# Do Stock Splits Really Signal?

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## Abstract

Although stock splits seem to be purely cosmetic, there is ample empirical evidence that they are associated with abnormal returns. This study analyzes the effect of stock splits using intraday data and insider trading data in Hong Kong from 1980 to 2000. Consistent with the findings of other countries, we observe positive price reactions in Hong Kong. These positive reactions can be attributable to improved liquidity and favorable signals. Our microstructural analysis shows that stock splits improve corporate liquidity. Regression analysis shows the presence of a possible signaling role for split announcements confounded by increased liquidity. We further use the abnormal insider trading activity to assess the informativeness of the split signal. We find abnormally high insider trading activities three to four months before the split announcement and in the post-announcement period, however, insider trading activities in the two months immediately before the split announcement is immaterial. Our results suggest that firms use stock splits to signal in order to increase liquidity.



*Keywords*: Stock splits, signaling, liquidity, insider trading.

*JEL Classifications*: G12, G15, G32

## 1. Introduction

Theoretically, stock splits should be cosmetic corporate events as they merely involve the break up of one share into a certain number of shares and a reduction of a higher to a lower per-share trading price without changing shareholders' wealth and relative shareholdings. However, previous studies provide mixed empirical results. For the widely explored U.S. market, although early empirical studies find no abnormal performance after stock splits (Fama, Fisher, Jensen and Roll, 1969), most recent studies (to name a few, Grinblatt, Masulis and Titman, 1984; McNichols and Dravid, 1990; Maloney and Mulherin, 1992; Ikenberry, Rankine and Stice, 1996; Ikenberry and Ramnath, 2002; and Byun and Rozeff, 2003) find a positively significant market reaction to stock split announcements. Stock splits do not appear to be as cosmetic as they should be. In the finance literature, the role of stock splits remains an enigma. On the other hand, there are relatively less stock split studies for other countries: the examples include Kryzanowski and Zhang (1993) for the Canadian market, and Kunz and Majhensek (2004) for the Swiss market. The finance literature has proposed several hypotheses to explain the stock split phenomenon, the most popular being the signaling hypothesis, the optimal trading range hypothesis, and the liquidity hypothesis. However, previous studies provide mixed empirical evidence for different markets and different sample periods.

As a determination of the robustness of these findings to other markets is of considerable interest, using a long and recent sample period from 1980 to 2000, this paper studies the effect of stock splits in Hong Kong with an attempt to differentiate the hypothesis that best explains the stock split phenomenon. Specifically, our analyses explore stock splits in three respects: share price performance, corporate liquidity, and insider trading activity. Firstly, we assess the abnormal market reactions of the splitting firms. We use both the market model and the control firm approach to measure the abnormal returns. Secondly, we compare the liquidity proxies in

terms of bid-ask spread, depth and trading volume in the pre-split and post-split periods. Our third analysis involves using a prior-period comparison method to examine the insider trading activity around the stock split announcement. Finally, we conduct a regression analysis to find the hypothesis that best explains stock splits after controlling for insider trading and other factors.

This paper contributes to the existing literature in several ways. It extends the international empirical evidence on stock splits to another important stock market, the Hong Kong stock market[1]. It also provides additional insight into the relative explanatory power of the existing hypotheses. The analysis contributes further to the liquidity hypothesis using microstructural data and the signaling hypothesis using insider trading data. Stock liquidity has two inseparable dimensions: the price dimension and the size dimension. Previous studies focus on the price dimension of liquidity and only give a partial view of liquidity. The microstructural data in Hong Kong provides us with an opportunity to estimate both dimensions of liquidity. We use the absolute and relative spreads as our measures of the price dimension, and volume depth, dollar depth, ask depth, and bid depth as our measures of size dimension. Using insider trading to study whether a stock split conveys a signal is appealing because we can bypass a specification of performance benchmark.

We find significant and positive share price performance associated with split announcements, which indicates that the splitting firms use stock splits to signal favorable information to the market. The insider trading activity analysis reports that there are both abnormal buying and selling activities before stock splits. Our microstructural analysis shows that, in general, stock splits improve corporate liquidity. The post-split depth measures and

[1] As of September 30, 2004, in terms of market capitalization, the Hong Kong Stock Exchange was among the ten largest stock exchanges in the world, and was the second largest in Asia (World Federation of Exchanges: http://www.fibv.com/publications).

trading volume (spread measures) are significantly higher (lower) than those in the pre-split period. The enhancement of post-split corporate liquidity provides support to the liquidity hypothesis. Finally, our regression analysis presents evidence for the signaling, optimal trading range and liquidity hypotheses. As argued by Amihud and Mendelson (1988), the greater the liquidity of an asset, the greater its value, firms may engage in liquidity-increasing policies to mitigate the cost and risk of illiquidity. Therefore, firms use stock splits to signal in order to increase liquidity. Our overall results suggest that stock splits matter. This seemingly non-economic event serves multiple functions of signaling, realigning trading price and improving liquidity. There is no single unique motivation for stock splits. Stock split performs a signaling function of the firms' liquidity-improvement policy.

This study is structured as follows. Section 2 presents the literature review and theoretical proposition. The data and methodology are described in Section 3. Section 4 reports the results, and Section 5 concludes the study.

## 2. Literature Review and Theoretical Proposition

Since the publication of the classic paper of Fama, Fisher, Jensen and Roll (1969) that investigate the share price performance of splitting firms, many hypotheses have emerged and empirical studies have been conducted to explain the puzzling market reaction to stock splits. The more prominent hypotheses are the signaling hypothesis, the optimal trading range hypothesis, the liquidity hypothesis, the tax option hypothesis, and the managerial entrenchment hypothesis.

The signaling hypothesis argues that stock splits convey information about the current performance and future prospects of the splitting firms (Grinblatt, Masulis and Titman, 1984). To be a valid and credible signal, the signal has to be costly. Stock splits are costly signals

because the fixed component of the brokerage commission increases the post-split per-share trading cost (such as odd-lot trading costs and administrative cost) of the lower priced shares (Brennan and Copeland, 1988; Brennan and Hughes, 1991). The presence of positive abnormal returns around the stock split announcement that is found in many empirical studies (e.g., Ikenberry, Rankine and Stice, 1996; Mukherji, Kim and Walker, 1997; Ikenberry and Ramnath, 2002) provides evidence for the signaling hypothesis.

According to the optimal trading range hypothesis, stock splits are used as tools to realign the share price to a desired price range so that it is more affordable for small investors to buy round lots of shares. If the pre-split share price is at a high level, then a stock split is justified for improving the marketability of the shares (Baker and Gallagher, 1980; Lakonishok and Lev, 1987; McNichols and Dravid, 1990). The reduction in trading price through stock splits enables the post-split shares to become more attractive to previously wealth constrained investors. In addition, Angel (1997) argues that stock splits can be used to move the share price into the price range where the institutionally mandated minimum absolute tick size is optimal relative to share price.

Related to the optimal trading range hypothesis is the liquidity hypothesis. The liquidity hypothesis is based on the argument that corporate liquidity is affected by the per-share trading price (Maloney and Mulherin, 1992; Muscarella and Vetsuypens, 1996). If the trading price is too high, then the liquidity may decline. A low per-share trading price attracts more individual investors and reduces trading costs. However, the evidence for the liquidity hypothesis is mixed. Conroy, Harris and Benet (1990) show an increase in bid-ask spreads after stock split announcements. Ferris, Hwang and Sarin (1995) present results of a reduction in depth. Ohlson and Penman (1985) and Koski (1995) report an increase in return volatility. These results indicate that corporate liquidity decreases rather than increases after the split. In contrast,

Maloney and Mulherin (1992) and Desai, Nimalendran and Venkataraman (1998) observe an increase in trading volume during the post-split period, and hence provide support for the liquidity hypothesis of stock splits.

