, then the success of a trading strategy that buys every splitting company following the announcement date may depend on whether these firms will split multiple times in the future. Specifically, when a firm subsequently splits again, this is prima facie evidence that the firm is a strong performer; otherwise it would not implement another split. However, such information is only observed ex-post.

This intuition motivates us to investigate whether ex-ante or ex-post information is the major cause of the long-run excess returns following a split. We first partition our sample into firms that have split before in the last three years versus firms that have not. To evaluate the impact of ex-post information, we classify our sample into firms that will split again in the next three years versus firms that will not. Finally, to compare the effect of ex-ante versus ex-post information, we divide the "split before" and "do not split before" sub-samples into firms that will split again versus firms that will not.

Our findings indicate that for the period 1975-2006, there is evidence of positive long-run excess returns following the announcement date. However, consistent with the studies by Byun and Rozeff (2003) and Boehme and Danielsen (2007), these returns are sensitive to the time period and the firm's market capitalisation. In addition, we also document that companies that have not split before outperform companies that have. This suggests that it is unlikely that stock splits are signals of future share price performance. If they are, companies that have split before should do better than companies that have not. More importantly, there is a drastic difference in the behaviour of the excess returns for firms that split again versus firms that do not. Firms that split again in the future experience positive abnormal returns, on the other hand, for firms that do not split again in the future, the abnormal return is significantly negative. This pattern does not seem to be influenced by the time period examined or the firm's market capitalisation. In fact, we find that the magnitude and statistical significance of the abnormal returns for a particular period is dependent on the number of firms that will split again within that period. Specifically, the 1975-1987 and 1988-1997 sub-periods yield much higher long-run abnormal returns compared to the 1998-2006 period because there is a higher proportion of firms that will split again in the first two sub-periods compared to the last one. This key insight explains why past studies document variation in the behaviour of the abnormal returns across different time periods. Finally, although there is evidence of positive excess returns in companies that have not split before, once the split again condition is controlled for, most of the abnormal returns are concentrated in companies that will split again. Specifically, positive excess returns only exist in firms that will announce another split in the future regardless of whether the firm has split before. Thus, the abnormal returns seem to be driven by ex-post information rather than ex-ante information.

Easley, O'Hara and Saar (2002) state that stock splits are one of the simplest events, yet they remain one of the least understood phenomena in equity markets. In this chapter, we hope to reconcile some of the conflicting evidence observed in previous research. Moreover, we aim to provide valuable insights that could potentially enhance investors' understanding on the long-run behaviour of equity returns following a split. Our findings are consistent with prior research by Byun and Rozeff (2003) and Boehme and Danielsen (2007) in that we show that the abnormal returns are dependent on the period examined. Indeed, we go a step further and explain why the abnormal returns vary across time. Specifically, the post-split announcement returns are likely to be significantly positive in periods where there is a high proportion of companies that announce multiple splits. However, knowing which companies have split multiple times in the past will not guarantee positive abnormal returns; these returns are mainly concentrated in companies that will split multiple times in the future. In other words, while abnormal returns may exist in aggregate, they are not distributed equally across all companies. This explains why the option investors on average, do not believe that they can make money from this event. Finally, our result is especially useful for investors in formulating their trading decision. Evidence from previous research suggests that investors can earn excess returns by purchasing every company that announces a split in a strong market, our study is better. We show that instead of buying every splitting company, investors can achieve higher returns by focusing their attention on those that have not split before. Nevertheless, we present a precautionary warning to investors as our finding indicates that positive excess returns can only be earned with certainty based on ex-post information. The rest of this chapter is organised as follows: Section 5.2 reviews the relevant literature, section 5.3 outlines the data, section 5.4 presents the methodology, section 5.5 discusses the results, section 5.6 performs sensitivity analysis and section 5.7 concludes.

5.2 Literature review

The first empirical study on stock splits was done by Fama, Fisher, Jensen and Roll (1969). In their paper, they ask whether there is any unusual behaviour in stock returns in the month surrounding the split and if there is, can this relationship be linked with other fundamental variables? They analyse a sample of 940 stocks, which are listed on the New York Stock Exchange and announce a split during the period January 1927 to December 1959. First, they run monthly Capital Asset Pricing Model (Sharpe, 1964 and Lintner, 1965) regressions on stock returns for each sample firm over the period 29 months prior to the split and 30 months after the split. Every month, they compute the average residual derived from the regressions and examine the behaviour of the average residual during this period. In the 29 months prior to the split, the average residuals are consistently positive for all splits. This indicates that stock splits are usually followed by a period of unusual high returns. However, after the split, the average residuals are randomly distributed around zero.

Next, they sort their sample into two subsets: one with splits that are associated with an increase in the dividend while the other is with splits that are followed by a decrease in the dividend[9]. They found that the average residuals for stocks in the dividend increase sample are slightly positive while for the dividend decrease sample, the average residuals drop in the few months following the split. Thus, the behaviour of split returns will differ depending on the whether or not a dividend increase will occur. In other words, abnormal returns can only be earned after the split has become effective if one could predict which of the split securities will experience increased dividends and this higher return mainly comes from superior information or analytical skill rather than just the splits themselves. What they conclude from their findings is that: First, splits are followed by a period of outstanding performance by the firm. This is further validated by Lakonishok and Lev (1987) and Asquith, Healy and Palepu (1989). Second, there are no abnormal returns to be earned following the split, rather these excess returns are conditioned on whether the firm will increase its dividend in the future. In other words, the market uses the information in stock splits as a signal about future dividends and correctly responds to this information.

[9] Increased and decreased dividends are measured relative to the average dividends paid by all securities on the New York Stock Exchange. They define the dividend change ratio as total dividends paid in the twelve months after the split divided by total dividends paid in the twelve month before the split. Dividend increases are cases where the dividend change ratio of the split stock is greater than the ratio for the Exchange as a whole, while dividend decreases are cases of relative dividend decline.

Over the past twenty years, evidence on the market under-reacting to the split announcements starts to accumulate. Ikenberry, Rankine and Stice (1996) examine the long-run performance of split stocks for the period 1975-1990 and document results, which contrast with Fama et al. (1969). Using a sample of companies that are listed on the NYSE and Amex, they compare the returns of an equal-weighted trading strategy that invests in split stocks with the returns of a reference portfolio. They find that the returns to splitting firms in the first three years following the split announcement are significantly greater than the returns of a reference portfolio. Hence, their finding supports the self-selection hypothesis. That is, managers in firms with high share prices condition their decision to split on expected future performance. Thus, the market has not correctly responded to the implication contained in the split announcement and it takes the market a while to fully appreciate the information signalled through the splitting process.

Not long after Ikenberry, Rankine and Stice (1996), Desai and Jain (1997) also investigate the long-run performance of common stocks following both stock split and reverse stock split announcements over a very similar time period (1976 to 1991). As an extension of Ikenberry et al. (1996), they examine the role of the dividend signal conveyed by a dividend increase at the same time as the stock split announcements. They calculate the buy and hold abnormal returns for all split stocks by subtracting from the sample return the return of the benchmark portfolio, where the benchmark is formed based on three criteria: size, book-to-market and momentum. The excess return is then averaged across all stocks in the sample. Consistent with Ikenberry et al. (1996), they find that split firms earn significant abnormal returns and one does not need to possess private information about cash dividends to participate in the abnormal profits following the split announcement.

Byun and Rozeff (2003) aim to reconcile the conflicting evidence between earlier and later empirical findings by providing an extensive study on the market reaction to stock splits over a much longer time period (1927 to 1996). They argue that the differing findings from Fama et al. (1969), Ikenberry, Rankine and Stice (1996) and Desai and Jain (1997) are reconcilable, since the performance of splitting firms is affected by the time period studied. To examine the long-run performance of the split firm, they use both the buy and hold abnormal return (BHAR) and calendar time abnormal return (CTAR) methodologies. They find that for the sample of 2-1 splits (the most popular splits), there is evidence of under-reaction where the benchmark is an equally weighted portfolio with the same size and book-to-market as the sample firm. However, if their split sample includes not only the 2-1 split but all splits greater than 25 percent, the magnitude of the BHAR falls considerably and is only significant at the 10 percent level. In addition, when the benchmark portfolio is formed using value weighting, the BHAR is much smaller (on average about one percent, which falls in the range of error produced by inadequate modelling as well as transaction costs) and is not significant for both samples of split firms.

Next, instead of controlling for both size and book-to-market, they test the BHARs using size matching only. While controlling for size alone might not adequately capture all the relevant characteristics that affect the firm's returns, it has the advantage of expanding the sample size. They find that regardless of how the weight in the benchmark portfolio is defined, the BHARs are no longer statistically significant.

Finally, Byun and Rozeff (2003) analyse the long-run performance of splitting companies in different time periods. For the period 1927 to 1959 (Fama et al., 1969), it is unlikely that significant abnormal returns can be earned following the split. From 1975 to 1990 (Ikenberry, Desai and Jain, 1997), the post split abnormal return is positive and significant although smaller in magnitude than what was documented in Ikenberry et al. (1996) and Desai and Jain (1997). They attribute this difference to the fact that Ikenberry, Rankine and Stice calculated the BHAR following the announcement date whereas in Byun and Rozeff (2003), the BHAR was calculated following the effective date. Similarly, they recalculated the BHAR from 1976 to 1991 (Desai and Jain, 1997), the BHAR is once again positive and significant. In summary, while this study does not make any claim that findings from the previous studies are erroneous, it certainly provides new evidence that the stock market is efficient with respect to stock splits.

The debate on whether stock splits exhibit a positive drift in abnormal returns following the split event or the announcement date did not end there. Ikenberry and Rammath (2002) analyse the long-run performance for a sample of split stocks that listed on the NYSE, Amex and NASDAQ from 1988 through 1997 and find a drift of nine percent following a split announcement. To find a match for a given sample firm, they form a candidate pool of firms that had not split their stock in the previous year. They then use a rank order to categorise the candidate firms based on three dimensions: market capitalisation, value/growth and momentum. A firm with the lowest cumulative rank is selected. If the first match becomes ineligible at any point in time in the future, the firm with the second lowest cumulative rank is selected and so on.

Next, they calculate the one-year buy and hold returns for the sample firms and compare these with the returns of the control firm. They find that the average difference in returns between the sample firm and the control firm is nine percent and is statistically significant. They then ask if there appears to be a market under-reaction to the split event, then what is the market is under-reacting to? Looking at the distribution in earnings growth of split firms and the control firms, they notice that the difference lies in the fact that splitting firms have a lower propensity for negative earnings growth compared to the control firms. Thus, stock splits may not be a signal of strong earnings performance in the future, but rather it may signal manager's confidence that the level of past earnings are likely to be sustained. Taken as a whole, Ikenberry and Ramnath (2002) present further evidence against market efficiency.

Commenting on Ikenberry and Ramnath (2002), Titman (2002) argues that the fact that investors under-react or over-react to corporate announcements in the short-run might have nothing to do with psychological biases, as advocates of behavioural finance have claimed. Since it is generally quite difficult to evaluate how asset prices "should" respond to new information, when prices systematically under-react or over-react to new information in a short time interval, this does not suggest that investors are irrational. Rather, this over- or under-reaction might simply be a combination of random mistakes and slow learning. In other words, when the market takes time to learn about the implication of the new information; this is not necessarily evidence against market efficiency. However, he does not expect this learning process to last too long in a well functioning market. Given that a stock split is a clean and simple event, which happens frequently, Titman (2002) is quite surprised to find that the average abnormal return for splitting firms in the year following the split is 9.19% when learning should be straightforward. He is also not convinced by the explanations of why the under-reaction persists and emphasises that future researchers should look at this matter more closely.

Recently, Boehme and Danielsen (2007) study the long horizon return following stock splits for the period from 1950 to 2000. Consistent with previous research, they find strong evidence of abnormal performance in the first year after the announcement of the splits. However, following the effective date, this one-year abnormal return is no longer robust and completely disappears when calculated on a value-weighted basis. Thus, one can infer that the announcement abnormal returns documented earlier are short lived and are more likely to be concentrated around the period from the announcement date to the effective date. To investigate this argument further, they calculate the cumulative abnormal returns around the announcement/effective date in different time intervals: three days around the announcement/effective date, ten days after the effective date as well as the entire interval between the announcement and the effective date. Their results indicate that a substantial component of the post announcement abnormal returns is attributable to the short-term price adjustments that occur from the announcement date to the effective date. They contend that this price drift pattern is not the result of a behavioural under-reaction, rather it is more consistent with the notion that market friction might induce a delay in the speed with which prices respond to new information.

They construct a delay measure following Hou and Moskowitz (2005) and show that the higher the delay, the higher the cumulative abnormal returns around the announcement/effective date. This suggests that stocks with greater ex-ante price delay experience a greater surprise response to the split announcements than stocks that incorporate new information efficiently. Moreover, when they examine the cumulative abnormal returns between the announcement and the effective date, they find that the most price-delayed stocks also exhibit the largest abnormal returns following the announcement date. In other words, high delay firms are relatively more sluggish in incorporating the information implied by the split announcement than low delay firms. Overall, they conclude that the stock split post announcement drift is short lived and is the result of trading frictions rather than behavioural biases.

In summary, while stock splits provide one of the cleanest tests on how asset prices respond to a corporate announcement, the evidence on the long-run performance of equities after stock splits is still inconclusive. In other words, how investors react to this simple and straightforward event is subject to debate. Some researchers argue that this under-reaction is a mis-evaluation whereas others claim that the excess returns are due to market frictions and the time period studied. Overall, there is a need to thoroughly investigate the impact of a stock split on the long-run performance of the firm.

5.3 Data and sample characteristics

The sample consists of all stock splits during the period from 1975-2006, as contained on the Center for Research in Security Prices (CRSP) file, which have a split factor greater than or equal to 25 percent. We exclude ADRs, SBIs, REITs and closed-end funds. Thus, the splitting shares are ordinary common shares. Our sample contains 13,644 split events.

Stock splits normally occur in a bull market, therefore it is reasonable for researchers to examine a time period when the market has performed well since this will increase the number of observations in the sample. However, the studies by Byun and Rozeff (2003) and Boehme and Danielsen (2007) argue that the long-run performance of splitting firms are in fact sensitive to the choice of the time period. That is, splitting firms are more likely to exhibit positive excess returns in a strong market. They also suggest that the 1975-1996 (1997) period is an exceptional period where long-run excess returns following the splits are robust to different statistical analysis techniques while there are not any meaningful excess gains for other time periods studied. What constitutes this difference is unclear, however, it is important to evaluate whether long horizon abnormal returns are indeed affected by the choice of time period.

