Liquidity Changes around Stock Splits*

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Abstract

This study examines whether liquidity improves for firms that undertake stock splits. We find that most liquidity measures improve following stock splits. The improvement in liquidity is particularly significant over the five-day interval that surrounds the split announcement date. After the ex date, most liquidity measures revert to their pre-split levels. Thus, the improved liquidity after stock splits appears to be only a short-term phenomenon. Our results seem to be more consistent with the signaling/attention explanations of stock split actions than with the target range/improved liquidity story. We also find that changes in liquidity can significantly explain both the stock split announcement effect and the ex-date effect.

1. Introduction

Stock splits appear to be an interesting corporate event to analyze. While stock splits do not affect a firm's cash flows, the market tends to react to them positively. The literature suggests that one main motive for splitting stocks is to realign share prices to an "optimal" trading range (see Lakonishok and Lev (1987)). Realigning share price may draw more attention to a stock (Grinblatt, Masulis, and Titman (1984)) and hence lead to an improved liquidity (Muscarella and Vetsuypens (1996)). Indeed, the survey research by Baker and Powell (1992) reports that moving the stock price into a better trading range and improving the stock's liquidity are the primary motives for firms to undertake a split. Theoretically, Anshuman and Kalay (2002) present a model that shows firms split their stocks to create liquidity. Their model implies that because of price discreteness related commissions, liquidity traders will time their trades based on stock price levels. Specifically, liquidity traders may defer their trades until stock prices drop to lower base levels to save transaction costs. Under this framework, a firm can enhance its stock's trading liquidity by resetting the stock price to an optimal level with a stock split.

Empirically, there is little evidence that liquidity increases following splits. While several studies (Powell and Baker (1993/1994), Schultz (2000), Easley, O'hara, and Sarr (2001), and Dhar, Goetzmann, Shepherd, and Zhu (2003)) document an enlarged ownership base after split, other studies (e.g., Conroy, Harris, and Benet (1990) and Gray, Smith, and Whaley (2003)) show an increase in relative spread after the split effective date,[1] suggesting that stocks become less liquid after a stock split.

In this paper, we examine liquidity changes around stock splits using a sample of split announcements during 1927-2004. Unlike prior studies that mostly focus on bid-ask spreads as liquidity measures, we consider six liquidity measures because liquidity has various dimensions. Our liquidity measures represent various dimensions of liquidity including spreads, price impacts, and trading volume. Additionally, our estimates of liquidity measures require only daily data, rather than intraday data, and hence we are able to perform our analysis for a much longer time period than most prior studies.

[1] Gray, Smith, and Whaley find that stock splits increase investor trading costs. The higher trading costs are equivalent to increased market maker excess profits. Similarly, Kadapakkam, Krishnamurthy, and Yse (2005) find that the relative increase in spread provides incentives for brokers to promote splitting stocks to small investors.

Furthermore, prior studies confine their analysis to liquidity changes after the split effective date. The impact of splits on liquidity over short periods, especially after announcement dates and before ex dates, has not been examined in detail in the literature.[2] In addition to examining liquidity change after the ex date, we also examine liquidity change for the period between the announcement date and the ex date. It is noteworthy that the two popular stories behind a split decision—the signaling hypothesis and the target range/improved liquidity hypothesis—have different implications on trading liquidity of splitting stocks over time. If the signaling hypothesis holds and hence stock splits convey positive information content about a firm's future prospect, then we should expect an increase in demand of splitting stocks' shares. Accordingly, the split announcement will come with a positive market reaction and an increase in liquidity. In contrast, if the target range/improved liquidity hypothesis holds, a positive market reaction and improved liquidity may not occur until the split ex date when the new stock replaces the unsplit stock in trading. Thus, whether there is a change in liquidity after the split announcement or after the ex date has different implications on the validity of the two hypotheses. To this end, we evaluate liquidity changes between the pre-announcement period and various event windows that surround the split announcement and effective dates, including the announcement, the post-announcement to pre-ex, the ex-date, and the post-ex periods.

Using 5,497 stock splits for the period 1927-2004, we find abnormal returns in the five-day window that surrounds the split announcement and ex dates. No evidence of abnormal returns is found in the period between the announcement and ex dates and in a longer period after these two dates. We also find significant increase in return volatility after the split. Moreover, this post-split increase in return variance apparently is due to the increase in systematic risk after the split.