The tax-option hypothesis, proposed by Lamoureux and Poon (1987), suggests that stock splits increase the return volatility of the splitting firms and hence allow the investors to benefit from tax-timing options[2]. The managerial entrenchment hypothesis, put forward by Demsetz and Lehn (1985), Morck, Shleifer and Vishny (1988), McConnell and Servaes (1990), and Kole (1995), among others, argues that high shareholdings "entrench" non-wealth maximizing behavior in management. Lakonishok and Lev (1987) apply the managerial entrenchment hypothesis to explain stock splits. Managers make use of stock splits to enlarge the ownership base so that the percentage of shares held by large institutional investors is reduced. In this way, management makes it more difficult for any one group of shareholders to initiate action against them. Mukherji, Kim and Walker (1997) find that the number of shareholders increases after a stock split.

In this study, we focus on the impact of stock splits in several aspects. According to the signaling hypothesis, there should be positive abnormal returns for splitting firms in our study. By the optimal trading range hypothesis, if the stock split is a device that brings the stock price to an acceptable level to attract more investors, particularly wealth constrained investors, then we predict that the stock split announcements should receive favorable market reactions. We use the event study methodology to measure the abnormal share price reaction of the splitting firms around the stock split announcement. In addition, we examine the insider trading activity of the directors before the stock split. If the stock split conveys an informative and favorable signal to

[2] Preferential treatment is given to long-term capital gains according to the U.S. tax code. Short-term capital losses can be used to offset short-term gains. A security with a price that fluctuates wildly presents its holder with the

the market, the directors may make use of their private information advantage to trade before the news is publicly released. We expect significant insider purchases rather than insider sales before the stock split. By the liquidity hypothesis, we expect that there should be significant changes in the liquidity patterns (narrower spreads and wider depth) in the post-split period.[3]

## 3. Data and Methodology

### *3.1. Data*

The stock split data are obtained from the Capital Distribution file of the PACAP database. The PACAP database includes two types of companies, finance companies, and industrial companies. Our analysis includes only the industrial companies[4]. The PACAP Capital Distribution file maintains records of the announcement date, ex-distribution date and adjustment factor of the stock split. The share price return data and accounting data are retrieved from the Company Returns file and Financial Statement File of the PACAP database respectively.

We collect the insider trading information from the Inside Trade Asia database maintained by Primark [5] and the Securities (Disclosure of Interest) Daily Summary and Directors'/Chief Executives' Notification Report[6]. The insider trading records include all types

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opportunity to realize losses short term or gains long term to re-establish short-term status. However, investors do not need to pay any tax on capital gains in Hong Kong.

[3]Some empirical studies in the finance literature investigate the signaling role of stock splits and stock dividend jointly (e.g., Grinblatt, Masulis and Titman, 1984; Banker, Das and Datar, 1993). These two events are similar as they relate to the firm's stock distribution policy by increasing the number of outstanding shares of the stock dividend-paying and splitting firms without changing the proportional ownership of shares held by the existing stockholders, the cash flow, the assets and the liabilities of the firms. However, the market responses to there two events may be quite different (Lakonishok and Lev, 1987; Rankine and Stice, 1997). In this paper, we concentrate on the stock splits and insider trading, and we also investigate the possible different market reactions to the stock dividend and splits announcement in a separate paper.

[4] Finance companies are usually the more regulated firms. In addition, as the types of accounting variables in measuring the performance for finance and industrial companies are substantially different, including the finance companies in our sample may create problems in our control firm selection for event study.

[5] The Inside Trade Asia database maintained by Primark is an electronic version of the trading transactions of companies directors reported in the Securities (Disclosure of Interest) Daily Summary and Directors'/Chief Executives' Notification Report.

[6] By the Laws of Hong Kong (Chapter 396 (Disclosure of Interest Ordinance)) and the Listing Rules of the Hong Kong Exchange, the directors of listed firms are required to disclose their securities transactions in the market within

of securities transactions that change the shareholding percentage of the directors. Our analysis of the insider trading activity around the stock split announcements examines only those inside transactions that increase or decrease the shareholdings of directors through open market purchase and sale of shares. Other types of inside transactions such as options and warrants trading, bonus shares, scrip dividend and gifts are excluded from our sample (Lin and Howe 1990). Our bid-ask records are from the database maintained by the Research and Planning Division of the Hong Kong Exchange. The database provides intra-day trading information such as the ask price, bid price, trading price, trading volume, and trading value of all securities that are traded on the Hong Kong Exchange recorded at 30-second intervals. The types of securities in the bid-ask data file are ordinary shares, preference shares, warrants, debt securities, and unit trusts. However, in this study, we measure the changes in the liquidity patterns around the stock split announcement for ordinary shares only.

Our sample period covers 21 years from 1980 to 2000 and contains 162 stock split events.[7] Of the 162 events, 9 are without valid announcement dates. In addition, 10 stock split announcements are made by finance companies. We use the control firm approach to measure the abnormal share price reaction of the firms making the split announcements. The selection criteria using the control firm approach for event study further removes 23 events from our sample. Therefore, our final sample consists of a total of 120 cases for event study analysis[8]. Table 1 reports the summary statistics of our sample. Of these 120 events, there are 3 from the

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five business days from the day they conduct transactions on the Hong Kong Exchange. The Hong Kong Exchange publishes the trading information of the directors in the Securities (Disclosure of Interest) Daily Summary and Directors'/Chief Executives' Notification Report. The information reported includes the name of the director, the name of the securities traded, the class of the securities, the transaction date, the disclosure date, the number of shares and the price at which the shares were traded.

[7] Following Grinblatt, Masulis and Titman (1984), our sample consists of pure splits. We select the split announcements that are not contaminated by other announcements over the period around the split announcement date (one month prior and one month after).

[8] To show that our results for stock splits are not affected by reverse splits, we perform a check on stock consolidation events and find that our sample firms do not conduct stock consolidation during our examination period.

utilities sector, 35 from the properties sector, 43 from the consolidated enterprises sector, 31 from the industrial sector, 5 from the hotels sector, and 3 from the miscellaneous sector. Our analyses of the insider trading activity and the changes of liquidity patterns around the split announcements cover the sample period from 1993 to 2000 and from 1996 to 2000 respectively due to the availability of the insider trading and microstructure data.

The average split factor (the average of the number of new shares exchanged for one old share of the splitting firms in the sample) and the market capitalization of the splitting firms are 6.9560 and HK$ 4,457,789,000 respectively. Comparing the average number of shares outstanding between the splitting firms and the corresponding industry mean, the number of shares outstanding of the industries is two times those of the splitting firms. While the average number of shares outstanding is higher for the industries, the average share price is higher for the splitting firms, which is 4.8 times those of the industries. The higher average pre-split share price of the splitting firms than the industry average suggests that the splitting firms may have been motivated to use stock splits to realign their share prices to their preferred trading range and lower their share prices to enhance attractiveness (Lakonishok and Lev, 1987).

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### *3.2. Methodology*

#### *3.2.1. Abnormal Share Price Reaction*

We use the event study methodology to evaluate the abnormal share price reaction of the corporate announcements of stock splits. The event date, $t = 0$, is the announcement date recorded in the Capital Distribution file of the PACAP database. We use the market model[9] to

[9] When using event study methodology to measure the abnormal share price reaction of an event, the clustering of corporate events is a common problem. The clustering problems of corporate events may create bias in abnormal return measurement. For robustness purposes, we also compute the abnormal return using the control firm approach

estimate abnormal share price reactions to the announcement of stock splits. For the market model, we use returns on the Hong Kong Hang Seng Index as the proxy of the market returns. The abnormal return on day $t$, $AR_{itm}$, is defined as the difference between the realized returns of sample firm $i$ and of the market index.