First, we examine the performance of splitting companies during the 1975-2006 period. We then divide this time period into three sub-periods, 1975-1987, 1988-1997 and 1998-2006. Our justifications are as follows: Ikenberry, Rankine and Stice (1996) study the long-run returns during the period 1975-1990, Desai and Jain (1997) investigate the 1976-1991 period while Ikenberry and Ramnath's (2002) study covers the 1988-1997 period. By partitioning the full sample into different sub-periods, our aim is to compare the findings in this chapter with previous research. Moreover, the return behaviour of splitting companies during the period 1998-2006 allows us to perform an out of sample test. Second, we will be able to assess the effect of the split announcements in different stages of business cycles since the 1975-1997 period is a major bull market (except 1987) while the 1998-2006 period is a neutral market.

We define a split event as "split after" if the firm splits again within the next three years. Conversely, a split event is classified as "do not split after" if the firm does not split again within the next three years. Similarly, a split event is classified as "split before" if the firm has split within the last three years and "do not split before" if the firm has not split within the last three years. Table 5.1 reports the distribution of splits for the full sample period and within each sub-period.

Table 5.1: Distribution of stock splits by time period

This table reports the distribution of splits for the full sample period and within each sub-period. The average number of splits per year is calculated as the total number of splits in each period divided by the number of years. We classify the sample into "split before" if the firm has split within the last three years and "do not split before" if the firm has not. Meanwhile, a split event is defined as "split after" if the firm will split again within the next three years and "do not split after" if the firm will not.

Time period	Total splits	Average number of splits per year	Split after	Do not split after	Split before	Do not split before
1975-2006	13,644	423	5,031 (37%)	8,613 (63%)	5,016 (37%)	8,628 (63%)
1975-1987	6,321	486	2,569 (41%)	3,752 (49%)	2,403 (38%)	3,918 (62%)
1988-1997	4,304	430	1,638 (38%)	2,666 (62%)	1,485 (35%)	2,819 (65%)
1998-2006	3,019	335	824 (27%)	2,195 (73%)	1,128 (37%)	1,891 (63%)

For the entire period from 1975-2006, there are 13,644 splits events of which 5,031 events (36.87%) are "split after" and 8,613 (63.13%) events are "do not split after". For the sub-period from 1975 to 1987, there are 6,321 split events, with "split after" events making up 40.64% of the total splits. The figures are quite similar for the period 1988-1997. Out of the total 4,304 splits, 38.06% are "split after" and 61.94% are "do not split after" events. However, in the last sub-period (1998-2006), the number of "split after" events are only 824 (27.29%) out of the total 3,019 splits. What we notice is that the average number of splits per year shares a similar pattern with the proportion of events that are "split after" in each sub-period. That is, the average number of splits per year is relatively higher in the first two sub-periods compared to the last one. As discussed earlier, the 1975-1997 period is a major bull market (except 1987) whereas the 1998-2006 period is a neutral market. Thus, this preliminary evidence allows us to infer that not only are companies more likely to split in a bull market, they are also more likely to split again in such a market.

Unlike "split after", the proportion of the split events that are "split before" does not seem to fluctuate much across different time periods. During the period 1975-2006, "split before" events makes up 37% of the total splits. This figure is very similar across three sub-periods. Specifically, 38%, 35% and 37% of the total splits are "split before" for each of the 1975-1987, 1988-1997 and 1998-2006 sub-periods, respectively. We do not make any specific conclusion at this point, but if splitting again is the main reason why a firm outperforms its peers, then we expect the average excess return to be higher in a sub-period where there are a large number of "split after" events. In this case, aggregate long-run abnormal returns should be higher in the first and second sub-periods compared to the last one. On the other hand, if splitting before is the major cause of long-run abnormal returns, then we expect the magnitude of the abnormal returns to be similar across three sub-periods.

Monthly closing share prices, monthly returns, number of shares outstanding and returns on the three-month U.S. Treasury Bill are obtained from the CRSP database. Accounting data regarding book value of equity, preferred stocks, deferred taxes and investment tax credit are collected from Compustat. Monthly Fama-French and momentum factors are gathered from Ken French's website. Since this study utilises size, book-to-market and momentum matching, firms have to meet the following criteria: (1) stock prices and number of shares outstanding are available in month t-1, where month t is the month when the split is announced; (2) at least six months of returns are available in the 12-month period prior to the announcement date; (3) the Compustat annual files contain information on the firms book equity in the year prior to the split and (4) the firm's ending stock price in the announcement month must be $2.00 or greater (this restriction is imposed to mitigate econometric biases induced by the bid-ask bounce of low priced stocks, as documented by Conrad and Kaul, 1993). In the month prior to the announcement date, we have 11,165 splits that meet these criteria. Consistent with past studies, most of the splits are either two for one (44.04%) or one for two (36.60%).

5.4 Methodology

To test whether positive long-run abnormal returns exist, we employ the buy and hold abnormal returns (BHARs) approach and the calendar time portfolio regression approach.

5.4.1 Buy and hold abnormal return

Our investment horizon is one-year following the announcement date. We use discrete monthly returns rather than continuously compounded returns. According to Barber and Lyon (1997), continuously compounded returns yield negatively biased estimates of long-run excess returns. We do not use CARs because CARs and BHARs are not the same and should be used to answer different questions (Ritter, 1991). Specifically, CARs are a biased predictor of long-run buy and hold abnormal returns because they ignore compounding while BHARs include the effect of compounding. Thus, we favour the use of buy and hold abnormal returns, which are designed to detect long-horizon abnormal stock returns.

We define an abnormal return as:

$$AR_{it} = R_{it} - E(R_{it}) \tag{5.1}$$

where R_{it} is the return of security i in month t and $E(R_{it})$ is the expected rate of return for the sample firm. Following Barber and Lyon (1997) and Ikenberry and Ramnath(2002), we estimate expected returns using the return of the matching firm instead of the reference portfolio for the following reasons: Barber and Lyon (1997) identify three potential biases from using the reference portfolio, which can either overstate or understate the BHAR.

The first is the new listing bias. Following the event month, many new firms begin trading and these newly listed firms then become part of the reference portfolio. Ritter (1991) find that firms that go public generally under-perform an equally weighted market index and it is likely that these firms make up a large portion of the newly listed firms. Therefore, over long horizons, if we measure the returns of the sample firms against the matching portfolio, which includes these newly listed firms, it is likely that the abnormal return of the sample firm will be positively biased.

The second bias relates to the skewness in the distribution of the sample firms. Specifically, it is common to observe a sample firm with an annual return in excess of 100% but it is uncommon to observe a return on the portfolio in excess of 100%. If the abnormal returns are calculated as the sample firm return less the portfolio return, the abnormal returns are positively skewed. Barber and Lyon argue that skewness will have an impact on the test statistic depending on whether the distribution is positively skewed or negatively skewed.

Finally, when buy and hold abnormal returns are calculated using an equally weighted market index, the long-run return on the portfolio is compounded assuming monthly rebalancing of all securities constituting the portfolio. Thus, to achieve equal weighting of all securities, securities that have beaten the market are sold while those that have under-performed the market are purchased. This rebalancing will lead to an inflated return on the matching portfolio, which will likely result in negative buy and hold abnormal returns.

The control firm approach on the other hand eliminates the new listing bias (both the sample and control firm must be listed in the month prior to the announcement date), the rebalancing bias (there is no rebalancing involved when calculating the buy and hold return of the sample firm and the control firm) and the skewness bias (the sample and control firm are equally likely to experience large positive/negative returns). Although Lyon, Barber and Tsai (1999) outline a methodology that enables us to construct a matching portfolio that is free of the new listing and rebalancing bias, we still favour the use of a control firm approach because this represents a genuine trading strategy that investors can use to make money by longing the company every time it announces a split and at the same time shorting the matching firm. This is more realistic than assuming the investor shorts the corresponding reference portfolio, such a strategy will generate high transaction costs.

We select a matching firm by controlling for size, book-to-market and momentum since these firm characteristics are known to influence equity returns. First, we construct 64 size, book-to-market and momentum reference portfolios as follows: For each month from January 1974 to December 2006, we rank all NYSE stocks in our population by size (price times the number of shares outstanding) and form four size portfolios based on these rankings. Next, we calculate a firm's book-to-market ratio using the book value of equity for the fiscal year ending in calendar year t-1 divided by the market value of common equity. We define book to common equity BE as the COMPUSTAT book value of equity plus deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Preferred stock is the redemption value, liquidation or carrying value. Negative BEs are excluded. Book-to-market equity, B/M is then the common book equity for the fiscal year ending in calendar year t-1, where year t is the current year, divided by the market value of equity of each month in year t. We rank all NYSE firms based on book-to-market ratios and form another four portfolios based on these rankings. Amex and NASDAQ firms are placed in the appropriate NYSE size and book-to-market portfolios. Finally, firms are sorted into four groups based on their preceding twelve-month returns. Together this gives us 64 portfolios based on size, book-to-market and momentum. The reference portfolio of a sample firm is the portfolio which the firm belongs to in the month prior to the announcement date.

To find a matching firm, we identify all firms in each reference portfolio that have not split within the last 12 months. Note that we do not exclude firms that will split in the future because this is not known at the time of the portfolio construction. Within each portfolio, firms are ranked from 1 to n (n is the number of firms in each portfolio) based on the closeness with the splitting firm on size, book-to-market and momentum. Ranks are summed across these three dimensions and the firm with the lowest rank is selected. If the control firm for some reason stops trading, we assume the proceed of the delisted firm is invested in a firm with the second lowest sum of ranks from that point forward and so on. Table 5.2 presents descriptive statsistics for the sample and control firms on the three matching dimensions.

Table 5.2: Descriptive statistics of the split firms and the control firms

This table reports the descriptive statistics for the sample firms and the control firms across three dimensions: size, book-to-market and past 12-month returns (momentum). Size (in millions) is defined as share price multiplied by the number of shares outstanding. Book to common equity BE is estimated as the COMPUSTAT book value of equity plus deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Book-to-market equity, BE/ME, is book common equity for the fiscal year ending in calendar year t-1 where year t is the current year divided by the market value (in millions) of equity of each month in year t. Momentum is determined based on the preceding 12-month compounded return.

		Mean		Median	
Full Sample	**N**	**Sample**	**Control**	**Sample**	**Control**
Size (market cap)	11,165	2,246	1,572	229	223
Book-to-market	11,165	0.45	0.46	0.37	0.37
Past 12-month returns	11,165	0.92	0.78	0.57	0.56
Size Quartiles					
1 (Small)	3,835	54	51	41	40
2	2,757	235	231	200	198
3	2,421	793	771	675	653
4 (Large)	2,151	10,384	6,913	3,486	3,136
Book-to-market Quartiles					
1 (Low)	6,728	0.25	0.26	0.23	0.24
2	2,678	0.59	0.59	0.55	0.55
3	1,338	0.88	0.88	0.82	0.83
4 (High)	421	1.42	1.39	1.33	1.31
Past Return Quartiles					
1 (Low)	151	-0.13	-0.14	-0.12	-0.12
2	926	0.09	0.09	0.08	0.07
3	3,034	0.33	0.33	0.30	0.30
4 (High)	7,054	1.30	1.09	0.86	0.81

Overall, the split and control firms match reasonably well across all the three dimensions. For the full sample, splitting firms appear to be larger and have higher momentum than the control firms, however, this difference mainly stems from the last group (large capitalisation and high momentum stocks). In the remaining size, book-to-market and momentum quartiles, there does not appear to be any major discrepancy between the sample firm and the control firm. Finally, while split announcements are distributed evenly over all market capitalisations, they seem to concentrate in the growth (low book-to-market) and high momentum quintiles. This is expected because splits are usually preceded by a period of strong performance, which causes them to have high momentum and low book-to-market relative to their peers.

The abnormal return of a buy and hold strategy that longs the sample firm and shorts the control firm every time the sample firm announces a stock split is calculated as follows:

$$BHAR_{i\tau} = \prod_{t=1}^{\tau}[1+R_{it}] - \prod_{t=1}^{\tau}[1+E(R_{it})], \tag{5.2}$$

where $BHAR_{i\tau}$ is the buy and hold abnormal return, R_{it} is the return of firm i and $E(R_{it})$ is the expected return, which is proxied by the return of a matching firm as discussed above. To test the null hypothesis that the mean buy and hold abnormal returns are equal to zero for a sample of n firms, we employ the parametric statistic:

$$t_{BHAR} = \overline{BHAR_{i\tau}} / (\sigma(BHAR_{i\tau}) / \sqrt{n}) . \tag{5.3}$$

Barber and Lyon (1997) find that this conventional t-statistic calculated using the return of a control firm to proxy for the expected return yields a well-specified test statistic.

5.4.2 Calendar time abnormal return

A stock split is a self-selected event and is often observed in bull markets. This means that the occurrence of the event itself is not random but clusters around a particular calendar time or by a specific industry, which is often the case with self-selected corporate events. Mitchell and Stafford (2000) argue that if the event clustering leads to positively correlated individual BHARs, statistical significance will be overstated by any methodology that assumes independence. Their intuition is that event firms are different from non-event firms, since event firms choose to participate in a corporate event while non-event firms do not. Thus, trying to compare the empirical distribution of the event firm with a control firm based on similarities in size/book-to-market cannot account for the differences in the covariance structure. If one employs the bootstrapping method to test for the significance of the abnormal return, this does not solve the problem since the typical bootstrapping approach does not capture the cross-sectional correlation structure that exists in the underlying original event sample. In other words, the test statistic calculated assuming independence between observations might be overstated. Therefore, the magnitude of the BHAR might be correct but it might not be statistically significant.

An alternative approach to measuring long-term abnormal returns is the calendar time portfolio approach. This method tracks the performance of the split shares portfolio in calendar time relative to either an explicit asset-pricing model or some other benchmark. By forming event portfolios, the cross-sectional correlation of the individual event firm returns is automatically accounted for in the portfolio variance. For each month from January 1976 to December 2007, we form equal-weighted portfolios of all split firms that either announce or split within the last year. Portfolios are rebalanced monthly to drop firms that reach the end of their one-year period and add companies that have just split their shares. Since stocks that split experience high returns before they split, price momentum may relate to subsequent returns. Therefore, we use the Carhart (1997) model, which accounts for momentum instead of the Fama-French model when calculating abnormal returns. The portfolio excess returns are regressed on the four-factor model as follows:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p (R_{mt} - R_{ft}) + s_p SMB_t + h_p HML_t + m_p PR1YR_t + \varepsilon_{pt}, \qquad (5.4)$$

where R_{pt} is the simple monthly return on the calendar portfolio, R_{ft} is the monthly return on three-month Treasury bills, R_{mt} is the return on a value-weighted market index, SMB_t is the difference in the returns of value-weighted portfolios of small stocks and big stocks, HML_t is the difference in the returns of value-weighted portfolios of high book-to-market stocks and low book-to-market stocks and $PR1YR_t$ is the difference in the returns of value-weighted portfolios of winner stocks and loser stocks.