More importantly, we find that most liquidity measures improve following stock splits. The improved liquidity is particularly significant over the five-day interval that surrounds the split announcement date. After the announcement date but before the ex date, our liquidity measures appear to

[2] Goyenko, Holden, and Ukhov (2006) examine whether liquidity changes after splits in both short- and long-run. However, they focus on monthly liquidity measures and skip the announcement month in their analysis.

decline, although they are still greater than their pre-split levels. After the ex date, liquidity has returned to the level before the split. Similar results also hold when comparing the liquidity measures of split firms to control firms. In short, the improvement in liquidity after splits appears to be a short-term phenomenon that is observed only in the period between the split announcement and ex dates. We also find that liquidity can significantly explain the abnormal returns in both the split announcement and the ex-date periods.

The rest of the paper is organized as follows. Section 2 provides a brief literature review on stock splits. Section 3 describes the various liquidity measures that we use, the data, and abnormal stock returns around the split announcement and ex dates of the sample splitting firms. In Section 4, we report various liquidity measures for split firms and matched non-split firms around the split announcement and ex dates. Section 4 also analyzes the determinants of abnormal returns. Section 5 concludes the paper.

2. Related Research

Stock splits are a puzzling corporate event. While a split does not change a firm's cash flows, the market tends to react to split announcements favorably. Two hypotheses, the signaling hypothesis and the trading range/liquidity hypothesis, have been proposed to explain the positive excess stock returns that are associated with stock splits.

The signaling hypothesis suggests that splits are an action made by management to reveal information about the firm's future profitability to the market. Lakonishok and Lev (1987) provide some evidence that supports the signaling hypothesis. Their analysis shows that splitting firms exhibit a median growth in earnings of 16.31 percent in the first post-split year, which is slightly higher than 13.28 percent for their control sample of non-split firms. However, their major finding leads them to conclude that stock splits are made mainly to adjust stock prices to "normal" levels. Asquith, Healy, and Palepu (1989) examine 121 stock splits that do not pay dividends prior to or in the announcement year, and report significant earnings increases several years before the split. McNicholes and Dravid (1990) find that analysts' one-year-ahead earnings forecast errors are positively correlated with announcement abnormal returns. Ikenberry, Rankine, and Stice (1996) and Desai and Jain (1997) find excess returns in the three years following a split announcement. Both studies' results seem to support the view that a split reflects management's optimism about the future. Ikenberry et al. also find a negative excess return three years after the split for a sample of 52 firms that have a negative stock price run-up prior to the split, suggesting that some splits may contain a false signal. Nevertheless, since neither Ikenberry et al. nor Desai and Jain analyze future operating performance, their results do not necessarily imply a positive relation between splits and future profitability.[3] The evidence provided in Ikenberry and Ramnath (2002) suggests that the positive drift in the year following a split announcement is related to market underreaction. Specifically, they find that financial analysts tend to underestimate split firms' earnings and this underestimation would gradually decline and approach zero when the actual earnings are announced. However, it is not clear whether Ikenberry and Ramnath's finding indicates improved future operating performance or instead reflects a forecast bias in analysts' earnings expectations. Indeed, Lakonishok and Lev (1987) report that the median growth rates of earnings for their sample split firms drop from 26.35 percent one year prior to the announcement to 16.31 percent, 8.61 percent, and 8.02 percent, respectively, in the three years following the announcement. In short, the empirical evidence is somewhat limited to support the claim that stock splits convey favorable information about future profitability.

Instead of signaling, Grinblatt, Masulis, and Titman (1984) argue that splits can reduce informational asymmetries by attracting attention paid to a firm. Brennan and Hughes (1991) find that the number of security analysts following a firm is positively related to the magnitude of stock splits, which is consistent with the Grinblatt et al. argument. Admati and Pfleiderer (1988) further argue that splits not only attract informed traders, but also noise traders because of lower post-split share prices.

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[3] Byun and Rozeff (2003), however, show that the long-term abnormal returns following stock splits are sensitive to time period and method of estimation used. Using a longer time period and a variety of subperiods and testing methods, they find negligible long-run abnormal returns after splits.