The test statistic for the significance of the abnormal return is computed by the standard deviation measured in the estimation period over 200 days from $t$ = -300 to $t$ = -101 (Brown and Warner, 1985). Our test period is from $t$ = -60 to $t$ = +360. According to the signaling hypothesis, the trading range hypothesis, and the liquidity hypothesis, stock splits are expected to signal favorable information about the value of the splitting firms to the market, bring the share prices of the splitting firms down to a desired price range, increase the trading volume, enhance liquidity, and improve marketability. Therefore, we would expect to have a positive market reaction to the splitting firms around the stock split announcements.

*3.2.2. Abnormal Insider Trading Activity*

Many studies document that insiders are in possession of private information about the current and future performance of firms (e.g., Seyhun, 1986; Lin and Howe, 1990). Insider trading activities have been found around different types of corporate events such as earnings releases (e.g., Udpa, 1996), seasoned equity offerings (Gombola, Lee and Liu, 1997), mergers and acquisitions (e.g., Meulbroek, 1992), corporate bankruptcy petitions (e.g., Seyhun and Bradley, 1997), listing and delisting (e.g., Lamba and Khan, 1999), and analysts' earnings

(Barber and Lyon, 1997). The control firm approach involves a matching process to choose a control firm that possesses similar characteristics in terms of market value and book-to-market ratio with a sample firm (Fama and French, 1992). All firms are categorized into five groups (from 1 to 5) according to the magnitude of the monthly market values and book-to-market ratios and a sample firm is matched to a control firm if the control firm is in the same quintile as the sample firm in terms of market value and book-to-market ratio. In addition, as we measure the insider trading activity around the split announcements, the control firm selected should have neither made the examined announcement nor conducted inside transactions around the announcement period of the sample firm

forecast revisions (e.g., Sivakumar and Vijayakumar, 2001). These studies report that there is a "regular" trading pattern for insiders, who buy before good news and sell before bad news. In this study, we examine the abnormal insider trading activity around the impending split announcement to obtain insights into the authenticity of the split signal from the perspective of the insiders of the splitting firms.

Our abnormal insider trading activity analysis examines whether the directors use their inside information about the upcoming announcements of share splits to trade in the market for their own accounts. Therefore, we assess whether the insider trading activity before the split announcements (six-month period) is abnormally different from that of the other period. Based on the methodology of Gombola, Lee and Liu (1997), we use the prior-period comparison method to measure the abnormal insider trading activity before the announcement. The time-length of the estimation period for comparison is a 6-month period between $m = -12$ and $m = -7$ before the announcement month of share split ($m = 0$).

The average of the trading measure (the proportion of number of shares traded to number of outstanding shares, the market value, or the number of transactions) over the estimation period ($-12 \leq m \leq -7$) is the expected trading level. The abnormal insider trading activity is estimated as the difference between the actual trading level in the examination period ($-6 \leq m \leq +6$) and the expected trading level computed over the estimation period. We also measure the standard deviation in the estimation period ($-12 \leq m \leq -7$) and use it to test the significance of the abnormal trading activity in the examination period ($-6 \leq m \leq +6$) (Brown and Warner, 1985).

If the stock split is simply cosmetic, then there should be no significant insider trading activity around the split announcement. If the stock split is not as cosmetic as it appears to be, then there should be significant insider trading activity, particularly insider buying activity.

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(twelve months before and twelve months after). Using the control firm approach, we estimate the abnormal return

*3.2.3. Liquidity Pattern (Spread and Depth)*

We examine the changes of the two dimensions, spread and depth, of the liquidity pattern around the stock split announcements. The spread measures the price aspect while the depth measures the size aspect of liquidity. The spread quantifies the cost of trading. A wider spread level means a higher cost of trading and hence lower liquidity. Depth reveals the effects of the volume and dollar amounts of trading. Greater depth reflects larger trading volume and dollar value, and hence higher liquidity. These two dimensions exhibit a negative relation (Lee, Mucklow and Ready, 1993; Brockman and Chung, 1999): that is, a large (small) spread with a narrow (wide) depth. We use two spread measures and four depth measures to assess the changes in liquidity.

Absolute Spread and Relative Spread are our two spread measures. Absolute Spread is the daily average of the absolute dollar difference of bid and ask recorded at 30-second intervals on day *t*. Relative Spread is the daily average of the dollar difference of bid and ask divided by the bid-ask midpoint recorded at 30-second intervals on day *t*. The depth is estimated by Volume Depth, Dollar Depth, Ask Depth, and Bid Depth. Volume Depth is the sum of the number of shares at the highest bid and the number of shares at the lowest ask recorded (adjusted by the number of outstanding shares) relative to the number of shares outstanding. Dollar Depth is the sum of the product of the number of shares at the highest bid and the highest bid price and the product of the number of shares at the lowest ask and the lowest ask price recorded (adjusted by the product of price and number of outstanding shares) at 30-second intervals on day *t* relative to the market value. Ask (Bid) Depth is the product of the lowest ask (highest bid) price (adjusted by the number of outstanding shares) and the number of shares at the lowest ask

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on day *t*, $AR_{itc}$, as the difference between the realized returns of sample firm *i* and of matched control firm *j*.

(highest bid) price recorded at 30-second intervals on day *t* relative to the market value respectively.

One of the explanations for positive market reactions to stock splits is the expected increased liquidity of the shares of the splitting firms after the splits (Maloney and Mulherin, 1992; Muscarella and Vetsuypens, 1996). This argument is based on the notion that corporate liquidity may decline if the trading price of the shares is too high. To examine the changes in corporate liquidity due to stock splits, we compare the liquidity patterns in terms of spread and depth in the pre-split period and the post-split period. We expect to have a smaller post-split spread and a larger post-split depth.

*3.2.4. Regression Analysis*

Table 2 reports that there are significant market reactions for splitting firms around the split announcements. Numerous hypotheses (the signaling hypothesis, the optimal trading range hypothesis, the liquidity hypothesis, the tax option hypothesis, and the managerial entrenchment hypothesis) and empirical studies (Grinblatt, Masulis and Titman 1984; Lakonishok and Lev 1987; Lamoureux and Poon 1987; McNichols and Dravid 1990; Ikenberry and Ramnath 2002; and many others) have attempted to explain positive abnormal announcement returns. Similar to those studies, we construct a cross-sectional model to explain the level of abnormal returns of the splitting firms. The model is defined as:

$$CAR = \alpha_0 + \beta_1 FACTOR + \beta_2 MktValue + \beta_3 VolRatio + \beta_4 EPSChg + \beta_5 Multiple + \beta_6 RetVar + \beta_7 PriceDev + \beta_8 ShareDev + \varepsilon \quad (1)$$

*CAR* is the cumulative abnormal return over the different periods examined[10]. *FACTOR* is the natural logarithm of the size of the split factor. *MktValue* is the natural logarithm of the market

[10] The CARs of the following periods are estimated ($-60 \le t \le -1$, $-30 \le t \le -1$, $-10 \le t \le -1$, and $-10 \le t \le +10$).

value (the product of price and number of shares outstanding) of the firm for the month before the split announcement. *VolRatio* is the ratio of pre-split trading volume to post-split trading volume normalized by the number of shares outstanding[11]. *EPSChg* is the percentage change in earnings per share of the current year to those of the previous three years. Multiple is a dummy variable that takes the value of 1 if there is more than one split announcement over the sample period from 1980 to 2000. *RetVar* is the standard deviation of return. *PriceDev* is the deviation of share price to the industry median price. *ShareDev* is the deviation of shares outstanding to the industry median of shares outstanding.