The intercept α_p measures the average monthly abnormal return on the portfolio of event firms. A significant positive intercept suggests that the splitting firm, on average, earns positive abnormal returns after controlling for risk. However, Mitchell and Stafford (2000) argue that if the model provides only an imperfect description of expected returns, then the intercept represents a combined effect of the abnormal return that is the result of the event and model misspecification. To control for this potential bias or model misspecification, we construct an arbitrage (zero-investment) calendar time portfolio consisting of long positions on splitting firms and short positions on control firms. As mentioned earlier, the control firms are matched to our sample firms based on size, book-to-market and momentum. If stocks with these types of characteristics are not well explained by the four-factor model, then the arbitrage calendar time portfolio regressions should correct for this bias in the intercept. We regress the returns of the hedge portfolio on the four-factor model:

$$R_{pt} - R_{ct} = \alpha_{adjp} + \beta_{adjp}(R_{mt} - R_{ft}) + s_{adjp}SMB_t + h_{adjp}HML_t + m_{adjp}PR1YR_t + \varepsilon_{adjpt} \quad (5.5)$$

where R_{pt} is the simple monthly return on the sample calendar portfolio, R_{ct} is the monthly return on the control portfolio and α_{adjp} is the adjusted intercept.

Although the calendar time portfolio approach represents an improvement over the traditional BHAR by addressing the cross-sectional correlations of the individual event firm returns, it also has several potential problems. Most of them are the result of the portfolio's composition. Specifically, since the number of firms in the portfolio changes every month, this may introduce heteroskedasticity, as the variance is related to the number of firms in the portfolio. In addition, this approach weights each month equally, so the months with heavy event activity (many event firms in the portfolio during that month) is treated the same as months with low activity (few event firms in the portfolio). If there is a difference in abnormal performance in periods of high activity versus periods of low activity, then this approach may fail to detect the abnormal performance. To address this issue, we restrict the number of firms in a given month to be no less than 10 and employ a weighted least squares regression (WLS), where the weight is the number of firms in the portfolio for a given month. For the OLS regressions, all the t-statistics are calculated using White's (1980) method.

5.4.3 Equal-weights versus value-weights

Fama (1998) in his review of previous event studies claims that anomalies in long horizon post event returns shrink considerably and often disappear when sample firms are value-weighted rather than equal-weighted. Loughran and Ritter (2000) argue that even if mis-valuations among large firms and small firms are similar, there are good reasons to expect this effect to be stronger in small firms. Since the liquidity of small stocks is typically lower than large stocks, the ability to capitalise on the same percentage mis-valuations for small stocks will be less than large stocks as it is unlikely that investors can buy or sell large quantities of small stocks without affecting the price. In equilibrium, Loughran and Ritter (2000) contend that percentage mis-valuations will be larger for small stocks because it is more difficult to arbitrage small stocks than large stocks.

While value-weighted returns might capture the total wealth effects experienced by investors more closely, if a single firm is a large proportion of the portfolio, then the unsystematic risk is not completely diversified away. This will result in a high variance of returns that leads to a lower t-statistic thereby reducing the power of the test. Thus, the most accurate method is still subject to further debate and there is no consensus amongst researchers. We do not assert that it is better to use equal-weights rather than value-weights and vice versa, but as a standard procedure, we first evaluate the equal-weighted abnormal returns for the full sample. Next, we examine whether the pattern in the long-run average abnormal returns changes across firms with different market capitalisations. This method allows us to study the impact of firm size on the behaviour of the abnormal returns while minimising the increasing variance problem associated with value-weighted portfolios.

Every month, we rank all firms that listed on the NYSE, Amex and NASDAQ based on market capitalisation in descending order. Next, we divide the population into four categories: large-cap stocks (firms that comprise the top 70% of all companies listed on NYSE, NASDAQ and Amex by market capitalisation), mid-cap stocks (firms that are in the 70^{th} to 80^{th} percentile based on market capitalisation), small-cap stocks (firms that are in the 80^{th} to 90^{th} percentile based on market capitalisation) and micro stocks (firms that comprise the remaining 10% of the market capitalisation). The sample firms are then allocated in each group accordingly. This classification scheme is very similar to the S&P1500 construction method employed by Standard and Poor's, where the S&P500 index (large-cap stocks) makes up 75 percent of the U.S. market cap, the S&P400 index (mid-cap stocks) and the S&P600 (small-cap stocks) make up seven and three percent of the U.S. market, respectively. However, data on the S&P400 index only starts in 1991 while the S&P600 index starts in 1994. Since we begin our long horizon study in 1975, we do not have enough data coverage for each of the indices for the full sample. Thus, we construct our own market cap classifications as described above. Table 5.3 reports the summary statistics for each of the size groups.

Table 5.3: Summary statistics across different size groups

This table reports the market capitalisation (in millions) and number of companies across four different size groups: large-cap stocks (firms that comprise the top 70% of all companies listed on the NYSE, NASDAQ and Amex by market capitalisation), mid-cap stocks (firms that are in the 70th to 80th percentile based on market capitalisation), small-cap stocks (firms that are in the 80th to 90th percentile based on market capitalisation) and micro stocks (firms that comprise the remaining 10% of the population).

Size Group	Average capitalisation	Minimum capitalisation	Maximum capitalisation	Average no. companies	Minimum no. companies	Maximum no. companies
Large-cap	12,841	365	602,433	352	213	504
Mid-cap	2,474	201	11,650	261	134	414
Small-cap	1,050	65	5,416	616	286	982
Micro-cap	126	0.004	1,994	5,118	1,607	7,579

For the largest size group, the average market capitalisation is close to 13 billion dollars, the minimum market capitalisation is 365 million while the maximum market capitalisation is 602 billion dollars. The number of companies in the largest capitalisation group varies between 213 and 504. For the mid size group, the mean market capitalisation is 2.5 billion dollars with a minimum market capitalisation of 201 million and a maximum market capitalisation of 11.7 billion dollars. The number of companies in this group fluctuates between 134 and 414. For the small-cap group, the average market capitalisation is 1.1 billion dollars. The minimum and the maximum market capitalisation are 65 million and 5.4 billion dollars, respectively.

The number of companies varies between 286 and 982. For the micro group, the mean market capitalisation is 126 million dollars with a minimum size of 40,000 dollars and a maximum size close to 2 billion dollars. The number of companies in this group fluctuates between 1,607 and 7,579.

What we notice from this table is that the number of companies in each of the size category following this methodology is generally less than the numbers of companies in the S&P indices. For example, while our mid-cap stocks comprise 10% of the total market capitalisation (firms in the S&P400 covers 7-8% of the total U.S. market capitalisation), the average number of companies in this group is 261 with a maximum number of 414, less than 400. Similarly, the average number of companies in the large-cap group is 352, while the maximum number of companies is 504. While we expect the number of firms in this group to be less than 500 since this category only makes up 70% of the total market capitalisation (the S&P500 covers 75% of the total market capitalisation), the difference is too high to be justified by a discrepancy in the market coverage between the two groups. The reason is that each of our size groups only includes firms that are equities (CRSP share codes 10 and 11) because we only examine splits of common stock. We exclude ADRs, REITs, closed-end funds and SBIs. The Standard and Poor’s index on the other hand consists of all operating companies. That is, REITs (Real Estate Investment Trusts) and BDCs (Business Development Companies) are eligible candidates for inclusion.

5.5 Results

5.5.1 Long horizon returns following the announcement date

Panel A of table 5.4 presents the one-year Buy and Hold Abnormal Returns (BHARs) following the announcement date for the entire 1975-2006 period, and for the 1975-1987, 1988-1997 and 1998-2006 sub-periods. Since long horizon returns tend to exhibit positive skewness, we report both the mean and median returns.

Table 5.4: Long horizon abnormal returns following the announcement date

This table reports the equal-weighted average long-run abnormal return following the announcement date. Abnormal returns are estimated based on the Buy and Hold Abnormal Return (BHAR) approach and the calendar time portfolio regression approach. Panel A presents the one-year buy and hold abnormal return following the announcement date. Numbers in parentheses are the t-test statistic of the means and the p-value of the Wilcoxon signed-rank test for medians. Panel B presents the intercept and the coefficient estimates for the calendar time portfolio regressions on sample firm portfolios and arbitrage portfolios that long the sample firms and short the control firms.

Panel A: Buy and hold abnormal returns following the announcement date				
	1975-2006	1975-1987	1988-1997	1998-2006
n	11,165	5,141	3,512	2,512
Mean BHAR	0.0507	0.0488	0.0658	0.0336
	(6.75)	*(5.24)*	*(5.17)*	*(1.61)*
Median BHAR	0.0370	0.0419	0.0412	0.0282
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0010)*

Table 5.4: continued

Panel B: Calendar time abnormal returns											
		OLS					WLS				
		Intercept	β_p	s_p	h_p	m_p	Intercept	β_p	s_p	h_p	m_p
Long portfolios											
	1975-2006	0.0048	1.0711	0.6141	-0.1617	0.0958	0.0047	1.0755	0.5960	-0.1956	0.0853
		(4.41)	*(34.70)*	*(11.32)*	*(-2.84)*	*(1.96)*	*(5.29)*	*(49.21)*	*(20.76)*	*(-5.86)*	*(3.95)*
	1975-1987	0.0052	1.0182	0.8026	-0.2187	0.1884	0.0056	1.0241	0.7499	-0.2788	0.1827
		(4.06)	*(30.02)*	*(16.13)*	*(-4.54)*	*(5.54)*	*(6.39)*	*(50.74)*	*(21.84)*	*(-8.06)*	*(7.15)*
	1988-1997	0.0045	1.0475	0.7375	-0.1019	0.1284	0.0042	1.0197	0.7618	-0.0765	0.1347
		(3.54)	*(31.66)*	*(16.55)*	*(-1.94)*	*(2.02)*	*(3.39)*	*(31.83)*	*(17.20)*	*(-1.47)*	*(3.16)*
	1998-2006	0.0044	1.0771	0.4490	-0.2228	0.0687	0.0055	1.1417	0.4026	-0.24904	0.0516
		(1.61)	*(10.87)*	*(4.61)*	*(-2.11)*	*(0.78)*	*(2.03)*	*(15.15)*	*(5.94)*	*(-2.97)*	*(1.15)*
Arbitrage portfolios											
	1975-2006	0.0032	-0.0090	-0.1159	-0.0152	0.1096	0.0036	0.0079	-0.1281	-0.0350	0.1035
		(3.79)	*(-0.50)*	*(-3.63)*	*(-0.44)*	*(3.41)*	*(5.45)*	*(0.48)*	*(-5.98)*	*(-1.41)*	*(6.42)*
	1975-1987	0.0042	0.0047	-0.0337	-0.0637	0.0311	0.0050	0.0045	-0.0541	-0.1165	0.0327
		(3.34)	*(0.24)*	*(-0.82)*	*(-1.16)*	*(0.81)*	*(5.71)*	*(0.22)*	*(-1.58)*	*(-3.38)*	*(1.28)*
	1988-1997	0.0042	0.0199	-0.0360	-0.0313	0.0806	0.0042	0.0076	-0.0275	-0.0269	0.1038
		(3.54)	*(0.77)*	*(-1.00)*	*(-0.73)*	*(1.64)*	*(3.83)*	*(0.27)*	*(-0.70)*	*(-0.58)*	*(2.75)*
	1998-2006	0.0020	-0.0747	-0.1957	-0.0344	0.1444	0.0022	-0.0054	-0.2396	-0.0269	0.1657
		(1.06)	*(-1.43)*	*(-3.42)*	*(-0.53)*	*(3.24)*	*(1.28)*	*(-0.12)*	*(-5.66)*	*(-0.51)*	*(5.91)*

Consistent with past studies, the buy and hold abnormal return for the full 1975-2006 period is significantly positive. The mean abnormal return is 5.07% p.a. (t-statistic is 6.75). The overall median abnormal return is 3.7% and the p-value for the Wilcoxon signed-rank test is less than 0.0001. However, the results are not robust across all sub-periods. Specifically, the average long-run abnormal return is only positive and significant for the 1975-1987 and 1988-1997 periods. In the recent period 1998-2006, the mean BHAR is no longer significant. This preliminary result confirms Byun and Rozeff (2003) and Boehme and Danielsen's (2007) conjecture that the long horizon excess returns are sensitive to the time period studied.

Panel B of table 5.4 summarises the intercept and parameter estimates for the equal-weighted calendar time regressions on sample firm portfolios and arbitrage portfolios that long the splitting firms and short the control firms using both ordinary least squares (OLS) and weighted least squares (WLS). For the full sample, the average equal-weighted monthly abnormal return amounts to 0.48% per month (annualises to 5.76% p.a.) under OLS and 0.47% per month (annualises to 5.64% p.a.) under WLS and both are significant at the 5% level. Similar to the findings observed for the BHAR, only two sub-periods, 1975-1987 and 1988-1997, consistently yield significantly positive intercepts, which annualise to 6.24% and 5.4% under OLS, respectively. For the last period 1998-2006, the average intercept is only significant when estimated under WLS, the OLS intercept while positive (0.44% per month) is not significant. After adjusting for the characteristics of the sample firms, the magnitude of the intercepts for the full period and each sub-period are generally smaller. While the adjusted intercepts are positive and significant for the 1975-1987 and 1998-1997 periods, they are insignificant for the 1998-2006 period under both

OLS and WLS. Finally, what we notice is that while the coefficients on the SMB and momentum factors are positive for the event firm portfolios, for the arbitrage portfolios, the coefficient on the SMB factor is significantly negative while it remains positive for the momentum factor. This is expected given our result from table 5.2. Specifically, since our sample contains a large number of small and high momentum stocks, this explains why we observe positive SMB and momentum factor loadings. For the arbitrage portfolios, the fact that splitting firms tend to be larger and have higher momentum than the control firms actually justifies a negative coefficient on the SMB factor and a positive coefficient on the momentum factor.