Another explanation for stock splits is that firms may prefer their shares to trade within a particular price range (Copeland (1979)). Management might have this preference because when stock prices are too high, many small or uninformed investors cannot afford to trade in round lots, thereby affecting the liquidity of the stock. Splitting shares would improve liquidity by enlarging clientele and hence reduce the trading cost of the stock (Muscarella and Vetsuypens (1996)).[4] Stock split can also create market liquidity when there are minimum tick size restrictions (Anshuman and Kalay (2002)). Moreover, management may prefer to bring more small investors, investors who tend not to exercise too much control, into the firm to create a more controllable ownership mix (Powell and Baker (1993/1994)). Baker and Gallagher's (1980) survey reports that 94% of their sample of chief financial officers cited returning their firm's share price to an optimal trading range as the main reason for the split. Nevertheless, empirical evidence for an improved post-split liquidity is mixed. For instance, several studies (e.g., Lamoureux and Poon (1987), Conroy, Harris, and Bent (1990), and Desai, Nimalendran, and Venkataraman (1998)) find a significant increase in proportional bid-ask spread, implying worsened liquidity after the split. Goyenko, Holden, and Ukhov (2006) find that the worsened liquidity experienced by splitting firms is a short-term phenomenon. They document an improved liquidity after the split in the long run (2 years). Easley, O'Hara, and Saar (2001) find an increase in the number of uninformed trades, though they also find an increase in the overall trading costs of uninformed traders. Easley et al. interpret their finding to be consistent with the trading range hypothesis in that stock splits attract the clientele of small ownership holdings. Dhar et al. (2003) also find individual investors trade more after stock splits with smaller trade sizes, suggesting improved liquidity.

3. Liquidity Measures, Sample Data, and Control Firm Selection

A. *Liquidity Measures*

[4] Angel (1997) provides another explanation by arguing that splits are to move tick sizes relative to the stock price to desired levels. Angel's idea is that a large tick size may provide market making firms additional incentives to promote the split stock to small investors. Schultz (2000) finds that there are a lot of small orders, but not large orders, subsequent to splits, which is consistent with the view that splits do promote stock trading.

We employ six variables to measure liquidity. These six liquidity variables represent measures on trade, price impact, and spread. Unlike prior studies that rely on intraday trade and quote data available from the intraday Trades and Quotes (TAQ) database to estimate bid-ask spreads, we use daily data to calculate effective spreads. Using daily data allows us to conduct our analysis for a sample period as far back as 1926—the year that the CRSP daily database begins, rather than after 1994 when the TAQ database becomes available. The liquidity measures include the following six variables:

1. Turnover ratio: The turnover ratio is calculated as the average of the daily ratio of trading volume (in shares) to shares outstanding. Prior studies have used the turnover ratio as a proxy for liquidity because turnover is negatively correlated with the bid-ask spread.

2. Amihud's illiquidity ratio: This illiquidity measure is proposed by Amihud (2002) and is calculated as $\frac{1}{N}\sum\frac{|R_d|}{VOLD_d}$, where N is the number of days for which data are available (i.e., trading volume is not zero), $|R_d|$ is the absolute return on day d, and $VOLD_d$ is dollar trading volume on day d. As Amihud points out, this ratio measures how daily stock price reacts to a dollar of trading volume and hence is closely related to Kyle's (1985) concept of illiquidity, defined as the price impact of order flow. Intuitively, a larger trading volume would lead to a small price change. Accordingly, a more liquid market should be the one with a smaller Amihud illiquidity ratio. Amihud shows that this illiquidity ratio is strongly positively correlated with liquidity measures that are calculated from microstructure data.

3. The Amivest liquidity ratio: This liquidity ratio is calculated as $\frac{1}{N}\sum\frac{VOLD_d}{|R_d|}$, where all the terms are defined as those in the Amihud illiquidity ratio. Just the opposite to the Amihud illiquidity ratio, a more liquid market should have a larger Amivest liquidity ratio since in a liquid market a larger dollar trading volume should lead to a small price change.