## 4. Empirical Results

### *4.1. Abnormal Share Price Reaction*

The signaling hypothesis argues that one of the motivations for firms to split their shares is that they are optimistic about the future potential increase of their share price. Therefore, although stock splits appear to be cosmetic, their announcement should lead to positive share price performance. Table 2 reports the market reaction of the splitting firms over different time periods from $t$ = -60 to $t$ = +360 and Figure 1 portrays the cumulative abnormal return path. The abnormal returns are mostly positive from a pre-announcement period of 60 days to a post-announcement period of 120 days. We find positive abnormal returns, significant at the 0.01 level, for the three days around the announcement day. The 3-day cumulative abnormal return ($-1 \leq t \leq +1$) is 5.19% using the market model[12]. The result of positive abnormal returns in this study is consistent with previous studies for the U.S. market, and suggests that stock splits signal favorable information to the market. Comparing the abnormal returns around the announcement

[11] The number of outstanding shares before the split announcement is different from that after the announcement. To better compare the changes in the trading activity before and after the announcement, we need to standardize the trading volume by the number of outstanding shares.

day and the pre-split period ($-60 \leq t \leq -1$), the magnitude of the abnormal returns is as high as 42%. The high pre-split abnormal returns may be due to the leakage of insider information about the impending split announcement.

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Asquith, Healy and Palepu (1989) suggest that the information conveyed by stock split is not short-lived, and may persist for years following a split. Ikenberry, Rankine and Stice (1996) and Desai and Jain (1997) provide evidence that stock splits result in long-term excess returns. We also examine the long-term share price performance of the splitting firms and find that, on one hand, the long-term abnormal returns over the post-split period of $+10 \leq t \leq +240$ and $+10 \leq t \leq +360$, although not significant, are negative; on the other hand, the cumulative abnormal return from 60 days before to 360 days after the split announcement as portrayed in Figure 1 maintains at a very high level of around 40% persistently for up to 360 days. Our results provide evidence that stock split affects share price performance of the splitting firms over a long run from pre-split to post-split period.

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*4.2. Abnormal Insider Trading Activity*

The fundamental argument of the signaling hypothesis is that the splitting firms use stock splits to signal favorable information to the market. We use the abnormal insider trading activity to assess the informativeness of the split signal. Intuitively, as the insiders are aware of the

[12] Although not reported here, we also find significantly positive abnormal returns using the control firm approach. For example, the 3-day cumulative abnormal returns ($-1 \leq t \leq +1$) is 3.85% ($t$-statistic = 2.89) using the control firm approach, which is also significant at 0.01 level.

impending corporate news of stock splits and expect positive market reactions to the news, they should buy the shares of the splitting firms before the stock split announcements. Therefore, we expect to have significant buying activity from the insiders of the splitting firms. Table 3 reports our results for abnormal insider trading analysis[13]. Three variables, "Buy", "Sell", and "Net (difference between purchases and sales[14])" are used to assess the intensity of the trading activity in different trading directions.

In the pre-split period of $-6 \leq m \leq -1$, we find significant buying and selling activities between $m = -6$ and $m = -3$. However, comparing the trading activities between $-6 \leq m \leq -3$ and $-2 \leq m \leq -1$, the trading activity in $-2 \leq m \leq -1$ is trivial. The immaterial trading activities in the two months immediately before the split announcement month may be due to the potential threat of investigation for trading with private and price-sensitive information. Therefore the insiders may choose to cash in their private information in advance. Indeed, we observe that there are significant net purchase of shares in $m = -4$ and consequently significant net sale of shares by insiders in $m = -3$.)

For the cumulative abnormal trading activity ($-6 \leq m \leq -1$), the abnormal market values of purchase and sale are 54.622 and 36.222 respectively, which are both significant at the 0.01 level. The 54.622 (36.222) abnormal market value of purchase (sale) suggests that the directors have bought (sold) firms' shares with a value \$54.622 million (\$36.222 million) in the examination period for the six months ($-6 \leq m \leq -1$) higher than in the estimation period for the six months ($-12 \leq m \leq -7$) before the split announcement. The net (difference between purchase and sale) cumulative abnormal market value is 2.455, which is insignificant. There are several possible explanations for the inconsistent trading patterns and lack of significant buying activity. The

[13] Table 3 shows the result using the market value as the measure of insider trading activity. To demonstrate robustness, we also conduct the analysis using the proportion of number of shares traded to number of outstanding

insiders may have had no private information about the stock splits or may have had genuine information about cosmetic stock splits with non-signaling functions. In addition, they may have intentionally sold their shares (i.e., a contrarian strategy) to justify their securities trading before corporate announcement to avoid potential accusations of illegal trading with private information. Therefore, we cannot find significant purchases of shares before split announcement. There are also abnormal trading activities in the post-announcement period, particularly in $+3 \leq m \leq +6$. Both the buying and selling activities are significant. The increase in trading activity following the split announcements can be explained by the fact that the post-announcement period is a more appropriate time for insiders to conduct securities trading.

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*4.3. Liquidity Pattern (Spread and Depth)*

The liquidity hypothesis argues that stock splits can lead to improved liquidity. Following previous studies, we compare the changes in the corporate liquidity in both the price and size dimensions around the split announcement. To avoid the potential effect of the temporary increase in trading just before and following the split due to the split announcement itself, we exclude 20 days before and 20 days after the split announcement from our examination of the changes in liquidity pattern[15]. The pre-split period and post-split period are defined as 20 trading days before and following the exclusion period from the split announcement. Both the parametric two-sample *t*-test and the non-parametric Mann-Whitney test for sample differences

shares and the number of transactions. The results are qualitatively similar to those that are reported in Table 3.
[14] A positive value for "Net" means that there is a higher value for the purchase than for the sale measure.
[15] Such an exclusion of a certain period following the split announcement from the analysis is similar to excluding the period between the split announcement day and the ex-split date from the analysis. Conroy, Harris and Benet (1990), Ferris, Hwang and Sarin (1995) and Desai, Nimalendran and Venkataraman (1998), in the microstructural examination of stock splits, also exclude the period around the announcement day and the ex-split date from their

are conducted. Table 4 reports the test results[16]. Improved liquidity is evidenced by a lower post-split spread and a greater post-split depth.

We find that the two measures of spread, Absolute Spread (0.089 vs. 0.024) and Relative Spread (0.023 vs. 0.021), decrease from the pre-split period to the post-split period. The decrease in absolute spread is significant at the 0.01 level in both the parametric and non-parametric tests for sample differences. Although the fall in Relative Spread is not as pronounced as that in Absolute Spread, the mean difference of the pre-split and post-split spread levels is also significant at the 0.01 level using the parametric test. A narrower post-split spread suggests that there is an increase in liquidity following stock splits.

For the four measures of depth, Volume Depth (0.194 vs. 0.303), Dollar Depth (0.240 vs. 0.475), Ask Depth (0.110 vs. 0.258), and Bid Depth (0.130 vs. 0.217), the increase in depth level from the pre-split period to the post-split period indicates an improvement in corporate liquidity. In particular, the post-split increase in depth is statistically significant for the Volume Depth, Dollar Depth, and Ask Depth.