So far, our results are consistent with Byun and Rozeff (2003) and Boehme and Danielsen's (2007) evidence that long-run post announcement excess returns are sensitive to the time period studied. For the 1975-1997 period, the magnitude and the statistical significance of the abnormal returns are similar to Ikenberry et al. (1996), Desai and Jain (1997) and Ikenberry and Ramnath (2002). However, excess returns are not observed in the 1998-2006 period. In the next section, we aim to provide the reason(s) why these returns vary across different times.

5.5.2 Sub-sample analysis

In this section, we examine whether the long-run abnormal returns in a given period depends on the number of firms that have split before in the past or whether these returns are influenced by the number of firms that will split again in the future. In other words, we compare the impact of ex-ante information versus ex-post information. According to the signalling hypothesis, managers convey their private information about the subsequent performance of the firm through a stock split. While previous findings suggest that stock splits are not associated with stronger earnings, there is a possibility that this event contains favourable information about the firm's share price. Thus, the fact that a company has split multiple times in the past may suggest that the firm is a strong performer and will continue to do well in the future. If this is the case, then it is reasonable to expect that firms that have split before will outperform firms that have not split before.

On the other hand, we also anticipate higher positive excess returns for firms that will split again in the future compared to firms that will not. While it is not clear whether excess returns exist in every company that announces a split, it is almost certain for companies that will split again. The reason is that firms normally split after a recent share price run-up. Therefore, firms that will split again are likely to exhibit strong performance; otherwise they would not implement another split.

5.5.2.1 Split before versus do not split before

A split event is classified as "split before" if the firm has split within the last three years. If the firm has not split within the last three years, it is classified as "do not split before". The results are outlined in table 5.5. Panel A reports the mean/median one-year BHAR while panel B presents the results of the calendar time regressions on portfolios of event firms and arbitrage portfolios following the announcement date for the "split before" versus "do not split before" sub-samples.

Table 5.5: Sub-sample analysis on the long horizon abnormal returns: Split before versus do not split before

This table reports the equal-weighted average long-run abnormal returns for firms that have split within the last three years (split before sub-sample) versus firm that have not (do not split before sub-sample). Panel A outlines the result under the BHAR analysis while panel B reports the results for the calendar time regressions on both the sample firm portfolios and arbitrage portfolios.

Panel A: Buy and hold abnormal returns following the announcement date

	1975-2006		1975-1987		1988-1997		1998-2006	
	Split before	Do not split before	Split before	Do not split before	Split before	Do not split before	Split before	Do not split before
n	4,360	6,805	2,103	3,038	1,274	2,238	983	1,529
Mean BHAR	0.0193	0.0709	0.0165	0.0712	0.0451	0.0776	-0.0082	0.0605
	(1.61)	*(7.36)*	*(1.15)*	*(5.83)*	*(2.28)*	*(4.70)*	*(-0.23)*	*(2.35)*
Median BHAR	0.0180	0.0489	0.0193	0.0567	0.0356	0.0430	-0.0078	0.0427
	(0.0007)	*(0.0000)*	*(0.0431)*	*(0.0000)*	*(0.0022)*	*(0.0000)*	*(0.4936)*	*(0.0002)*

Table 5.5: continued

Panel B: Calendar time abnormal returns											
		OLS					WLS				
		Intercept	β_p	s_p	h_p	m_p	Intercept	β_p	s_p	h_p	m_p
Long portfolios											
Split before	1975-2006	0.0036	1.1415	0.5733	-0.1800	0.0939	0.0034	1.1225	0.5035	-0.2420	0.0708
		(3.19)	*(28.31)*	*(9.89)*	*(-2.81)*	*(2.49)*	*(3.28)*	*(44.15)*	*(15.17)*	*(-6.20)*	*(2.87)*
	1975-1987	0.0041	1.0775	0.8300	-0.2635	0.1345	0.0048	1.0285	0.7161	-0.3715	0.1502
		(2.50)	*(19.80)*	*(11.98)*	*(-3.65)*	*(3.20)*	*(4.26)*	*(39.79)*	*(16.10)*	*(-8.22)*	*(4.64)*
	1988-1997	0.0041	1.0859	0.6718	-0.2006	0.1420	0.0034	1.0597	0.6572	-0.1751	0.1377
		(2.73)	*(27.35)*	*(13.04)*	*(-2.88)*	*(2.30)*	*(2.11)*	*(25.81)*	*(11.40)*	*(-2.56)*	*(2.51)*
	1998-2006	0.0029	1.1997	0.3973	-0.1889	0.0928	0.0025	1.3191	0.3447	-0.1596	0.0621
		(1.04)	*(11.47)*	*(4.37)*	*(-1.66)*	*(1.52)*	*(0.83)*	*(16.04)*	*(4.82)*	*(-1.76)*	*(1.33)*
Do not split before	1975-2006	0.0059	1.0397	0.6411	-0.1667	0.0968	0.0055	1.0406	0.6586	-0.1687	0.0943
		(4.62)	*(34.69)*	*(11.12)*	*(-2.72)*	*(1.46)*	*(5.88)*	*(44.67)*	*(21.43)*	*(-4.76)*	*(4.04)*
	1975-1987	0.0063	1.0129	0.7906	-0.2059	0.1998	0.0061	1.0202	0.7641	-0.2196	0.2012
		(5.61)	*(35.82)*	*(17.27)*	*(-4.86)*	*(6.51)*	*(6.50)*	*(46.58)*	*(20.63)*	*(-5.92)*	*(7.20)*
	1988-1997	0.0049	1.0225	0.7785	-0.0446	0.1137	0.0046	0.9931	0.8238	-0.0191	0.1295
		(3.64)	*(30.49)*	*(14.46)*	*(-0.75)*	*(1.60)*	*(3.55)*	*(29.10)*	*(17.63)*	*(-0.35)*	*(2.87)*
	1998-2006	0.0069	0.9943	0.4690	-0.2862	0.0603	0.0075	1.0237	0.4567	-0.3061	0.0425
		(2.17)	*(9.07)*	*(4.22)*	*(-2.48)*	*(0.49)*	*(2.59)*	*(12.49)*	*(6.06)*	*(-3.34)*	*(0.85)*
Arbitrage portfolios											
Split before	1975-2006	0.0005	-0.0126	-0.0475	0.1013	0.0757	0.0019	0.0140	-0.1352	-0.0044	0.0651
		(0.28)	*(-0.43)*	*(-0.96)*	*(1.33)*	*(1.88)*	*(2.03)*	*(0.61)*	*(-4.54)*	*(-0.13)*	*(2.94)*
	1975-1987	-0.0005	-0.0507	0.0792	0.1226	0.0224	0.0032	-0.0313	-0.0283	-0.1280	-0.0287
		(-0.11)	*(-1.20)*	*(1.04)*	*(0.64)*	*(0.25)*	*(2.65)*	*(-1.14)*	*(-0.60)*	*(-2.66)*	*(-0.83)*
	1988-1997	0.0029	0.0753	-0.0634	0.0185	0.0883	0.0026	0.0590	-0.1039	0.0088	0.1128
		(1.78)	*(1.71)*	*(-1.22)*	*(0.31)*	*(1.62)*	*(1.68)*	*(1.48)*	*(-1.86)*	*(0.13)*	*(2.11)*
	1998-2006	-0.0016	-0.0539	-0.0807	0.0962	0.0885	-0.0013	0.0631	-0.1772	0.0882	0.1242
		(-0.54)	*(-0.67)*	*(-0.90)*	*(1.01)*	*(1.35)*	*(-0.51)*	*(0.89)*	*(-2.86)*	*(1.12)*	*(3.07)*
Do not split before	1975-2006	0.0040	0.0495	-0.0513	0.0489	0.0939	0.0047	0.0050	-0.1217	-0.0575	0.1319
		(4.03)	*(1.05)*	*(-0.73)*	*(0.57)*	*(1.86)*	*(5.98)*	*(0.26)*	*(-4.78)*	*(-1.96)*	*(6.82)*
	1975-1987	0.0048	0.1206	0.1087	0.0448	-0.0777	0.0062	0.0341	-0.0810	-0.1125	0.0763
		(3.23)	*(1.91)*	*(0.98)*	*(0.42)*	*(-0.77)*	*(5.73)*	*(1.35)*	*(-1.90)*	*(-2.63)*	*(2.37)*
	1988-1997	0.0052	-0.0152	-0.0131	-0.0579	0.0741	0.0051	-0.0240	0.0171	-0.0463	0.0981
		(3.73)	*(-0.58)*	*(-0.27)*	*(-1.09)*	*(1.32)*	*(3.80)*	*(-0.68)*	*(0.36)*	*(-0.82)*	*(2.11)*
	1998-2006	0.0039	-0.0748	-0.2493	-0.0978	0.1814	0.0043	-0.0419	-0.2777	-0.1001	0.1984
		(2.16)	*(-1.41)*	*(-4.49)*	*(-1.53)*	*(4.37)*	*(2.39)*	*(-0.83)*	*(-5.95)*	*(-1.76)*	*(6.37)*

Contrary to our expectations, firms that have split within the last three years do not outperform firms that have not. Specifically, during the period 1975-2006, the average one-year BHAR for the "split before" sub-sample is 1.93% p.a. (t-statistic is 1.61) while for the "do not split before" sub-sample, it is 7.09% p.a. (t-statistic is 7.36). In fact, the mean BHAR for the "split before" sub-sample is only significantly positive during the 1988-1997 sub-period while the mean BHAR for the "do not split before" sub-sample is positive and significant in all three sub-periods. Moreover, regardless of which period is examined, the BHARs from the "do not split before" sub-samples are consistently higher than the BHARs obtained from the "split before" sub-samples.

Under the calendar time portfolio regression analysis, the average monthly abnormal return of the "split before" sub-sample is significantly positive during the period 1975-2006 and it amounts to 0.36% per month (t-statistic is 3.19) and 0.34% per month (t-statistic equals 3.28) under OLS and WLS, respectively. The monthly abnormal returns for the "do not split before" sample however are higher, and equate to 0.59% per month under OLS and 0.55% per month under WLS. Both of these abnormal returns are significant at the 5% level. For the calendar time arbitrage portfolio regressions, the intercepts for the "split before" sub-samples are much lower and are only significant when estimated under WLS. Moreover, the magnitude and statistical significance of the WLS intercepts vary across different sub-periods. Specifically, the adjusted intercept is significantly positive during the 1975-1987 period, for the period 1988-1997, it is only significant at the 10% level and for the 1998-2006 period, the adjusted intercept is negative (although insignificant). While the adjusted intercepts for the "split before" sub-samples are sensitive to the methodology and the period studied, the adjusted intercept for the "do not split before" sub-samples are significantly positive regardless of which methodology is employed in all time periods. This result indicates that it might be profitable for investors to purchase splitting companies that have not split within the last three years. Our next task is to study the return behaviour for companies that will split again in the future versus companies that will not.

5.5.2.2 Split after versus do not split after

We define a split event as "split after" if the firm splits again within the next three years. Meanwhile, a split event is classified as "do not split after" if the firm does not split again within the next three years. The results for the equal-weighted one-year BHAR for the firms that will split within the next three years and firms that will not are detailed in panel A of table 5.6. For the "split after" sub-sample, there is clear evidence of long-run excess returns to be earned following the announcement date. From 1975 to 2006, the average one-year BHAR is 31.27% p.a. and it is clearly significant. Meanwhile, the one-year BHAR for the "do not split after" sub-sample is much lower, in fact, it is significantly negative. The average one-year BHAR is -10.75% p.a. (t-statistic equal to -13.64). Moreover, these patterns of excess returns are observed across all sub-periods, including the 1998-2006 period.

Panel B reports the result from the equal-weighted calendar time regressions on sample firm portfolios and arbitrage portfolios under both OLS and WLS. The findings are very similar to the BHAR analysis. The average monthly abnormal return for the "split after" sub-sample is significantly positive, amounting to 2.27% per month (27.24% p.a.) under OLS and 2.13% per month (25.56% p.a.) under WLS.

Once again, these excess returns are consistently positive in all time periods. In contrast, the average intercept for the "do not split after" sub-sample is negative and significant, and it equates to -0.54% per month (-6.48% p.a.) under OLS and -0.58% per month (-6.96% p.a.) under WLS. The excess returns are reliably less than zero in all sub-periods. Adjusting for the characteristics of the sample firms via the arbitrage portfolios does not change the behaviour of the excess returns within each sub-sample. Specifically, the average monthly abnormal return is significantly positive for firms that will split again. For firms that will not split again within the next three years, the abnormal return is actually negative. We interpret this result as evidence of the excess return reverting to its long-term mean. Specifically, companies usually experience an abnormal increase in share price prior to the split, if some of them continue to split in the future, then this indicates that these companies are strong performers and are more likely to exhibit positive excess returns. For those that do not split again, since the firms have experienced an exceptional share price run-up before, the fact that the price is substantially reduced after the split is consistent with the notion of the return of these firms converging to its long-term mean.

So far, we have documented that firms that have not split before tend to outperform firms that have. Firms that will split again in the future experience positive excess returns while firms that will not split again in the future experience negative excess returns. If firms that have not split before consistently exhibit positive abnormal returns after controlling for the splitting again condition in all time periods, then this suggests that investors can earn excess returns with certainty based on ex-ante information. To investigate this matter further, we compare the impact of ex-ante information versus ex-post information.

Table 5.6: Sub-sample analysis on the long horizon abnormal returns: Split after versus do not split after

This table reports the equal-weighted average long-run abnormal returns for firms that will split again within the next three years (split after sub-sample) versus firms that will not (do not split after sub-sample). Panel A outlines the result under the BHAR analysis while panel B reports the results under the calendar time regressions on both the sample firm portfolios and arbitrage portfolios.