4. Zeros: This variable is defined as the ratio of the number of days with zero returns to the total number of trading days. This measure was developed by Lesmond, Ogden, and Trzcinka (1999) as a

proxy for transaction costs, which can be seen as the sum of the spread and commission. They propose a security model that relates transaction costs to the incidence of zero returns. A key feature of their model is that marginal investors will not trade or will reduce trading if transaction costs exceed the value of information signal. It is expected that a security with high transaction costs will have more zero returns and is less liquid than a security with low transaction costs. Thus, one can simply use the observed incidence of zero returns to infer the liquidity of a security.

5. Effective spread: Following Holden (2007), we estimate dollar effective spread of a stock using the time series of daily stock returns. Holden develops an estimate of the dollar effective spread that is based on price clustering (see the Appendix for detailed discussions of this measure). In his model with a fractional tick size, the dollar effective spread can be inferred by checking the frequency of transactions that occur on odd 1/16s, odd ⅛s, odd ¼s, odd ½s, and whole dollars. Similarly, for a decimal pricing, the dollar effective spread can be inferred by checking the frequency of transactions that occur on off pennies, off nickels, off dimes, off half dollars, and whole dollars. Note that his estimation of dollar effective spread does not require continuously quoted bid-ask spreads and instead requires only time series of daily stock trading prices. Consequently, we are able to perform our analysis for time periods that intraday data (e.g., the TAQ database) are not available.
6. Relative spread: The relative spread is calculated by dividing the dollar effective spread with the average daily trading price. Goyenko, Holden, Lundblad, and Trzcinka (2005) sample various proxies for liquidity based on daily data and compare them with those calculated from the TAQ database. They find that Holden's effective spread and price impact proxies are the best monthly liquidity measures.

B. *Sample Data*

We employ the CRSP daily return file to identify all NYSE, AMEX, and NASDAQ firms that have stock splits. To be included in the sample, a firm has to meet the following criteria: (1) it announced a stock split during the time period 1927-2004; (2) the split factor is at least 0.25, which is equivalent to a 5-for-4 split; (3) splits are not made by ADRs, SBIs, REITs, and closed-end funds; (4) stock prices, trading volume, and return data are available in the CRSP daily return file from one year prior to the split announcement date to one year after the split effective date; and (5) in the estimation period spanning 252 days before the split announcement date and 260 days after the split ex date with at least 60% of the daily data are not missing. We also require a split firm to wait for two years before it can reenter the final sample to avoid dependence in overlapping data. The resulting sample consists of 5,497 split announcements.

Table 1 reports the number of stock splits by split ratio. Similar to prior research, our results show that certain split ratios are more common than others. About 57 percent (3,116 observations) of the sample have a 2-for-1 stock split ratio; another 28 percent are for a 3-for-2 split.

Table 1 also reports the price run-up before the split and the cumulative market-adjusted abnormal returns (calculated as the return difference between the sample split firm and the CRSP equally-weighted index) for various windows around the split. The mean (median) price run-up (rate of return calculated using the stock price of a firm five trading days prior to the split and the price one year before the split) of 168.841% (143.652%) indicates that most firms exercise a stock split when they experience a substantial increase in the stock price during the year prior to the announcement. Similarly, the split firms experience significant abnormal returns in the year before the announcement. Consistent with the literature, the market reacts to the split announcements favorably in our sample. The mean (median) cumulative market-adjusted abnormal return during days –2 to +2 relative to the split announcement is 3.044% (2.087%). These positive announcement return results suggest that splits lead to a higher demand in stock share by investors. This greater demand could be due to some sort of information content in signaling, a more “attractive” stock, or both. Either case, the higher demand will lead to improved trading liquidity.

Our sample split firms experience a *negative* mean (median) cumulative market-adjusted abnormal return of 0.314% (0.534%) during the period from the split announcement date ($t_{announce}$+3) to the split ex-date (t_{ex}−1). Nayar and Rozeff (2001) point out that trading unsplit or pre-split shares prior to the split ex date is inconvenient because of frictions associated with the delivery of split shares and the settlement of a due bill that the sellers provide to the buyers. Thus, investors are reluctant to buying shares after the record date and before the ex date. Consequently, prices are depressed during the announcement-to-ex-date period and the negative abnormal return likely reflects this phenomenon.