Besides using the spread and depth to examine the changes in the liquidity pattern, to measure whether stock splits enhance or reduce trading activity, we compare the trading volume and market value in the pre-split and post-split periods. Maloney and Mulherin (1992) and Desai, Nimalendran and Venkataraman (1998) report a post-split increase in trading volume and conclude that it is evidence of increased liquidity. In Table 4, we observe that both the average number of shares traded (0.011 vs. 0.034) and the market value of shares traded (0.011 vs. 0.034) increase substantially. The increase is statistically significant at the 0.01 level using the

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analyses to avoid information contamination around the announcement day, transient microstructure effects around the ex-split date, and distortions due to dual trading in both pre-split and when-issued shares.

[16] We show the results using the examination period of 20 days before and 20 days after the exclusion period from the split announcement. To demonstrate robustness, we repeat the comparison analysis using various examination windows of ±10 days, ±15 days, ±20 days, ±25 days, ±35 days and ±40 days. The results of a narrower spread and a greater depth in the post-split period are not affected by the length of the examination window.

parametric test. These findings suggest that by reducing the share price to a lower trading range, the shares become more marketable and hence the trading activity is enhanced.

As the splitting firms use stock splits to reduce their share price to a preferred level, there is a significant difference in the average pre-split and average post-split share prices. The pre-split price is 3 times the post-split price (6.583 vs. 2.181). While the share price decreases substantially in the post-split period, the return volatility increases significantly as a result of the split (0.007 vs. 0.012). This finding is similar to those of Ohlson and Penman (1985), Koski (1998) and Gray, Smith and Whaley (2003). As a lower price may improve the attractiveness of the shares, increased return volatility adversely affects marketability. There are two possible explanations for the higher return volatility. Ohlson and Penman (1985) and Dravid (1987) argue that the enlarged return volatility is the result of a wider spread following the split. Karpoff (1987) explains that the increased return volatility may be due to the positive relation between volatility and trading volume following the split. Jones, Kaul and Lipson (1994) further argue that enhanced trading activity brings in information to the market and hence affects share prices and return volatility. As we observe only greater trading volume and not wider spreads following splits, our result of enlarged return volatility should be mainly due to increased trading activity.

Our sample comparison results show that narrower spread, wider depth and higher trading volume follow the split announcement. Consistent with the liquidity hypothesis, our findings provide evidence that stock splits improve the liquidity of shares.

**********
TABLE 4 HERE
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*4.4. Regression Analysis*

Table 5 reports the results of the regression model (1).[17] The descriptive statistics and regression results of the variables are shown in Panel A and Panel B, respectively. The *p*-values for the coefficients are adjusted for heteroskedasticity using White's procedure (1980).

The size of the split factor is a signal to the market about the desired trading range in equilibrium and the extent of firms' private information about future earnings (Brennan and Copeland, 1988; McNichols and Dravid, 1990; Brennan and Hughes, 1991). According to the optimal trading range hypothesis, stock splits are used to bring the share price down to the desired trading range. The share price of a split event with a large split factor indicates that the current share price is far outside the favorable trading price range. McNichols and Dravid (1990) provide strong evidence for the optimal trading range hypothesis and report a positive relation between the announcement abnormal return and the split factor. As the size of the split factor signals information to the market, we include *FACTOR*, which is a measure of the size of the split factor, in our regression model to control for the effect of the split size. A larger split factor results in a greater reduction in the ex-split share price and hence a smaller amount for round lot investment requirements. From both the signaling hypothesis and the optimal trading range hypothesis, we expect the abnormal market reaction to the splitting firm with a larger split factor to be more positively significant. In Table 5, *FACTOR* is positively and statistically significant related to the announcement returns at the $-10 \leq t \leq +10$ period. The market responds more favorably to the move of the splitting firms to a lower range of share prices from their current prices. This result provides evidence that the split factor choice is a signal to the market about firms' value.

[17] The data of insider trading activity is available from 1993 to 2000, while the intraday data is available from 1996 to 2000. If we include both variables in the regression analysis, then the sample size would be significantly reduced. Therefore, we use earnings change (*EPSChg*) as the measure of signaling and trading volume (*VolRatio*) as the measure of liquidity.

Since small firms have less effective ways to attract investors' attention and to signal to the general public, stock split announcement by small firms serves a stronger signaling function. If a stock split serves a signaling function, then the split informative signal that is conveyed by a small firm should be stronger than that of a large firm. Therefore, the split announcement abnormal return should be higher for small firms than for large firms. Ikenberry, Rankine and Stice (1996) find that the abnormal returns are higher for small splitting firms than for large splitting firms. We use *MktValue*, which denotes firm size, as a proxy for information asymmetry and expect a negative relation between abnormal return and *MktValue*. As shown in Table 5, the result for *MktValue* is mixed. *MktValue* is negatively related to abnormal returns in the short-run and positively related to them in the long-run. The negative relation between *MktValue* and abnormal return around the split announcement in the short term suggests that stock splits are a better device for smaller firms than for larger firms in signaling information[18].

In the finance literature, trading volume can be used as a proxy of liquidity. Therefore, we include trading volume in the regression model to examine the liquidity hypothesis. *VolRatio* is our liquidity measure. A small value of *VolRatio* means that there is a great difference in the trading volume between the pre-split and post-split periods. If the stock split is motivated by liquidity reasons to lower the share price to enhance trading activity, then we expect an inverse relation between abnormal return and *VolRatio*. Muscarella and Vetsuypens (1996) find an increase in trading activity after the stock split, which is evidence of improved liquidity. In Table 5, the coefficients on *VolRatio* are negative around the pre-split and announcement periods. In particular, *VolRatio* is negatively significant in the pre-split periods of $-60 \leq t \leq -1$ and $-30 \leq t$

[18] To show that our sample is not biased in terms of firm size, we perform a check on the size of the firms in our sample. The firms in our sample are divided into five groups. The number of firms and average price in the first quintile are 12 (10%) and 3.94, in the second quintile are 26 (21.67%) and 6.54, in the third quintile are 21 (17.50%) and 8.85, in the fourth quintile are 29 (24.17%) and 10.91, and in the fifth quintile are 32 (26.67%) and 24.92. These statistics suggest that our sample does not suffer from serious firm size bias.

≤ -1, which suggests that the positive pre-split abnormal returns are due partly to the enhanced liquidity following the split as compared to the pre-split period.

As it is argued that stock splits have signaling effects that shares are undervalued, Asquith, Healy and Palepu (1989) provide evidence that splitting firms usually have better earnings performance before the split, and that split announcement return is related to prior earnings growth. Therefore, we include a variable, *EPSChg*, which represents the pre-split earnings performance of the splitting firms, in our regression model. We expect *EPSChg* to be positively related to abnormal returns. We observe that the coefficients on *EPSChg* are mostly positive and significant in the periods of $-60 \leq t \leq -1$ and $-30 \leq t \leq -1$ in Table 5. The result of positive coefficients is consistent with that of Asquith, Healy and Palepu in that split return is correlated with prior earnings performance.

Through the 20 years of our sample period, we observe that some firms conduct more than one split (9.87%). Pilotte and Manuel (1996) study the effects of recurring split events and find that the market reaction is more favorable if the current stock split is preceded by a previous split. If the split is a signaling device, too frequent announcement may be indicative of non-signaling motivation. According to the efficient market hypothesis, the share price reaction should be less pronounced for the repeated split announcement with no signaling motivation. The optimal trading range hypothesis argues that repeated splits imply the superior performance of the splitting firms in using splits to periodically lower their share prices. To assess the merits of these arguments and the difference in the abnormal return due to repeated splits, we include Multiple to examine the effect of split frequency. None of the coefficients on Multiple are significant. This finding suggests that repeated split announcements provide no additional signals to the market.