Panel A: Buy and hold abnormal returns following the announcement date

	1975-2006		1975-1987		1988-1997		1998-2006	
	Split after	Do not split after	Split after	Do not split after	Split after	Do not split after	Split after	Do not split after
n	4,204	6,961	2,119	3,022	1,375	2,137	710	1,802
Mean BHAR	0.3127	-0.1075	0.2493	-0.0917	0.3423	-0.1121	0.4446	-0.1283
	(22.00)	*(-13.64)*	*(15.23)*	*(-8.98)*	*(14.78)*	*(-8.40)*	*(8.64)*	*(-6.56)*
Median BHAR	0.2337	-0.0551	0.2023	-0.0402	0.2568	-0.0699	0.3273	-0.0540
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

Table 5.6: continued

Panel B: Calendar time abnormal returns		OLS					WLS				
		Intercept	β_p	s_p	h_p	m_p	Intercept	β_p	s_p	h_p	m_p
Long portfolios											
Split after	1975-2006	0.0227	1.1131	0.6642	-0.1478	0.3169	0.0213	1.1113	0.6955	-0.1614	0.3047
		(18.59)	*(28.87)*	*(12.06)*	*(-2.75)*	*(9.06)*	*(20.51)*	*(43.06)*	*(20.80)*	*(-4.10)*	*(11.71)*
	1975-1987	0.0194	1.0438	0.9107	-0.2140	0.2420	0.0188	1.0679	0.9160	-0.2290	0.2438
		(11.28)	*(21.19)*	*(12.56)*	*(-3.68)*	*(6.38)*	*(15.47)*	*(36.39)*	*(19.20)*	*(-4.81)*	*(7.09)*
	1988-1997	0.0227	1.1333	0.7895	-0.1783	0.2923	0.0217	1.0979	0.7763	-0.1646	0.3257
		(12.46)	*(26.31)*	*(14.51)*	*(-2.59)*	*(3.66)*	*(13.49)*	*(24.79)*	*(13.50)*	*(-2.42)*	*(5.66)*
	1998-2006	0.0296	1.2312	0.4116	-0.1810	0.4232	0.0300	1.2362	0.4073	-0.1540	0.4354
		(10.79)	*(12.95)*	*(4.59)*	*(-1.79)*	*(6.44)*	*(10.24)*	*(15.86)*	*(5.76)*	*(-1.69)*	*(8.56)*
Do not split after	1975-2006	-0.0054	1.0330	0.5324	-0.1830	-0.0027	-0.0058	1.0481	0.5181	-0.2122	-0.0398
		(-4.66)	*(32.59)*	*(8.42)*	*(-2.90)*	*(-0.05)*	*(-5.53)*	*(41.19)*	*(15.38)*	*(-5.46)*	*(-1.60)*
	1975-1987	-0.0050	0.9911	0.6638	-0.2670	0.1222	-0.0041	0.9979	0.6029	-0.3126	0.1173
		(-4.34)	*(34.62)*	*(12.96)*	*(-5.65)*	*(3.03)*	*(-4.22)*	*(45.16)*	*(15.57)*	*(-7.97)*	*(3.98)*
	1988-1997	-0.0068	0.9962	0.6800	-0.1212	0.0555	-0.0068	0.9685	0.7123	-0.0660	0.0339
		(-5.19)	*(26.95)*	*(11.47)*	*(-1.78)*	*(0.85)*	*(-4.69)*	*(26.54)*	*(13.67)*	*(-1.08)*	*(0.69)*
	1998-2006	-0.0046	1.0199	0.4044	-0.2139	-0.0577	-0.0057	1.1469	0.3893	-0.2194	-0.1024
		(-1.52)	*(9.53)*	*(3.79)*	*(-1.85)*	*(-0.60)*	*(-1.80)*	*(12.78)*	*(4.86)*	*(-2.24)*	*(-2.00)*
Arbitrage portfolios											
Split after	1975-2006	0.0190	0.0906	-0.0532	0.0460	0.1952	0.0201	0.0323	-0.0601	-0.0707	0.1656
		(12.19)	*(2.31)*	*(-0.98)*	*(0.64)*	*(3.77)*	*(17.83)*	*(1.15)*	*(-1.65)*	*(-1.65)*	*(5.85)*
	1975-1987	0.0161	0.0534	0.0959	0.0011	-0.0316	0.0174	0.0198	0.0676	-0.1083	0.0036
		(8.33)	*(1.32)*	*(1.25)*	*(0.01)*	*(-0.53)*	*(12.59)*	*(0.60)*	*(1.25)*	*(-2.01)*	*(0.09)*
	1988-1997	0.0224	0.0706	-0.0075	-0.0917	0.1761	0.0218	0.0440	-0.0169	-0.0969	0.2254
		(11.29)	*(1.52)*	*(-0.12)*	*(-1.25)*	*(1.94)*	*(12.08)*	*(0.88)*	*(-0.26)*	*(-1.27)*	*(3.49)*
	1998-2006	0.0215	0.2593	-0.2157	0.0827	0.3748	0.0264	0.1762	-0.2452	-0.0209	0.3660
		(5.52)	*(2.47)*	*(-2.34)*	*(0.59)*	*(6.32)*	*(8.48)*	*(2.13)*	*(-3.27)*	*(-0.22)*	*(6.77)*
Do not split after	1975-2006	-0.0071	0.0360	-0.0382	0.1253	-0.0059	-0.0066	-0.0107	-0.1844	-0.0172	0.0601
		(-6.05)	*(0.55)*	*(-0.40)*	*(1.06)*	*(-0.09)*	*(-8.52)*	*(-0.57)*	*(-7.42)*	*(-0.60)*	*(3.27)*
	1975-1987	-0.0065	0.1180	0.1801	0.1301	-0.2072	-0.0039	-0.0048	-0.1645	-0.1186	0.0371
		(-3.23)	*(1.24)*	*(1.05)*	*(0.83)*	*(-1.33)*	*(-3.63)*	*(-0.19)*	*(-3.85)*	*(-2.74)*	*(1.14)*
	1988-1997	-0.0073	-0.0133	-0.0865	-0.0421	0.0341	-0.0068	-0.0233	-0.0737	-0.0245	0.0404
		(-6.05)	*(-0.45)*	*(-1.96)*	*(-0.96)*	*(0.81)*	*(-5.66)*	*(-0.77)*	*(-1.71)*	*(-0.48)*	*(1.00)*
	1998-2006	-0.0065	-0.1673	-0.2211	-0.0428	0.0566	-0.0085	-0.0616	-0.2457	0.0065	0.0807
		(-2.93)	*(-2.62)*	*(-3.36)*	*(-0.62)*	*(1.07)*	*(-4.40)*	*(-1.11)*	*(-4.96)*	*(0.11)*	*(2.55)*

5.5.2.3 Do not split before and split after versus do not split before and do not split after

To draw inference on whether the abnormal returns for firms that have not split within the last three years is pervasive, we divide the "do not split before" sub-sample into firms that will split again within the next three years versus firms that will not. If excess returns are conditional on ex-ante information, then it presents a real opportunity for investors to make money by buying companies that have not split before every time a firm announces a split. On the other hand, if ex-post information is the reason why a firm outperforms its peers, then the abnormal returns can only be guaranteed if investors can accurately predict which of the sample firms will split again in the future. The results are outlined in table 5.7

Here, the effect of ex-post information is stronger. Abnormal returns do not exist for all firms that have not split before; rather, they are only present in firms that will split again within the next three years. This behaviour of the excess returns does not seem to be affected by the time period or the methodology employed. Across all different periods, the abnormal returns for the firms that will split again are significantly positive while for firms that do not split within the next three years, they are negatively significant regardless of which benchmark is used to proxy for the expected return. In fact, this pattern is very similar to what was observed in section 5.5.2.2. It further supports our earlier conjecture that abnormal returns on splitting companies depend on whether these firms will implement another split in the future. For completeness, we also categorise the "split before" sub-sample into firms that will split again versus firms that will not.

Table 5.7: Sub-sample analysis on the long horizon abnormal returns: Do not split before/split after versus do not split before/do not split after

This table reports the equal-weighted average long-run abnormal returns for firms that have not split before and will split again within the next three years (not before/after) versus firms that have not split before and will not split again (not before/not after). Panel A outlines the result under the BHAR analysis while panel B reports the results for the calendar time regressions on the sample firm portfolios and arbitrage portfolios.

Panel A: Buy and hold abnormal returns following the announcement date								
	1975-2006		1975-1987		1988-1997		1998-2006	
	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after
n	2,352	4,453	1,156	1,882	789	1,449	407	1,122
Mean BHAR	0.3741	-0.0892	0.3028	-0.0710	0.4258	-0.1120	0.4764	-0.0904
	(19.51)	*(-9.05)*	*(13.65)*	*(-5.36)*	*(13.13)*	*(-6.86)*	*(7.27)*	*(-3.72)*
Median BHAR	0.2721	-0.0382	0.2338	-0.0259	0.3066	-0.0634	0.3309	-0.0306
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0001)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0039)*

Table 5.7: continued

Panel B: Calendar time abnormal returns		OLS					WLS				
		Intercept	β_p	s_p	h_p	m_p	Intercept	β_p	s_p	h_p	m_p
Long portfolios											
Not before/After	1975-2006	0.0244	1.1003	0.7328	-0.1802	0.3505	0.0230	1.0987	0.7799	-0.1481	0.3491
		(18.27)	*(29.46)*	*(12.47)*	*(-2.87)*	*(8.35)*	*(19.65)*	*(37.73)*	*(20.65)*	*(-3.36)*	*(11.83)*
	1975-1987	0.0208	1.0442	0.9475	-0.1863	0.2745	0.0201	1.0746	0.9651	-0.1766	0.2708
		(11.98)	*(24.02)*	*(13.61)*	*(-3.07)*	*(5.84)*	*(13.95)*	*(30.92)*	*(17.07)*	*(-3.15)*	*(6.49)*
	1988-1997	0.0248	1.1490	0.8490	-0.0960	0.2756	0.0239	1.1007	0.8499	-0.0741	0.3117
		(13.01)	*(24.89)*	*(15.42)*	*(-1.39)*	*(3.53)*	*(13.84)*	*(22.93)*	*(13.92)*	*(-1.03)*	*(5.06)*
	1998-2006	0.0324	1.2069	0.4462	-0.3213	0.4756	0.0319	1.2099	0.4730	-0.2574	0.4992
		(9.67)	*(11.62)*	*(4.40)*	*(-2.68)*	*(7.08)*	*(9.27)*	*(13.31)*	*(5.59)*	*(-2.40)*	*(8.27)*
Not before/Not after	1975-2006	-0.0038	1.0013	0.5500	-0.1607	-0.0068	-0.0041	1.0089	0.5708	-0.1776	-0.0372
		(-2.66)	*(30.52)*	*(7.44)*	*(-2.32)*	*(-0.09)*	*(-3.74)*	*(37.12)*	*(15.78)*	*(-4.28)*	*(-1.37)*
	1975-1987	-0.0038	0.9786	0.6484	-0.2117	0.1460	-0.0029	0.9904	0.6163	-0.2401	0.1448
		(-3.42)	*(40.51)*	*(13.82)*	*(-4.67)*	*(4.44)*	*(-2.84)*	*(42.23)*	*(15.18)*	*(-5.88)*	*(4.68)*
	1988-1997	-0.0054	0.9629	0.7245	-0.0839	0.0498	-0.0056	0.9366	0.7735	-0.0293	0.0472
		(-2.89)	*(19.49)*	*(11.30)*	*(-0.92)*	*(0.60)*	*(-3.66)*	*(24.23)*	*(14.14)*	*(-0.46)*	*(0.91)*
	1998-2006	-0.0020	0.9423	0.4157	-0.2367	-0.0796	-0.0028	1.0004	0.4278	-0.2658	-0.1387
		(-0.60)	*(8.05)*	*(4.20)*	*(-1.85)*	*(-1.10)*	*(-0.83)*	*(10.24)*	*(4.80)*	*(-2.48)*	*(-2.40)*
Arbitrage portfolios											
Not before/After	1975-2006	0.0218	0.1238	-0.0464	-0.0525	0.2255	0.0231	0.0523	-0.0345	-0.1418	0.2067
		(11.45)	*(2.92)*	*(-0.70)*	*(-0.60)*	*(3.12)*	*(16.79)*	*(1.52)*	*(-0.78)*	*(-2.73)*	*(5.95)*
	1975-1987	0.0191	0.1130	0.0959	-0.0799	-0.0229	0.0196	0.0800	0.0610	-0.1346	0.0197
		(9.51)	*(2.69)*	*(1.15)*	*(-0.99)*	*(-0.36)*	*(11.12)*	*(1.88)*	*(0.88)*	*(-1.96)*	*(0.39)*
	1988-1997	0.0265	0.0833	0.0353	-0.1069	0.1736	0.0266	0.0329	0.0292	-0.1215	0.2076
		(13.32)	*(1.67)*	*(0.56)*	*(-1.30)*	*(2.15)*	*(13.27)*	*(0.59)*	*(0.41)*	*(-1.45)*	*(2.90)*
	1998-2006	0.0235	0.2740	-0.2587	-0.0951	0.4281	0.0290	0.1676	-0.2505	-0.2004	0.4256
		(4.73)	*(2.17)*	*(-2.26)*	*(-0.57)*	*(4.56)*	*(7.31)*	*(1.59)*	*(-2.56)*	*(-1.62)*	*(6.08)*
Not before/Not after	1975-2006	-0.0057	0.0316	-0.0667	0.1267	0.0183	-0.0053	-0.0207	-0.1892	-0.0197	0.0859
		(-4.45)	*(0.46)*	*(-0.62)*	*(1.03)*	*(0.27)*	*(-5.65)*	*(-0.90)*	*(-6.19)*	*(-0.56)*	*(3.76)*
	1975-1987	-0.0052	0.1334	0.1388	0.1592	-0.1497	-0.0023	0.0075	-0.1909	-0.0930	0.1025
		(-2.48)	*(1.36)*	*(0.79)*	*(0.98)*	*(-0.95)*	*(-1.78)*	*(0.26)*	*(-3.82)*	*(-1.85)*	*(2.69)*
	1988-1997	-0.0061	-0.0680	-0.0644	-0.0770	0.0346	-0.0061	-0.0603	-0.0293	-0.0481	0.0494
		(-4.03)	*(-2.30)*	*(-1.15)*	*(-1.26)*	*(0.64)*	*(-4.24)*	*(-1.64)*	*(-0.56)*	*(-0.79)*	*(1.00)*
	1998-2006	-0.0039	-0.1670	-0.2899	-0.0630	0.0812	-0.0059	-0.0985	-0.3097	-0.0316	0.1032
		(-1.57)	*(-2.30)*	*(-3.08)*	*(-0.80)*	*(1.32)*	*(-2.45)*	*(-1.43)*	*(-4.93)*	*(-0.42)*	*(2.53)*

5.5.2.4 Split before and split after versus split before and do not split after

Table 5.8 compares the excess returns of firms that split again versus firms that do not for the "split before" sub-sample. Once again, only firms that will split in the future experience positive long-run excess returns. Specifically, the mean BHAR for the "split before/after" sub-sample is 23.48% p.a. whereas the mean BHAR for the "split before/not after" sub-sample is -13.98% p.a. for the full period. The time period and the methodology utilised do not have any effect on this behaviour of the abnormal returns. Combined with the findings from section 5.5.2.3, whether a firm has split before or not is not the major cause of why splitting firms perform well in the future. Rather, the excess return depends on whether the firm will split again. We see that the performance of splitting companies is highly dependent on ex-post information, not ex-ante information.