Consistent with prior studies, we also find significant abnormal returns during the ex-date period (from t_{ex}0 to t_{ex}+4). The mean (median) abnormal return during this period is 1.162% (0.601%) and is highly significant. Nayar and Rozeff (2001) argue that positive ex-date abnormal returns arise because the inconvenience of trading unsplit shares lead to declines in stock prices near record dates followed by price increases at ex-dates. On the other hand, Kadapakkam, Krishnamurthy, and Tse (2005) suggest that the positive ex-date abnormal return is related to an increased intensity of small investor buying near ex dates, which is due to brokers' promotion of split stocks to small investors. Regardless of which hypothesis is more appropriate in explaining the rises of stock prices near the ex dates, both the trading inconvenience and the broker promotion hypothesis suggest the existence of an ex-date effect.

It is reasonable to expect that market frictions associated with unsplit shares will be resolved quickly after the split ex date since at that time there is no longer a due bill problem. Thus, we expect there might not be abnormal returns after the split date if the trading inconvenience hypothesis holds. On the other hand, according to the broker promotion hypothesis, larger relative spreads after the split induce brokers to promote shares to small investors. If this is the case, we would expect brokers to continue to promote those already split shares after the ex date as long as relative spreads remain large. Consequently, abnormal returns might continue after ex date. However, we find a negative cumulative market-adjusted return in the five-day post-split interval (from t_{ex}+5 to t_{ex}+10) (see Table 1). Our results are therefore more consistent with the trading inconvenience hypothesis than with the broker promotion hypothesis.

We also examine abnormal returns for a longer term interval after the ex date—the one-year post-split period. The results reported in Table 1 show a negative abnormal return one year after the split effective date.

In short, abnormal returns exist only in a very short-term window surrounding the split announcement and ex dates. No evidence of abnormal returns is found in the period between the announcement and ex dates and in a longer period after the split.

C. *Control Firm Selection*

To evaluate whether or not splitting firms' trading liquidity improve after the split, we compare liquidity measures between the pre-split period and various periods after the split announcement and test whether these liquidity changes are significant. In addition, we compare measures of liquidity of splitting firms with those of control firms. Our selection of control firms is based on the exchange, share price, and trading liquidity. Our intention is to select matching firms that do not split but have similar pre-split share price and liquidity as the sample firms. Specifically, we select matching firms that do not split their stock over a two-year period using the following procedure: (1) firms that are from the same exchange and (2) the share price is within ±10% of the sample firm's share price three trading days prior to the split announcement. From the firms that meet these two characteristics, we choose the firm that has the closest Amihud's illiquidity ratio for the one-year pre-split interval (from $t_{announce}-252$ to $t_{announce}-3$). Just like the sample firms, we require the daily CRSP database to contain information on the matching firm's stock prices, trading volume, and returns for the two years (from $t_{announce}-252$ to $t_{ex}+260$) around the split announcement date.

4. **Empirical Results**

A. Changes in Liquidity

If splits convey positive information on firm's future profitability to the market, then trading liquidity of the split firm's stock share should increase after the split announcement because investors have more desire to buy the stock. On the other hand, if returning the share price to a target range and improving liquidity are the primary purpose of the split, then liquidity likely will not increase before the split effective date because the split does not become effective until this date. Moreover, all trading are in the unsplit shares before the ex-date and the inconvenience of trading unsplit shares because of due bills may delay the purchase from investors until the ex-date. Thus, the signaling hypothesis implies improvements in liquidity right after the announcement date, while the trading range hypothesis suggests improved liquidity after the ex date. To determine whether or not liquidity improves after the split, we first calculate the six liquidity measures for the split firms for six windows, including the pre-announcement (from $t_{announce}-252$ to $t_{announce}-3$), the announcement (from $t_{announce}-2$ to $t_{announce}+2$), the announcement-to-ex-date (from $t_{announce}+3$ to $t_{ex}-1$), the ex-date (from $t_{ex}0$ to $t_{ex}+4$), the short-term post-ex (from $t_{ex}+5$ to $t_{ex}+10$), and the post-ex (from $t_{ex}+11$ to $t_{ex}+260$) periods. These six intervals span a two-year window around the split announcement and ex dates. We can determine whether liquidity improves by evaluating how liquidity measures change over the six intervals.