Many studies document increases in return volatility following stock splits (Ohlson and Penman, 1985; Lamoureux and Poon, 1987; Dubofsky 1991; Koski 1998; Gray, Smith and Whaley, 2003). As shown in Table 5, we find a positive relation between return volatility and abnormal return in the short-term and a negative relation between them in the long-term. The positive relation is particularly significant in the pre-split period and around the announcement day. As mentioned earlier, higher return volatility may be due to wider post-split spread (Ohlson and Penman, 1985; Dravid, 1987) and greater post-split trading volume (Karpoff, 1987; Jones, Kaul and Lipson, 1994). Because we observe narrower (increased) rather than wider (decreased) post-split spread (trading activity) in Table 4, the higher return volatility is the result of enhanced trading volume. Therefore, we explain our positively significant relation between return volatility and split announcement return as the higher liquidity of the splitting firms' shares. This finding provides evidence for the liquidity hypothesis.

By the optimal trading range hypothesis, there exists a favorable share price range to improve share marketability. Lakonishok and Lev (1987) suggest that the split factor is driven by the deviation between the share price of the splitting firm and the market- or industry-wide average price. Stock splitting is used as a device to bring the share price down to the preferred share price range the firms consider to be appropriate, a price range which is normally shaped by the median or average price level of the industry or the market. We use two variables, *PriceDev* and *ShareDev*, to examine the optimal stock price hypothesis. *PriceDev* is the natural logarithm of the deviation of share price to industry median price. *ShareDev* is the natural logarithm of the deviation of shares outstanding to industry median of shares outstanding. *PriceDev* and *ShareDev* are expected to be positively related to abnormal returns. The larger the deviation from the median values, the higher the abnormal returns should be. In Table 5, we find that both *PriceDev* and *ShareDev* are positively significant in the pre-split period. This result suggests

that the market reacts more positively to the moves of splitting firms whose share prices (numbers of outstanding shares) are higher than the industry median price (number of outstanding shares). This result indicates that one of the motivations for stock splits is to return the price to a level that is consistent with those of other firms in the industry and with market averages.

Louis and Robinson (2005) argue that the incentive to signal private information is determined by the information environment of the firm and the ability of the insiders to use other means of communication. Since insiders have stronger incentive to signal to reduce information asymmetry by communicating favorable private information and we also find significant insider trading activities around the split announcement, especially three and four months before the split announcement, to further examine if the split announcement provides a signaling function to the market after controlling for insider trading, we repeat the regression analysis by including *InsiderD*, which is a communication means of the insiders to the market, and *InsiderD*MktValue*, in the following regression model:

$$CAR = \alpha_0 + \beta_1 FACTOR + \beta_2 MktValue + \beta_3 VolRatio + \beta_4 EPSChg + \beta_5 Multiple +$$

$$\beta_6 RetVar + \beta_7 PriceDev + \beta_8 ShareDev + \beta_9 InsiderD + \beta_{10} InsiderD*MktValue + \varepsilon \quad (2)$$

*InsiderD* is a dummy variable which takes the value of 1 if there is insider buying activity around the split announcement. We also include an interactive variable of *InsiderD*MktValue* to proxy the richness of information environment and the signaling hypothesis. Although Model (2) is a more general model than Model (1), Table 5 shows that the coefficients on *InsiderD* and *InsiderD*MktValue* are not significant while the variable, *FACTOR*, representing the signaling hypothesis remains significant.

To show that our regression results are robust to alternative testing methods and computation of variables, we conduct a number of sensitivity tests on our results. Similar to our

analysis for the liquidity pattern reported in Table 4, to demonstrate that our regression results in Table 5 are not sensitive to the period over which we measure our liquidity variable, *VolRatio*, we use different periods to measure *VolRatio*. In Table 5, *VolRatio* is computed using the average trading volume for 60 days in the pre-split and post-split periods. We repeat the analysis using period lengths of ±10 days, ±15 days, ±20 days, ±25 days, ±30 days, ±35 days, ±40 days, ±45 days, ±50 days, and ±55 days. Similar results are found regardless of the length of period we use to measure our *VolRatio*. Lamoureux and Poon (1987) suggest that the measurement for the difference in the trading volume between pre-split and post-split periods can be adjusted by the market trading volume. We repeat our regression analysis using this alternative measurement of *VolRatio*. Again, we find results similar to those reported in Table 5, which suggests that our findings are not sensitive to the method by which we compute the trading volume ratio.

The result of *ESPChg* that is reported in Table 5 is computed using net income (INC9 of the Financial Statement File of PACAP database). To demonstrate robustness, we use another variable, income from operation (INC5 of the Financial Statement File of PACAP database) to repeat the regression analysis. The results are qualitatively the same.

In Table 5, we use *PriceDev* as our measurement of the preferred share price range. Peterson and Peterson (1992) use an alternative method to estimate the target share price that the splitting firms consider to be appropriate. That price is computed as the share price before the split announcement ($t$-2) divided by the split factor. We re-run the regression model using the target share price. Similar results are found, which suggests that our findings supporting the optimal trading range hypothesis are robust to the different measurements of the desirable trading price.

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TABLE 5 HERE
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## 5. Conclusion

As stock splits "are just a finer slicing of a given cake" (Lakonishok and Lev, 1987), without altering the future cash flows of a company one would expect that stock prices would not react to the announcement of splits. However, many empirical studies in the U.S. and other countries indicate that splits tend to influence share prices, and the conflict between theory and practice warrants further study. This study analyzes the effect of stock splits using intraday data and insider trading data in Hong Kong from 1980 to 2000. We first investigate the abnormal market reaction of the splitting firms. In line with the results of many other studies in different capital markets, we find significant abnormal returns around the announcement. The positive reaction can be attributable to favorable signals and improved liquidity. When observing the positive price reaction around the split announcement, it is difficult to differentiate signaling effects from liquidity effects, we then use the abnormal insider trading activity to assess the informativeness of the split signal. We find abnormally high insider trading activities three to four months before the split announcement and in the post-announcement period, although insider trading activities in the two months immediately before the split announcement is immaterial. This can be explained by the fact that the post-announcement period is a more appropriate time for securities trading by insiders in order to avoid accusations of illegal trading. Our microstructural analysis shows that stock split improves the liquidity. We find the post-split spread measures are significantly lower than those in the pre-split period, and the post-split depth measures are significantly higher than those in the pre-split period. The regression analysis shows that the increase in future earnings per share and the increase in trading volume both occurred following the split. This suggests the presence of a possible signaling role for split announcements that are confounded with increased liquidity.

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Table 1

Summary Statistics of the Stock Split Sample

| | Sample Size | Mean (Median) Split Factor[a] | Market Capitalization (HK$'000) | Number of Shares Outstanding of Splitting Firms ('000) | Share Price of Splitting Firms | Average Number of Shares Outstanding of Each Industry Sector ('000) | Average Share Price of Each Industry Sector |
|---|---|---|---|---|---|---|---|
| Utilities | 3 | 4.6667 (2.00) | 36,289,748 | 559,382 | 64.50 | 2,124,766 | 7.97 |
| Properties | 35 | 8.2350 (5.00) | 2,753,490 | 308,808 | 17.97 | 581,837 | 3.72 |
| Consolidated Enterprises | 43 | 6.1977 (4.00) | 3,410,268 | 427,709 | 10.36 | 851,299 | 4.26 |
| Industrial | 31 | 5.5161 (5.00) | 5,379,383 | 332,302 | 22.52 | 627,735 | 2.32 |
| Hotels | 5 | 15.8000 (10.00) | 2,515,497 | 171,295 | 43.23 | 294,739 | 3.69 |
| Miscellaneous | 3 | 5.3333 (4.00) | 1,237,815 | 136,093 | 10.67 | 170,076 | 11.12 |
| Average | | 6.9560 (5.00) | 4,457,789 | 353,700 | 18.46 | 706,568 | 3.84 |
| Total | 120 | | | | | | |

[a] Split factor is defined as number of new shares exchanged for one old share.