In summary, what we can infer from our results is that it is doubtful that long-run abnormal returns exist in all splitting companies, as past studies have claimed. These excess returns are driven by whether the firms will announce another split in the future. The time period examined or whether a firm has split before has little to do with the post announcement performance of splitting firms. The sample firms are more likely to experience positive abnormal returns when there are a large number of "split after" events. Specifically, the average long-run abnormal return is higher in the 1975-1987 and the 1988-1997 periods compared to the 1998-2006 period because during the 1975-1987 period, the "split after" events make up 40.64% of the total splits while for the period 1988-1997, they amount to 38.06% of the sample. However, the figure drops considerably in the final sub-period 1998-2006, where only 27.29% of the sample is "split after" events.

Table 5.8: Sub-sample analysis on the long horizon abnormal returns: Split before/split after versus split before/do not split after

This table reports the equal-weighted average long-run abnormal returns for firms that have split before and will split again within the next three years (before/after) versus firms that have split before and will not split again (before/not after). Panel A outlines the result under the BHAR analysis while panel B reports the results for the calendar time regressions on the sample firm portfolios and arbitrage portfolios.

Panel A: Buy and hold abnormal returns following the announcement date								
	1975-2006		1975-1987		1988-1997		1998-2006	
	Before/After	Before/Not after	Before/After	Before/Not after	Before/After	Before/Not after	Before/After	Before/Not after
n	1,852	2,508	963	1,140	586	688	303	680
Mean BHAR	0.2348	-0.1398	0.1851	-0.1259	0.2300	-0.1124	0.4018	-0.1909
	(11.16)	*(-10.68)*	*(7.68)*	*(-7.91)*	*(7.23)*	*(-4.86)*	*(4.88)*	*(-5.83)*
Median BHAR	0.1909	-0.0831	0.1562	-0.0771	0.2016	-0.0810	0.2823	-0.0946
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

Table 5.8: continued

Panel B: Calendar time abnormal returns		OLS					WLS				
		Intercept	β_p	s_p	h_p	m_p	Intercept	β_p	s_p	h_p	m_p
Long portfolios											
Before/After	1975-2006	0.0198	1.1443	0.6082	-0.0959	0.2721	0.0190	1.1233	0.5852	-0.1929	0.2493
		(14.02)	*(22.34)*	*(8.92)*	*(-1.31)*	*(6.94)*	*(15.36)*	*(36.46)*	*(14.69)*	*(-4.06)*	*(8.09)*
	1975-1987	0.0176	1.0840	0.8948	-0.2203	0.1790	0.0173	1.0567	0.8415	-0.3052	0.2082
		(8.00)	*(14.16)*	*(8.75)*	*(-1.80)*	*(3.64)*	*(11.12)*	*(28.11)*	*(13.73)*	*(-4.96)*	*(4.86)*
	1988-1997	0.0203	1.1133	0.7184	-0.2914	0.2927	0.0188	1.0878	0.6765	-0.2937	0.3367
		(9.71)	*(22.30)*	*(9.68)*	*(-3.25)*	*(3.10)*	*(9.65)*	*(20.59)*	*(9.61)*	*(-3.50)*	*(4.84)*
	1998-2006	0.0242	1.2414	0.4164	-0.0069	0.3504	0.0271	1.2816	0.3394	-0.0304	0.3566
		(7.75)	*(11.15)*	*(4.26)*	*(-0.06)*	*(4.53)*	*(8.11)*	*(14.28)*	*(4.32)*	*(-0.29)*	*(6.25)*
Before/Not after	1975-2006	-0.0079	1.1137	0.4953	-0.2228	-0.0040	-0.0086	1.1067	0.4308	-0.2723	-0.0457
		(-6.10)	*(28.58)*	*(8.48)*	*(-3.32)*	*(-0.09)*	*(-6.77)*	*(36.33)*	*(10.76)*	*(-5.84)*	*(-1.58)*
	1975-1987	-0.0064	1.0554	0.6681	-0.3482	0.0518	-0.0061	1.0082	0.5547	-0.4439	0.0599
		(-3.80)	*(22.41)*	*(9.39)*	*(-5.25)*	*(0.81)*	*(-4.54)*	*(33.95)*	*(10.40)*	*(-8.14)*	*(1.49)*
	1988-1997	-0.0097	1.0562	0.5754	-0.2031	0.0607	-0.0094	1.0246	0.5848	-0.1461	0.0021
		(-5.18)	*(21.38)*	*(8.97)*	*(-2.23)*	*(0.73)*	*(-4.60)*	*(20.29)*	*(7.96)*	*(-1.69)*	*(0.03)*
	1998-2006	-0.0080	1.1775	0.3840	-0.1903	-0.0210	-0.0101	1.3737	0.3552	-0.1282	-0.0567
		(-2.41)	*(10.06)*	*(3.88)*	*(-1.48)*	*(-0.29)*	*(-2.80)*	*(13.61)*	*(4.07)*	*(-1.17)*	*(-1.04)*
Arbitrage portfolios											
Before/After	1975-2006	0.0162	0.0088	-0.0665	0.1397	0.1957	0.0163	0.0103	-0.0976	0.0052	0.1217
		(7.35)	*(0.22)*	*(-1.02)*	*(1.55)*	*(4.00)*	*(11.47)*	*(0.29)*	*(-2.14)*	*(0.10)*	*(3.44)*
	1975-1987	0.0118	-0.0741	0.0932	0.1500	0.0587	0.0147	-0.0498	0.0632	-0.0902	-0.0116
		(2.61)	*(-1.33)*	*(0.98)*	*(0.75)*	*(0.63)*	*(7.98)*	*(-1.12)*	*(0.87)*	*(-1.24)*	*(-0.23)*
	1988-1997	0.0172	0.0591	-0.0493	-0.0644	0.1776	0.0156	0.0530	-0.0873	-0.0773	0.2437
		(6.28)	*(0.95)*	*(-0.57)*	*(-0.74)*	*(1.48)*	*(6.49)*	*(0.81)*	*(-1.00)*	*(-0.75)*	*(2.84)*
	1998-2006	0.0214	0.2095	-0.1818	0.2314	0.3290	0.0227	0.2094	-0.2260	0.2065	0.2979
		(5.33)	*(2.20)*	*(-1.67)*	*(1.74)*	*(4.43)*	*(5.95)*	*(2.04)*	*(-2.51)*	*(1.74)*	*(4.55)*
Before/Not after	1975-2006	-0.0100	-0.0117	-0.1141	0.0098	0.0031	-0.0090	0.0049	-0.1774	-0.0134	0.0223
		-6.65	*-0.35*	*-2.06*	*0.17*	*0.07*	*-7.92*	*0.18*	*-4.99*	*-0.32*	*0.87*
	1975-1987	-0.0086	-0.0242	-0.0181	-0.0851	-0.0811	-0.0067	-0.0209	-0.1494	-0.1739	-0.0740
		(-3.84)	*(-0.56)*	*(-0.18)*	*(-0.90)*	*(-1.08)*	*(-4.41)*	*(-0.62)*	*(-2.46)*	*(-2.80)*	*(-1.62)*
	1988-1997	-0.0096	0.0909	-0.1295	0.0192	0.0330	-0.0081	0.0484	-0.1643	0.0263	0.0236
		(-4.68)	*(1.51)*	*(-2.14)*	*(0.24)*	*(0.47)*	*(-4.25)*	*(1.03)*	*(-2.39)*	*(0.32)*	*(0.37)*
	1998-2006	-0.0130	-0.1282	-0.0995	0.0384	-0.0062	-0.0132	0.0085	-0.1492	0.0859	0.0530
		(-3.54)	*(-1.34)*	*(-0.91)*	*(0.36)*	*(-0.08)*	*(-4.50)*	*(0.10)*	*(-2.10)*	*(0.96)*	*(1.19)*

If “split after” is the only source of abnormal returns, then one needs to be able to predict which company will split again within the next three years to participate in these abnormal profits. To examine whether the “split after” and “do not split after” firms exhibit any major difference in firms characteristics, we compare the size, book-to-market and momentum of “split after” firms versus “do not split after” firms. Our unreported results indicate that except for size, where firms that split again tend to be smaller than firms that do not, the ‘split after” and “do not split after” firms are indeed very similar in the value/growth and momentum dimensions. Specifically, the average size of the firms that split again within the next three years is 1.5 billion (median is 166 million) while for the firms that do not, the mean size is 2.7 billion (median is 278 million). Meanwhile, the average book-to-market and past 12-month return of the “split after” firms is 0.46 (median is 0.38) and 0.92 (median is 0.61), respectively. For the “do not split after” firms, the mean book-to-market is 0.45 (median is 0.36) while the mean past 12-month return is 0.91 (median is 0.55). Thus, the attribute that determines whether a company will announce another split is not directly observable.

If investors do not know this information with certainty, then the findings in table 5.1 suggest that even in the exceptional period, 1975-1997, every time a company announces a stock split, there is about a 40% chance that this company will announce another split within the next three years. Thus, the probability of earning these excess returns without ex-post information is around 40%. In the most recent period, this probability is reduced to 27%. Overall, our finding supports Fama et al. (1969) contention that positive excess returns are conditional and there is no convincing evidence of the market systematically under-reacting to the split announcements.

5.5.3 Sub-sample analysis for firms with different market capitalisations

To draw inference on how the return behaviour between firms that split before versus firms that split after changes with different market capitalisations, we analyse the large-cap stocks, mid-cap stocks, small-cap stocks and micro stocks separately. As mentioned earlier in section 5.3, we construct four size groups. Specifically, we rank all firms that are listed on the NYSE, Amex and Nasdaq based on size in descending order. We then divide the population into four categories: large-cap stocks (firms that comprise the top 70 percent of all companies listed on NYSE, Nasdaq and Amex by market capitalisation), mid-cap stocks (firms that are in the 70-80 percentile based on market capitalisation), small-cap stocks (firms that are in the 80-90 percentile based on market capitalisation) and micro stocks (firms that make up the remaining 10% of the total population). The sample firms are then allocated in each group accordingly. To conserve space, we estimate long-run abnormal returns for the period 1975-2006 instead of each sub-period separately. Moreover, due to sample size constraints, we only estimate the long-run abnormal return under the BHAR methodology, since reliable calendar time portfolio regressions require at least 10 firms in a portfolio for a given month.

Panel A of table 5.9 reports the mean/median BHARs for the large-cap stocks, mid-cap stocks, small-cap stocks and micro stocks separately. Here, the long-run abnormal return is no longer significant for firms that belong to the large and medium cap groups. The average BHAR for the large-cap firms is 1.46% p.a. (t-statistic is 1.06), for the mid-cap firms, it is actually negative although insignificant (mean BHAR amounts to -0.37% p.a., t-statistic equals to -0.18). On the other hand, the BHARs are, on average, significantly positive, 6.95% p.a. (t-statistic equals to 4.08) for stocks that belong to the small-cap group and 6% p.a. (t-statistic is 5.69) for the micro stocks. Our results indicate that most of the long-run abnormal returns observed in section 5.5.1 are caused by the small and micro stocks, which together make up 20% of the U.S. market cap. The BHARs for the remaining 80% of the U.S. market cap are, on average, insignificant.

Table 5.9: Buy and hold abnormal returns for stocks with different market capitalisations

This table reports the buy and hold abnormal return following the announcement date for the large capitalisation stocks, mid capitalisation stocks, small capitalisation stocks and micro stocks. We sort all firms that are listed on the NYSE, Amex and NASDAQ based on size in descending order. Large-cap stocks are firms that comprise the top 70 percent of the market capitalisation. Mid-cap stocks are firms that are in the 70^{th} to 80^{th} percentile based on market capitalisation, small-cap stocks are firms that are in the 80^{th} to 90^{th} percentile based on market capitalisation and micro stocks are firms that make up the remaining 10 percent of the total market capitalisation. Panel A reports the mean/median BHARs for the large-cap stocks, mid-cap stocks, small-cap stocks and micro stocks. Panel B reports the mean/median BHARs for firms that will split again versus firms that will not. Panel C reports the mean/median BHAR for firms that have split within the last three years versus firms that have not. Panel D reports the mean/median BHAR for firms that have split before and will split again versus firms that have split before and will not split again. Finally, panel E reports the mean/median BHAR for firms that have not split before and will split again versus firms that have not split before and will not split again.