Figure 1 plots the means of the six measures of liquidity for the six periods for the sample of split firms. There are several notable observations. First, all the liquidity measures (except the dollar effective spread) improve after the split announcement and remain improved before the ex date when compared to the pre-announcement level. Second, the five-day announcement period exhibits the largest improvement in various liquidity measures. Finally, the improved liquidity seems to be a short term phenomenon given that measures of liquidity tend to revert back to the levels before the split.

To test whether liquidity improves after stock splits, we perform a *t*-test and the results are given in Table 2. Panel A shows that the turnover ratio of the splitting firms increases substantially from the pre-announcement period to the announcement period, and then declines monotonically over the subsequent four periods following the announcement. After the ex-date, the turnover ratio appears reverting back to its pre-split level. Specifically, the mean turnover ratio increases from 2.955 in the pre-split period to 4.364 in the announcement period. After the split announcement, the mean falls to 3.428 in the announcement-to-ex period, 3.142 in the ex-date period, 3.005 in the six-day post-ex period, and 2.861 in the post-ex period. The peak of turnover ratio at the split announcement period may reflect the optimism on firm's operating performance shared by investors or increased attention paid to the firms upon the announcement. Thus, the trading turnover does increase after stock splits. However, this increase in trading turnover is limited to only the period between the announcement and effective dates.

Table 2, Panel B shows the split firms' Amihud illiquidity ratios. The Amihud illiquidity ratios follow a similar trend over time as that of turnover ratio. The mean split firm's Amihud illiquidity ratio declines substantially from 0.544 in the one-year period before the split to 0.210 in the five-day announcement period and then increases to 0.596 in the post-ex period. Similar to the turnover ratio, the Amihud illiquidity ratio suggests that an improved liquidity occurs only in the period between the announcement and the ex dates. After the ex date, the split stock's trading liquidity as measured by the Amihud illiquidity ratio reverts back to the level prior to the split.

Panel C of Table 2 shows the Amivest liquidity ratios. Unlike the previous two liquidity measures, the announcement-to-ex period exhibits the largest Amivest liquidity ratio. This result is somewhat surprising given that trading unsplit shares are inconvenient after the announcement date and before the split date. Moreover, we find a negative abnormal return in this period (see Table 1). The Amivest liquidity ratios decline in the ten-day period after the ex date, but increase in the one-year period after the split and remain high compared to the pre-split level.

In Panel D of Table 2, we report the proportion of days with zero returns, which is to proxy for transaction costs as proposed by Lesmond et al. (1999). After the split, this liquidity measure has improved. The values of Zeros are relatively low in the five-day periods that surround the announcement and ex dates compared to other values. Nevertheless, the results show more trading days after the split ex date having a zero price change than before the announcement date, indicating that improved liquidity disappears in the long run after the split.

Panels E and F show the mean dollar effective and relative spreads, respectively.[5] After the split, the dollar spreads are significantly higher than the pre-split level of \$0.189, ranging from \$0.217 in the announcement period to \$0.204 in the announcement-to-ex period. In the post-ex period, the dollar effective spread, however, drops to \$0.186, which is significantly lower than its pre-split level. However, with the pre-split spread of \$0.189 and an average split factor of 0.915, the expected post-split spread is \$0.099, which is much smaller than the \$0.186 realized. In contrast, the relative spread result shows a different story. The relative spreads decline in the two periods between the announcement date and the ex date. After the split becomes effective, the relative spreads increase and they increase to a level that is significantly greater than the pre-split level, which are consistent with prior studies that use quote data in their analysis (e.g., Lamoureux and Poon (1987), Conroy et al. (1990), and Gray et al. (2003)). Specifically, the relative spreads increase to 1.020 percent, 0.958 percent, and 0.887 percent in the ex-date, short-term post-ex, and post-ex periods, respectively, from the pre-split level of 0.807 percent.