Table 2

Abnormal Returns around Stock Split Announcements

| Event Window | Abnormal Return (t-statistics) |
|---|---|
| -60, -1 | 0.4235 |
| | (12.25)** |
| -30, -1 | 0.2528 |
| | (10.34)** |
| -10, -1 | 0.1028 |
| | (7.28)** |
| -1, +1 | 0.0519 |
| | (6.71)** |
| 0 | 0.0145 |
| | (3.24)** |
| -3, +3 | 0.0860 |
| | (7.28)** |
| -5, +5 | 0.0983 |
| | (6.64)** |
| -10, +10 | 0.1270 |
| | (6.21)** |
| +1, +10 | 0.0098 |
| | (0.69) |
| +10, +60 | 0.0572 |
| | (1.80) |
| +10, +120 | 0.0099 |
| | (0.21) |
| +10, +240 | -0.0360 |
| | (-0.53) |
| +10, +360 | -0.0856 |
| | (-1.02) |

** Significant at the 0.01 level.
* Significant at the 0.05 level.

Figure 1
Cumulative Abnormal Return Path

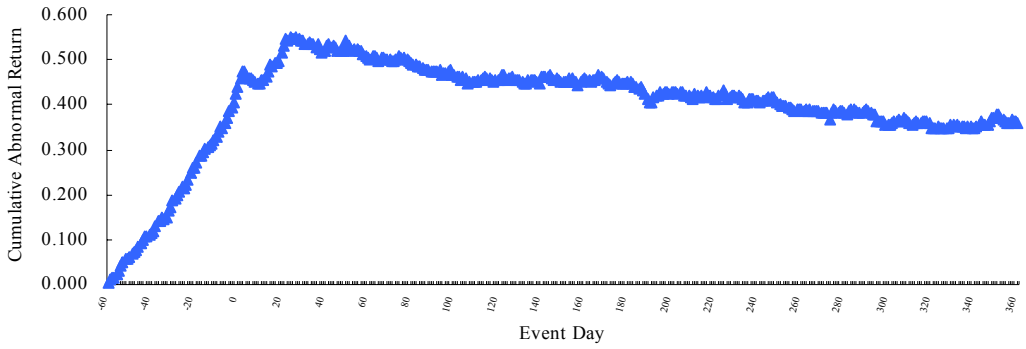

Table 3
Abnormal Insider Trading Activity in terms of Market Value around

Stock Split Announcements

The buy subsample consists of events where there is a purchase of shares. The sell subsample consists of events where there is a sale of shares. The net subsample consists of events where there is a net purchase of shares (the quantity of purchased shares exceeded the quantity of sold shares). A positive (negative) value for "Net" means that the number of purchased shares is higher (lower) than the number of sold shares. The 54.622 (36.222) abnormal market value of purchase (sale) suggests that the directors have bought (sold) firms' shares with a value \$54.622 million (\$36.222 million) in the examination period for the six months ($-6 \leq m \leq -1$) higher than in the estimation period for the six months ($-12 \leq m \leq -7$) before the split announcement. The net cumulative abnormal market value, which is the difference between purchase and sale, is 2.455.

| | Buy | Sell | Net |
|---|---|---|---|
| Event Month | Abnormal Insider Trading Activity (t-statistics) | | |
| -6 | 0.0933 | -7.8310 | 6.0820 |
| | (0.05) | (-2.12)* | (2.34)* |
| -5 | -1.3650 | 1.9202 | -2.5185 |
| | (-0.73) | (0.52) | (-0.97) |
| -4 | 40.1978 | -3.1780 | 24.1388 |
| | (21.40)** | (-0.86) | (9.28)** |
| -3 | 20.7692 | 47.2326 | -23.7649 |
| | (11.06)** | (12.78)** | (-9.14)** |
| -2 | -1.7300 | -1.1785 | -0.0610 |
| | (-0.92) | (-0.32) | (-0.02) |
| -1 | -3.3431 | -0.7431 | -1.4220 |
| | (-1.78) | (-0.20) | (-0.55) |
| 0 | -0.5055 | -0.1048 | -0.2009 |
| | (-0.27) | (-0.03) | (-0.08) |
| +1 | -2.9532 | -1.1664 | -0.7269 |
| | (-1.57) | (-0.32) | (-0.28) |
| +2 | -0.4615 | -0.2376 | -0.1183 |
| | (-0.25) | (-0.06) | (-0.05) |
| +3 | 20.5351 | 23.7863 | -4.7064 |
| | (10.93)** | (6.44)** | (-1.81) |
| +4 | -3.3266 | -0.4243 | -1.8513 |
| | (-1.77) | (-0.11) | (-0.71) |
| +5 | -0.1210 | 26.5397 | -18.3355 |
| | (-0.06) | (7.18)** | (-7.05)** |
| +6 | -3.8751 | -3.2408 | -0.0322 |
| | (-2.06)* | (-0.88) | (-0.01) |
| -6 to -1 | 54.6222 | 36.2222 | 2.4545 |
| | (11.87)** | (4.00)** | (0.39) |

* Significant at the 0.05 level.
** Significant at the 0.01 level.

## Table 4

## Sample Comparison of Liquidity Pattern around Stock Split Announcements

The Pre-split Period is a 30-day period before the stock split announcement day. The Post-Split Period is a 30-day period after the ex-split date. PRICE is the daily average trading price taken at the 30-second intervals. RETURN is estimated by taking the natural log of the contemporaneous average bid-ask to its respective lagged average taken at the 30-second intervals. VOLATILITY is the standard deviation of the daily continuous return. VOLUME is the daily total trading volume adjusted by the number of outstanding shares. Market Value is the daily market value of traded shares adjusted by the market value of the firm. Absolute Spread is the daily average of the absolute dollar difference of ask and bid recorded at 30-second intervals on day *t*. Relative Spread is the daily average of the dollar difference of ask and bid divided by the bid-ask midpoint recorded at 30-second intervals on day *t*. Volume Depth is the sum of the number of shares at the highest bid and the number of shares at the lowest ask recorded at 30-second intervals on day *t* (adjusted by the number of outstanding shares). Dollar Depth is the sum of the product of the number of shares at the highest bid and the highest bid price and the product of the number of shares at the lowest ask and the lowest ask price recorded at 30-second intervals on day *t* (adjusted by the market value of firm). Ask Depth is the product of the number of shares at the lowest ask and the lowest ask price recorded at 30-second intervals on day *t* (adjusted by the number of outstanding shares). Bid Depth is the product of the number of shares at the highest bid and the highest bid price recorded at 30-second intervals on day *t*.

| | Pre-Split Period | Post-Split Period | t-statistics for Mean Difference |
|---|---|---|---|
| PRICE | 6.583 | 2.181 | 16.257**[b] |
| RETURN | -0.0001 | -0.001 | 2.317*[b] |
| VOLATILITY | 0.007 | 0.012 | -2.845**[b] |
| VOLUME | 0.011 | 0.034 | -5.065**[a] |
| Market Value | 0.011 | 0.034 | -5.055**[a] |
| Absolute Spread | 0.089 | 0.024 | 23.684**[b] |
| Relative Spread | 0.023 | 0.021 | 2.918** |
| Volume Depth | 0.194 | 0.303 | -2.163*[b] |
| Dollar Depth | 0.240 | 0.475 | -3.296**[a] |
| Ask Depth | 0.110 | 0.258 | -4.545**[b] |
| Bid Depth | 0.130 | 0.217 | -1.495 |

[a] The mean difference between the Pre-Split Period and the Post-Split Period is significant at the 0.05 level by the Mann-Whitney test.
[b] The mean difference between the Pre-Split Period and the Post-Split Period is significant at the 0.01 level by the Mann-Whitney test.