Panel A: Buy and hold abnormal returns following the announcement date (full sample)				
	Large-cap stocks	Mid-cap stocks	Small-cap stocks	Micro-cap stocks
n	1,359	978	2,198	6,630
Mean BHAR	0.0146	-0.0037	0.0695	0.0600
	(1.06)	*(-0.18)*	*(4.08)*	*(5.69)*
Median BHAR	0.0029	0.0039	0.0524	0.0481
	(0.3842)	*(0.9010)*	*(0.0000)*	*(0.0000)*

Table 5.9: continued

Panel B: Buy and hold abnormal returns following the announcement date (sub-sample): Split before/do not split before

	Large-cap stocks		Mid-cap stocks		Small-cap stocks		Micro-cap stocks	
	Split before	Do not split before	Split before	Do not split before	Split before	Do not split before	Split before	Do not split before
n	561	798	463	515	1,002	1,196	2,334	4,296
Mean BHAR	-0.0104	0.0321	-0.0270	0.0172	0.0496	0.0862	0.0226	0.0803
	(-0.39)	*(2.31)*	*(-0.86)*	*(0.64)*	*(2.10)*	*(3.54)*	*(1.26)*	*(6.17)*
Median BHAR	-0.0216	0.0137	-0.0355	0.0419	0.0345	0.0600	0.0365	0.0590
	(0.4474)	*(0.0527)*	*(0.1810)*	*(0.1521)*	*(0.0031)*	*(0.0000)*	*(0.0006)*	*(0.0000)*

Panel C: Buy and hold abnormal returns following the announcement date (sub-sample): Split after/do not split after

	Large-cap stocks		Mid-cap stocks		Small-cap stocks		Micro-cap stocks	
	Split after	Do not split after	Split after	Do not split after	Split after	Do not split after	Split after	Do not split after
n	350	1,009	332	646	780	1,418	2,742	3,888
Mean BHAR	0.2216	-0.0573	0.2695	-0.1441	0.3301	-0.0738	0.3246	-0.1267
	(6.48)	*(-4.27)*	*(7.41)*	*(-6.23)*	*(8.51)*	*(-5.17)*	*(18.31)*	*(-10.53)*
Median BHAR	0.1402	-0.0415	0.1867	-0.0958	0.2557	-0.0346	0.2526	-0.0623
	(0.0000)	*(0.0001)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0001)*	*(0.0000)*	*(0.0000)*

Table 5.9: continued

Panel D: Buy and hold abnormal returns following the announcement date (sub-sample): Do not split before/(do not) split after								
	Large-cap stocks		Mid-cap stocks		Small-cap stocks		Micro-cap stocks	
	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after	Not before/ After	Not before/ Not after
n	165	633	151	364	379	817	1,657	2,639
Mean BHAR	0.2200	-0.0169	0.3101	-0.1042	0.4219	-0.0695	0.3843	-0.1107
	(6.56)	*(-1.15)*	*(5.89)*	*(-3.57)*	*(6.87)*	*(-3.63)*	*(17.05)*	*(-7.59)*
Median BHAR	0.1481	-0.0202	0.2367	-0.0370	0.2842	-0.0184	0.2906	-0.0561
	(0.0000)	*(0.2589)*	*(0.0000)*	*(0.0065)*	*(0.0000)*	*(0.0086)*	*(0.0000)*	*(0.0000)*

Panel E: Buy and hold abnormal returns following the announcement date (sub-sample): Split before/(do not) split after								
	Large-cap stocks		Mid-cap stocks		Small-cap stocks		Micro-cap stocks	
	Before/After	Before/Not after	Before/After	Before/Not after	Before/After	Before/Not after	Before/After	Before/Not after
n	185	376	181	282	401	601	1,085	1,249
Mean BHAR	0.2231	-0.1253	0.2356	-0.1955	0.2433	-0.0796	0.2335	-0.1606
	(3.88)	*(-4.84)*	*(4.69)*	*(-5.27)*	*(5.08)*	*(-3.73)*	*(8.20)*	*(-7.54)*
Median BHAR	0.1312	-0.1149	0.1395	-0.1550	0.2251	-0.0484	0.1933	-0.0751
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0018)*	*(0.0000)*	*(0.0000)*

Panel B compares the performance of firms that split within the last three years with firms that do not. Consistent with the result observed earlier, firms that have not split before tend to outperform firms that have. The abnormal returns of the "do not split before" sub-sample is significantly positive across most of the capitalisation groups (except the mid-cap stocks) while the abnormal returns for the "split before" sub-sample is only positive and significant for the small-cap stocks. Panel C depicts the mean/median BHARs for firms that split again versus firms that do not. There is a clear difference in the magnitude and statistical significance of the BHAR between the two sub-samples. Regardless of which size groups the firm belongs to, the mean BHAR is significantly positive for firms that will split again within the next three years. It is however significantly negative for firms that will not. In panel D and E, we condition the "do not split before" and "split before" sub-samples into firms that split again in the future versus firms that will not. Here, only firms that split within the next three years consistently earn positive abnormal returns. Overall, this implies that our finding in section 5.5.2 is not only robust to the time period examined, but also robust across different market capitalisations.

5.5.4 Volatility spread across different sub-samples

So far, we have documented that positive excess returns following stock splits can only be earned with certainty based on ex-post information. This further validates our result in chapter 4. Specifically, although stock splits induce a favourable response by the market on the announcement date, the option investors do not believe that they can make money from this event. However, one of the limitations with the option study is that due to the availability of the data, our analysis only covers the 1998-2007 period. This coincides with the time period where aggregate excess returns are not significantly different from zero. Thus, it is possible that the findings in chapter 4 are only specific to the 1998-2007 period, where there is a low proportion of “split after” events. If one examined the 1975-1987 and 1988-1997 periods, they would most likely observe a positive volatility spread between call and put options. Since the OptionMetrics Ivy database starts in 1996, we cannot evaluate whether the behaviour of the option volatility spread is sensitive to the time period. However, we are able to study the volatility spread between call and put options for firms that have split before versus firms that have not, and firms that will split again in the future versus firms that will not.

This result not only allows us to assess the robustness of our findings in chapter 4, it also provides evidence on whether the option investors are able to distinguish companies that will split again in the future versus companies that will not. That is, we aim to test whether the option investors value the information content of the split announcement for these firms differently. Our evidence in section 5.5.2.4 indicates that the attribute that determines whether a firm will announce another split is not directly observable. Thus, if firms that split again exhibit a positive volatility spread, then this information is particularly valuable to investors. Table 5.10 depicts the volatility spread for close at the money call and put options across four sub-samples. At-the-money options are defined in chapter 4, long maturity options are those that expire after the effective date while short maturity options are those that expire before the effective date. To conserve space, we only investigate the behaviour of the volatility spread for the period [-2, +2] days around the announcement date.

Table 5.10 Volatility spread between at-the-money call and put options across different sub-samples

This table reports the average change and abnormal change in the volatility spread (VS) between at the money call and put options during the period [-2, +2] where day zero is the announcement date. For each stock, we select the closest at-the-money call and put options given that these options are not out- or in-the-money by more than 10 percent. Split before are companies that have split within the last three years while split after are companies that will split again within the next three years.

		VS between long maturity options			VS between short maturity options		
Day	Sub-sample	N	ΔVS	AbΔVS	N	ΔVS	AbΔVS
-2	Split before	386	0.0015	-0.0153	342	0.0016	0.0022
			(0.87)	*(-2.69)*		*(0.60)*	*(0.31)*
-1	Split before	400	0.0014	0.0052	341	0.0031	-0.0021
			(0.81)	*(0.96)*		*(1.15)*	*(-0.31)*
0	Split before	413	0.0021	0.0005	346	0.0034	0.0004
			(1.00)	*(0.08)*		*(1.26)*	*(0.06)*
1	Split before	429	0.0053	0.0081	355	0.0030	-0.0049
			(2.47)	*(1.16)*		*(0.82)*	*(-0.73)*
2	Split before	436	0.0020	-0.0002	355	-0.0003	0.0035
			(0.92)	*(-0.04)*		*(-0.06*	*(0.41)*
-2	Do not split before	438	-0.0001	0.0006	463	0.0001	-0.0015
			(-0.08)	*(0.12)*		*(0.06)*	*(-0.25)*
-1	Do not split before	462	0.0005	-0.0059	466	0.0020	-0.0089
			(0.30)	*(-1.23)*		*(1.05)*	*(-1.43)*
0	Do not split before	462	0.0049	-0.0035	464	0.0005	-0.0013
			(2.41)	*(-0.77)*		*0.17*	*-0.19*
1	Do not split before	493	0.0040	0.0065	468	0.0042	-0.0004
			(2.37)	*(1.34)*		*(1.59)*	*(-0.06)*
2	Do not split before	499	-0.0015	-0.0067	472	-0.0014	-0.0053
			(-0.99)	*(-1.58)*		*(-0.63)*	*(-0.89)*
-2	Split after	243	-0.0005	-0.0139	216	-0.0005	-0.0050
			(-0.24)	*(-2.29)*		*(-0.17)*	*(-0.59)*
-1	Split after	250	0.0039	-0.0001	213	0.0056	-0.0114
			(1.82)	*(-0.01)*		*(1.65)*	*(-1.22)*
0	Split after	249	0.0050	-0.0058	220	0.0050	0.0002
			(2.01)	*(-0.83)*		*(1.30)*	*(0.02)*
1	Split after	269	0.0031	0.0069	224	0.0012	-0.0169
			(1.08)	*(0.73)*		*(0.26)*	*(-1.86)*
2	Split after	272	0.0002	-0.0025	221	0.0020	0.0127
			(0.07)	*(-0.28)*		*(0.45)*	*(1.40)*
-2	Do not split after	581	0.0011	-0.0040	589	0.0012	0.0019
			(0.92)	*(-0.90)*		*(0.70)*	*(0.35)*
-1	Do not split after	612	-0.0004	-0.0010	594	0.0013	-0.0041
			(-0.28)	*(-0.23)*		*(0.75)*	*(-0.77)*
0	Do not split after	626	0.0030	0.0000	590	0.0005	-0.0009
			(1.70)	*(0.00)*		*(0.21)*	*(-0.16)*
1	Do not split after	653	0.0053	0.0074	599	0.0046	0.0031
			(3.49)	*(1.67)*		*(1.91)*	*(0.62)*
2	Do not split after	663	0.0001	-0.0042	606	-0.0020	-0.0067
			(0.07)	*(-1.01)*		*(-0.73)*	*(-1.11)*

Here, we observe no evidence of a significant positive change in the volatility spread between call and put options in any days during the announcement period. For both the long and short maturity option, the abnormal change in the volatility spread is either negative or not significantly different from zero. Given that positive excess returns are concentrated in companies that will split again in the future, the fact that this sub-sample does not experience a positive change in the volatility spread suggests that the option investors do not interpret the information content of the split announcement for this group differently. In other words, they are not able to identify companies that will be strong performers based on the information contained in the announcement alone. This indicates that it is unlikely that our findings in chapter 4 are sensitive to the time period examined because the behaviour of the option volatility spread is not affected by the number of events that are "split after" in a given time period.

5.6 Sensitivity analysis

5.6.1 Overlapping return calculation

One potential problem that could be influencing our results is overlapping periods of return calculation for the same firm. For example, Oracle has announced common stock splits three times during our sample period. The first was in February 1999, the second in December 1999 and the last time was in September 2000. Clearly, the one-year abnormal return calculated from the 12-months following the announcement date is not independent because these abnormal returns share several months of overlapping returns. Lyon, Barber and Tsai (1999) have found that lack of independence generated by overlapping returns often yields mis-specified test statistics. The calendar time portfolio regression will not fix this problem since we still use these same monthly returns in the portfolio composition. Therefore, one might argue that the reason why the "split after" sub-sample exhibits higher abnormal returns than the "do not split after sub-sample" is that the "split after" sub-sample may contain firms that split many times, where monthly returns are more likely to overlap. In other words, the test statistic in the "split after" sub-sample might be overstated. However, a counter argument can be made for the “split before” sub-sample. Specifically, if overlapping returns is the main reason why there is a drastic difference in the statistical significance of firms that split after versus firms that do not, then we should also observe a higher and more significant excess return for firms that split before compared to firms that do not. The result in section 5.5.2.1 is actually contrary to this argument, which indicates that it is doubtful that overlapping returns are the major cause of the pattern in abnormal returns observed earlier.

Nevertheless, we correct for this source of bias by eliminating from our sample all observations with overlapping returns. Following Spiess and Affleck-Graves (1995) and Loughran and Ritter (1995), to be included in the sample, we require firms to have not split their shares within the last 12-months prior to the announcement date. This ensures that the time interval between each split for a given firm is at least 12-months so that there are no monthly overlapping returns in each abnormal return calculation. The result is depicted in panel A of table 5.11. To conserve space, we do not report the BHARs for the “split after” versus “do not split after, “split before” versus “do not split before” sub-samples across different time periods and market capitalisations.

Table 5.11: Sensitivity analysis on the buy and hold abnormal returns

This table reports the results of the sensitivity analysis. Panel A reports the one-year buy and hold abnormal return in samples where no overlapping returns exist. For a given firm, the time lag between each split is at least 12-months. Panel B reports the one-year buy and hold abnormal return following the effective date while panel C reports the one-year buy and hold abnormal return following the announcement date for different sub-samples under the new definition of "split after" and "split before". Specifically, we define a split event as "split after" if the firm will split again within the next five years. A split event is defined as "split before" if the firm has split within the last five years. The buy and hold abnormal returns are calculated following the announcement date.

Panel A: Buy and hold abnormal returns in samples with no overlapping returns

	Full sample	Split after	Do not split after	Split before	Do not split before	Before/ After	Before/ Not after	Not before/ After	Not before/ Not after
n	10,126	3,720	6,406	3,321	6,805	1,368	1,953	2,352	4,4453
Mean BHAR	0.0550	0.3197	-0.0987	0.0225	0.0709	0.2263	-0.1202	0.3741	-0.0892
	(7.05)	*(21.40)*	*(-12.08)*	*(1.69)*	*(7.36)*	*(9.61)*	*(-8.24)*	*(19.51)*	*(-9.05)*
Median BHAR	0.0406	0.2406	-0.0481	0.0224	0.0489	0.1934	-0.0702	0.2721	-0.0382
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0002)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

Panel B: Buy and hold abnormal returns following the effective date

	Full sample	Split after	Do not split after	Split before	Do not split before	Before/ After	Before/ Not after	Not before/ After	Not before/ Not after
n	12,042	4,453	7,589	4,634	7,408	1,943	2,691	2,510	4,898
Mean BHAR	0.0236	0.2720	-0.1221	0.0077	0.0336	0.2232	-0.1479	0.3097	-0.1080
	(3.41)	*(20.41)*	*(-16.95)*	*(0.71)*	*(3.73)*	*(11.90)*	*(-12.42)*	*(16.63)*	*(-11.94)*
Median BHAR	0.0232	0.2143	-0.0577	0.0110	0.0316	0.2034	-0.0856	0.2231	-0.0404
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0298)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

Panel C: Buy and hold abnormal returns under the new definition of split before/split after

	Split after	Do not split after	Split before	Do not split before	Before/ After	Before/ Not after	Not before/ After	Not before/ Not after
n	4,936	5,728	5,048	5,616	2,501	2,547	2,435	3,181
Mean BHAR	0.2488	-0.1136	0.0353	0.0711	0.2111	-0.1375	0.2875	-0.0946
	(19.55)	*(-12.78)*	*(3.24)*	*(6.42)*	*(12.41)*	*(-10.80)*	*(15.18)*	*(-7.66)*
Median BHAR	0.1843	-0.0591	0.0295	0.0493	0.1644	-0.0819	0.2029	-0.0429
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*	*(0.0000)*

In general, we observe very similar findings. Specifically, the average one-year equal-weighted BHAR is 5.50% p.a. (t-statistic equals 7.05). However, once we break the full sample into firms that do split after and firms that do not, the abnormal returns disappear for firms that do not split again. The pattern of the excess return for the split before versus do not split before sub-samples is repeated with firms that have not split within the last three years outperforming firms that have. Most of these returns are once again conditioned on whether the firms will split again within the next three years. In sum, the earlier findings are not driven by overlapping returns calculations.

5.6.2 Long-run abnormal return following the effective date

In addition to the announcement date, we also test the effect of a stock split on the one-year abnormal return following the effective date. Byun and Rozeff (2003) and Boehme and Danielsen (2007) find that long-run excess returns shrink considerably when calculated following the effective date. They argue that firms do not exhibit positive returns subsequent to the splits and the post announcement drift only lasts a short duration. However, if one believes that there are abnormal returns to be made, then they should trade as soon as the information becomes public, that is, following the announcement date. Nevertheless, we examine whether our results differ when abnormal returns are estimated following the effective date.