* Significant at the 0.05 level.
** Significant at the 0.01 level.

Table 5

Regression Analysis

$$CAR = \alpha_0 + \beta_1 FACTOR + \beta_2 MktValue + \beta_3 VolRatio + \beta_4 EPSChg + \beta_5 Multiple + \beta_6 RetVar + \beta_7 PriceDev + \beta_8 ShareDev + \varepsilon \quad (1)$$

$$CAR = \alpha_0 + \beta_1 FACTOR + \beta_2 MktValue + \beta_3 VolRatio + \beta_4 EPSChg + \beta_5 Multiple + \beta_6 RetVar + \beta_7 PriceDev + \beta_8 ShareDev + \beta_9 InsiderD + \beta_{10} InsiderD*MktValue + \varepsilon \quad (2)$$

*CAR* is the cumulative abnormal return over the different periods examined ($-60 \le t \le -1$, $-30 \le t \le -1$, $-10 \le t \le -1$, $-1 \le t \le +1$, $-3 \le t \le +3$, $-5 \le t \le +5$, $-10 \le t \le +10$, $+1 \le t \le +10$, $+10 \le t \le +60$, $+10 \le t \le +120$, $+10 \le t \le +240$ and $+10 \le t \le +360$). *FACTOR* is the natural logarithm of the size of the split factor. *MktValue* is the natural logarithm of the market value (the product of price and number of shares outstanding) of the firm for the month before the split announcement. *VolRatio* is the ratio of pre-split trading volume to post-split trading volume normalized by the number of shares outstanding. *EPSChg* is the percentage change in earnings per share of the current year to the previous three years. Multiple is a dummy variable that takes the value of 1 if there is more than one split announcement over the sample period from 1980 to 2000. *RetVar* is the standard deviation of return. *PriceDev* is the natural logarithm of the deviation of share price from industry median price. *ShareDev* is the natural logarithm of the deviation of shares outstanding from the industry median of shares outstanding. *InsiderD* is a dummy variable which takes the value of 1 if there is insider buying activity around the split announcement. *InsiderD*MktValue* is an interactive variable of *InsiderD* and *MktValue*. The *p*-values for the coefficients are adjusted for heteroskedasticity using White's procedure (1980).

Panel A: Descriptive Statistics

| | FACTOR | MktValue | VolRatio | EPSChg | RetVar | PriceDev | ShareDev |
|---|---|---|---|---|---|---|---|
| Mean | 1.5061 | 13.5455 | 3.3391 | 0.0377 | 0.0445 | 1.4604 | 12.1847 |
| Median | 1.6094 | 13.3043 | 1.3481 | 0.1534 | 0.0357 | 1.3894 | 12.4372 |
| Standard Deviation | 0.9312 | 1.5763 | 5.3115 | 0.6149 | 0.0321 | 1.6813 | 1.1356 |
| Maximum | 4.6052 | 18.2418 | 35.3581 | 0.9565 | 0.1876 | 5.4951 | 15.7564 |
| Minimum | -3.6889 | 10.2736 | 0.0005 | -0.9634 | 0.0055 | -2.4572 | 8.3700 |

Table 5 (continued)

Regression Analysis

Panel B: Regression Result

| | Model (1) | | | | Model (2) | | | |
|---|---|---|---|---|---|---|---|---|
| | $-60 \le t \le -1$ | $-30 \le t \le -1$ | $-10 \le t \le -1$ | $-10 \le t \le +10$ | $-60 \le t \le -1$ | $-30 \le t \le -1$ | $-10 \le t \le -1$ | $-10 \le t \le +10$ |
| | Beta Coefficient ($p$-value) | | | | | | | |
| Intercept | -0.0202 | 0.0042 | 0.0094 | -0.0254 | -0.0216 | 0.0057 | 0.0059 | -0.0327 |
| | (0.09) | (0.78) | (0.65) | (0.50) | (0.07) | (0.71) | (0.78) | (0.38) |
| FACTOR | -0.0013 | -0.0009 | -0.0007 | 0.0098 | -0.0011 | -0.0009 | -0.0006 | 0.0096 |
| | (0.19) | (0.38) | (0.78) | (0.05)* | (0.22) | (0.38) | (0.83) | (0.03)* |
| MktValue | -0.0005 | -0.0019 | -0.0037 | 0.0002 | -0.0003 | -0.0020 | -0.0034 | 0.0002 |
| | (0.47) | (0.01)** | (0.01)** | (0.90) | (0.65) | (0.01)** | (0.02)* | (0.90) |
| VolRatio | -0.0015 | -0.0015 | -0.0002 | -0.0009 | -0.0015 | -0.0015 | -0.0002 | -0.0010 |
| | (0.00)** | (0.01)** | (0.79) | (0.26) | (0.00)** | (0.01)** | (0.81) | (0.20) |
| EPSChg | 0.0046 | 0.0049 | 0.0021 | 0.0048 | 0.0048 | 0.0049 | 0.0023 | 0.0048 |
| | (0.01)** | (0.03)* | (0.51) | (0.23) | (0.01)** | (0.03)* | (0.48) | (0.24) |
| Multiple | -0.0015 | -0.0021 | 0.0004 | 0.0072 | -0.0009 | -0.0027 | 0.0019 | 0.0102 |
| | (0.56) | (0.42) | (0.92) | (0.21) | (0.74) | (0.29) | (0.68) | (0.07) |
| RetVar | 0.3288 | 0.2694 | 0.4561 | 0.4087 | 0.3305 | 0.2679 | 0.4599 | 0.4310 |
| | (0.00)** | (0.00)** | (0.00)** | (0.01)** | (0.00)** | (0.00)** | (0.00)** | (0.02)* |
| PriceDev | 0.0015 | 0.0020 | 0.0040 | -0.0019 | 0.0013 | 0.0022 | 0.0036 | -0.0026 |
| | (0.01)** | (0.02)* | (0.01)** | (0.33) | (0.03)* | (0.02)* | (0.03)* | (0.18) |
| ShareDev | 0.0017 | 0.0014 | 0.0022 | 0.0003 | 0.0016 | 0.0014 | 0.0022 | 0.0011 |
| | (0.04)* | (0.24) | (0.20) | (0.86) | (0.07) | (0.26) | (0.21) | (0.56) |
| InsiderD | | | | | 0.0279 | -0.0222 | 0.0467 | -0.0222 |
| | | | | | (0.32) | (0.48) | (0.51) | (0.77) |
| InsiderD*MktValue | | | | | -0.0020 | 0.0017 | -0.0034 | 0.0008 |
| | | | | | (0.33) | (0.45) | (0.47) | (0.87) |
| Adj $R^2$ | 0.6566 | 0.5284 | 0.4716 | 0.4289 | 0.6438 | 0.5087 | 0.4490 | 0.4597 |
| F-statistic | 12.9480 | 8.0035 | 6.1317 | 5.5994 | 10.0375 | 6.1770 | 4.6673 | 5.0832 |
| | (0.00)** | (0.00)** | (0.00)** | (0.00)** | (0.00)** | (0.00)** | (0.00)** | (0.00)** |

* Significant at the 0.05 level.
** Significant at the 0.01 level.