Panel B of table 5.11 outlines the BHAR following the effective date for the full sample and each of the sub-samples. Consistent with findings from Byun and Rozeff (2003) and Boehme and Danielsen (2007), the average BHAR following the effective date is much smaller and it amounts to 2.36% p.a. (t-statistic is 3.41). However, for the sub-samples, there is no material difference in the behaviour of the abnormal returns measured after the effective date or the announcement date. Specifically, the abnormal returns (following either the announcement date or the effective date) are concentrated in firms that will split again within the next three years.

5.6.3 Different classification of split after and split before

To examine whether our findings are sensitive to the definition of “split before” and “split after”, we classify a split event as “split before” if the firm has split within the last five years. On the other hand, a split event is defined as “split after” if the firm will split within the next five years. Since we only have data available until December 2009, our sample can only cover the 1975-2004 period as we need the split data five years ahead to be able to categorise a split event as split after. The result is depicted in panel C of table 5.11.

The behaviour of the excess returns across all sub-samples does not seem to be affected by our new classification scheme. Specifically, firms that split within the next five years outperform firms that do not and the abnormal returns in the “split after” sub-sample appears to be the main reason why, on average, we observe a positive abnormal return following the announcement date for the full sample. In summary, it is reasonable to conclude that our results in section 5.5 are robust and are not caused by either overlapping return calculations or how “split before” and “split after” events are defined. Moreover, while the long-run excess return is reduced considerably, the pattern in which the abnormal returns behave does not vary when calculated following the effective date.

5.7 Summary and conclusion

According to the signalling hypothesis, the market reacts positively to a stock split announcement because this event reflects managers' expectations about the future performance of the firm. However, up to now, there is no consensus amongst researchers on whether investors can use the information contained in stock splits to make money. The findings from Ikenberry et al. (1996, 2002) and Desai and Jain (1997) suggest that the positive excess returns around the announcement date seem to persist in the future. On the other hand, Byun and Rozeff (2003) and Boehme and Danielsen (2007) argue that these returns vary with the time period and the choice of the benchmark. Our analysis of the option market indicates that informed investors do not believe that splitting companies will outperform their peers. Clearly, the behaviour of the long-run abnormal returns deserves further investigation.

Unlike previous research, we examine the source of the long-run excess returns. Our study serve three purposes: First, we reconcile the conflicting evidence inherent in prior studies. Second, we provide the reason(s) why the option investors do not anticipate an abnormal increase in the companies' share price as a result of this event. Finally, the long-run performance of splitting companies allows us to evaluate the process which new information is incorporated into stock prices.

We find that, on average, the sample firms exhibit positive one-year post announcement abnormal returns for the period 1975-2006. The magnitude and level of significance for these excess returns vary with the time period studied and mainly exist in small-cap and micro stocks, which together comprise 20% of the total market capitalisation. Additionally, our evidence suggests that firms that have split before tend to underperform firms that have not, a result that has not been documented in prior research. However, the main source of the positive abnormal returns is whether the firm will split again in the future. After controlling for this effect, we see that the time period analysed is not the major determinant of the magnitude and statistical significance of the abnormal returns, as past studies have claimed. In fact, aggregate long-run abnormal returns will be higher during periods where a large number of companies split again. In addition, while firms that have not split before are more likely to outperform firms that have, this does not imply that positive abnormal returns can be made in all firms that have not split in the recent past. Once again, these returns depend on whether the firms will split again in the future. Further, although the aggregate long-run abnormal return shrinks considerably after the effective date, it remains very large for firms that split again.

We do not claim that we have addressed all the relevant issues associated with stock splits, however, our analysis certainly provides some important insights as to whether this event leads to positive excess returns in the future and why the returns vary with the time period. The findings in this chapter suggest that the post-split announcement drift does not exist following every split. The abnormal returns are conditional on ex-post information. This explains why the option investors do not believe that they can make money once the information has become public.

In summary, our results support Fama et al.'s (1969) and Titman's (2002) conjecture in that although the market might take time to digest the information content of some complex corporate announcements fully, with respect to stock splits where learning should be straightforward, the market has correctly interpreted the implication of this new information and responds accordingly. We hope that our research could potentially enhance investors' understanding on the long-run performance of companies following stock splits. In particular, our analysis presents a cautionary warning: while positive abnormal returns might exist following the split announcements in aggregate, exploiting these returns is not that straightforward. A stock split itself is not the cause of long-run abnormal returns and a decision to buy requires a cautious examination.

Chapter 6:

Conclusion

6.1 Introduction

This thesis conducts a comprehensive study on the market reaction to stock splits. Chapter 2 briefly reviews the literature, which outlines some of the proposed theories that aim to explain managers' splitting decision. Chapters 3 to 5 examine a range of fundamental issues related to: (1) the market response to the split announcement; (2) the perceptions of the option investors regarding the information content of this announcement and (3) the long-run performance of splitting companies following the event. This chapter provides an overview of the analysis, presents the conclusions, discusses the contribution and considers directions for future research.

6.2 Summary of the empirical chapters

The main aim of chapter 3 is to assess whether the positive market reaction to the split announcement is still observed in today's market. Analysis of the short-run returns indicates that the market responds to this event favourably, which implies that stock splits contain positive information. Next, we evaluate the role of optionability in influencing the announcement returns. We find that the firm's optionability status only has a limited ability in reducing the impact of the split announcement. Moreover, firms that have actively traded options do not experience lower abnormal returns around the announcement date. This is contrary to Chern, Tandon, Yu and Webb (2007) where they document a negative relationship between the firm's optionability status and the abnormal returns. The result in chapter 3 motivates us to investigate whether the positive abnormal returns observed persist in the future.

In chapter 4, we examine the perception of the option investors regarding the implication of the split announcements. If stock splits are associated with an abnormal increase in the firm's share price, then the option market is a perfect venue for informed investors to trade on their information. Our evidence suggests that the option investors do not believe that they can earn positive excess returns once the announcement has become public. However, they do anticipate an increase in the stock volatility following the effective date.

Investigating the long-run performance of splitting companies, chapter 5 seeks to answer the question of whether asset returns are predictable following the announcement date. The findings from this chapter allow us to reconcile the results in the option study with evidence from previous research where positive excess returns are observed subsequent to the event date. Tests of the long-run abnormal returns indicate that the post-split announcement drift does not exist unconditionally. Positive excess returns can only be earned with certainty based on ex-post information. In this chapter, we also discover an important pattern in the behaviour of the abnormal returns. Specifically, companies that have not split before consistently outperform companies that have. This information is especially useful to investors whose main goal is to earn excess returns based on the split announcement, as it implies that they should focus their attention on companies that have not split their shares in the past.

6.3 Overall conclusions

The first major aim of this thesis is to assess the market reaction to stock splits. The combined evidence from chapters 3 to 5 suggests that stock splits are perceived as good news, which induces a favourable response by the market. However, the information contained in this event has been incorporated into stock prices in a timely manner. There is no evidence of a systematic under-reaction by the market.

The second major aim of this thesis is to examine whether investors can earn positive excess returns by buying companies that announce a stock split. If there is such an opportunity, then this should be reflected in the behaviour of the stock returns and the option implied volatility. Evidence from both the stock and option market indicates that the positive excess returns following the announcement date are not exploitable. The post-event abnormal returns are not present in every split; these returns are mainly concentrated in companies that will split again in the future. In addition, the option investors do not believe that they can make money based on this information. The change in the option implied volatility suggests an increase in the stock volatility following the effective date.

Finally, we aim to investigate the reason(s) why previous research reaches different conclusions regarding the existence of long-run abnormal returns following the split. The findings in chapter 5 allow us to infer that the magnitude and level of significance of the abnormal returns depend on the number of companies that will announce another split in the future. In a strong market, not only are companies more likely to split, they are also more likely to split again. Thus, it is not surprising that the occurrence of positive excess returns is influenced by the state of the market. Taken together with the result from the option study, our overall conclusion is that the market is efficient with respect to stock splits.

6.4 Contribution

The principle contribution that this thesis makes is that it is the first comprehensive assessment of the market reaction to stock splits. Our analysis begins with investigating the short-run price reaction to the split announcement. Given that this event has some important implications that are valued by the market, we then examine the impact of the new information on shareholders' wealth by studying the behaviour of the option market and the long-run abnormal returns. In doing so, the readers can view the story associated with stock splits as a complete picture.

With regard to the long-run performance of splitting companies, we believe that we are the first to explore the source of the positive abnormal returns, rather than simply investigate whether abnormal returns exist in a particular time period. Moreover, we present a new approach in evaluating the profitability of trading following stock split announcements. Specifically, this thesis is the first to examine the behaviour of the option market in conjunction with the traditional tests of long-run abnormal returns. Our results indicate that the option investors do not believe that positive excess returns are exploitable and while these returns may appear to be predictable, they are not predictable following every split. In other words, both of the option and the long-horizon return studies document evidence that is consistent with each other.

Our results raise a potential concern with the design of event study methodologies. Since the traditional tests of long-run abnormal returns can only detect the average price adjustment to new information, when the abnormal returns are concentrated in a small group of firms with unique characteristics, this can lead to incorrect inference about the existence of positive excess returns due to the event itself. Meanwhile, the behaviour of the option market surrounding the announcement date can form the first point of reference in determining the presence of positive excess returns. If researchers reach similar conclusions using the traditional tests of long-run abnormal returns, then this provides investors more confidence in exploiting the information contained in any corporate announcements.

Finally, although the contribution in chapter 3 is not that strong, our findings in chapter 4 and 5 certainly have very important implications for both academics and practitioners. We are able to provide the reason(s) why excess returns exist in some periods and not others. This allows us to reconcile the inconsistency inherent in prior research. In addition, we also discover an important pattern in the return behaviour of splitting firms. That is, positive excess returns are not distributed equally, companies that have not split before tend to outperform companies that have. This is ex-ante information and therefore can be particularly useful to investors. However, we offer a pre-cautionary warning as the success of a strategy that purchases every company that has not split before depends on the state of the market, since excess returns can only be guaranteed with ex-post information.

6.5 Limitations

This thesis comprises a series of empirical chapters addressing the return behaviour of splitting companies following the announcement date. Limitations with respect to each area are noted where relevant within the chapters. Meanwhile, there are some general limitations that are worthy of brief comment.

First, the study exclusively analyses the U.S. equities market. Therefore, any conclusions drawn have direct applicability to the U.S. market only and imply no immediate relevance to that of other financial markets. However, one of the primary motivations of this thesis is to address the conflicting evidence documented in previous research. Since most of the seminal papers on stock splits are associated with the U.S. market, if we examine U.S. stocks, then this enables us to compare our findings with prior literature.

Second, the specific data requirements for each empirical chapter resulted in differing sample periods for each chapter. Specifically, in chapter 3 and 4, our sample period spans from 1998-2007 while in chapter 5, we cover the 1975-2006 period. This is because the first two empirical chapters utilise the OptionMetric Ivy database, which only begins in 1996. We acknowledge that the use of a consistent sample period throughout may have affected the results. Nevertheless, the uniformity of the conclusions across the empirical chapters should alleviate this concern. Specifically, studies of the behaviour of the long-run abnormal returns and the option implied volatility lead to the same conclusion. That is, the market is efficient with respect to stock splits and there is no reliable evidence of predictable excess returns following the announcement date.

6.6 Directions for future research

Event studies have become an important part of capital markets research because they provide crucial evidence on market efficiency. Over the past few decades, researchers have examined the market reaction to many corporate announcements. Some of these studies find that the market under-reacts while others contend that the market systematically over-reacts to new information. We revisit the issue of market efficiency through the lens of a stock split. Although our analysis is mainly related to the information content of the split announcement, there are a number of areas that are natural extensions to this thesis.

Specifically, we can apply our methodologies to other corporate events where the information content is more complex. These events can include earning announcements, mergers and acquisitions or dividend initiation. With the prominence of the post-earnings announcement drift, it would be interesting to examine the reaction of the option market in conjunction with the performance of companies following the event. Unlike stock splits, earnings announcements are non-self selected events. Current earnings may have important implications about future earnings. Therefore, there is much more speculation upon the arrival of this information.

Following Miller's (1977) argument, Boehme, Danielsen and Sorescu (2006) claim that stocks with higher divergence of opinion and short-sale constraints are more likely to be overvalued because pessimistic investors cannot incorporate their opinion into the stock price. Garfinkel and Sokobin (2006) examine the impact of differences of opinion in an event study context and find that firms that experience a greater degree of divergence of opinion around the earnings announcement date are associated with higher post-earnings announcement drift. If the main source of divergence of opinion amongst investors is information asymmetry, where some investors possess an information advantage compared to others (Miller, 2004), then we argue that optionable stocks should have lower differences of opinion than non-optionable stocks. This is because uninformed investors can observe the trading activity in the option market to infer the private information about the underlying stock. Moreover, firms with traded options are assumed to be less short sale constrained because by purchasing a put option, investors can take short positions in the securities without short selling them directly. This suggests that optionability not only reduces information asymmetry, it also allows investors to avoid short-sale restrictions. Based on Miller's (1977) argument, we expect that optionable stocks will adjust to corporate announcements more promptly than non-optionable stocks. In other words, the post-earnings announcement drift should be lower for optionable stocks compared to non-optionable stocks. We outline the procedure for examining the validity of this argument as follows:

First, one could study the reaction of the option market around the earnings announcement date. This forms the basis of evaluating whether part of the information contained in the earnings announcement has been reflected in the option market. If this is true, then optionable stocks should have lower differences of opinion than non-optionable stocks. Previous research has documented a number of proxies for divergence of opinion. These include the coefficient of variance in analyst's annual forecasts estimated from I/B/E/S data, the firm's idiosyncratic volatility and the trading volume divided by the number of shares outstanding. Given that optionable stocks consistently exhibit lower divergence of opinion regardless of which proxies are employed and there is a post-earnings announcement drift as past studies have claimed, we expect the magnitude of the drift to be smaller for optionable compared to non-optionable stocks. On the other hand, if findings from the option market suggest that informed investors do not anticipate that positive excess returns can be earned following the announcement date, then there is a possibility that the market reaction to corporate earnings announcement is similar to stock split announcements. That is, while excess returns are observed in aggregate, these returns are not exploitable because they are conditional on ex-post information.

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