To further evaluate whether split firms' liquidity improves after the split, we compare split firms' liquidity measures to those of the matched firms. Table 3 reports the mean liquidity measures for both the split and control firms and their differences. We test statistical significance of the mean difference using a *t*-statistic. While the split firms exhibit a higher trading turnover before the split, their turnover values are much higher than their counterparts after the split, especially in the periods before the announcement

[5] Clearly, our estimate of dollar effective spread is closely related to the minimum tick size. The minimum tick size educes from \$1/8 to \$1/16 on June 24, 1997 on NYSE/AMEX and on June 2, 1997 on NASDAQ, and further to \$0.01 on January 29, 2001 on NYSE/AMEX and on April 9, 2001 on NASDAQ. Thus, we calculate the dollar effective and relative spreads only if the two-year interval from $t_{announce}-252$ to $t_{ex}+260$ falls into one of the three minimum tick size regimes. We report only the results from the \$1/8 regime because the mean spread will be affected if all tick size regimes are included in the calculation. As a result, 1,172 firm observations are excluded from this part of analysis. Nevertheless, the results remain qualitatively the same if other regimes are included in the analysis.

and the ex dates (see Panel A). After the split, the trading turnover appears not to increase given that the post-split period has a mean difference of 0.393, which is smaller than the pre-split difference of 0.479.

The split firms also see their trading liquidity improves based on the Amihud illiquidity ratio after the split announcement and before the ex date (see Panel B). While the split firms have a higher Amihud illiquidity ratio than the control firms in the pre-split period, they show a smaller ratio in the announcement and announcement-to-ex periods. After the ex date, the split firms again become less liquid when compared to control firms. Similar to the Amihud illiquidity, the results of the Amivest liquidity measure shown in Panel C of Table 3 indicate that the split firms are more liquid than the matching firms only in the periods between the announcement and ex dates.

Panel D of Table 3 shows the results for Zeros. Before the split, the split firms are less liquid than the control firm with a difference in Zeros of 0.003. After the split announcement and before the ex date, the split firms become more liquid as they experience less trading days with zero returns. However, in the post-ex period, the split firms become less liquid again given that they have a larger Zeros value than the control firms.

Panel E shows the difference in the dollar effective spreads. The differences are either negative or insignificantly different from zero. While the split firms have smaller dollar effective spread, the difference seems to be small. The difference in dollar spread between the split and control firms is −\$0.005 before the split and is −\$0.007 after the split. Panel F shows the difference in the relative spreads. Before the split, the difference in the relative spreads is 0.246 percent. After the announcement date and before the ex date, firms that split their shares encounter smaller relative spreads than the firms that do not. Nevertheless, after the ex date, the differences in the relative spreads are all highly positive and larger than the pre-split level.

In summary, our results indicate that most liquidity measures show an improved liquidity after firms split their shares. However, the improvements in liquidity are short-lived and limited to the short periods between the split announcement date and the ex date. That is, there is no long-term impact of stock splits on trading liquidity of a stock. Thus, our results appear to be more consistent with the signaling hypothesis than with the target trading range hypothesis.

B. Changes in Risk

Prior studies (e.g., Lamoureux and Poon (1987), Dubofsky (1991), and Desai et al. (1998)) document that return volatility increases following the split ex date. Several studies (e.g., Desai et al. (1998) and Easley et al. (2001)) attribute the post-split volatility increase to increase in relative spreads of split firms. In the previous sub-section, we find that the relative spreads of split firms do increase after the split ex date. Alternatively, the increase in volatility could be caused by an increase in either equity beta or residual return variance.

In this study, we analyze changes in return variance and its systematic and unsystematic components to investigate the sources of volatility changes following splits. Table 4 contains various risk measures for the year (from $t_{announce}-252$ to $t_{announce}-3$) prior to the split announcement date and the year after the ex date (from $t_{ex}+11$ to $t_{ex}+260$). In the pre-split year, the mean daily return variance for the split firms is 0.063%, whereas it is 0.053% for the matching non-split firms (see Panel A). The mean difference in return variance is statistically significant. After the split, the mean return variance of the split firms increases significantly by 0.025% to 0.088% while the mean return variance of the matching firms also increases by 0.006% to 0.058%. The mean difference between the split and non-split firms after the split is highly significant and is larger than that before the split. Thus, consistent with the literature, our results indicate that after the split, the total risk of split firms not only increases but also increases at a larger amount relative to firms that do not split.

Table 4, Panel B reports beta estimates.[6] Similar to total risk, the mean equity beta of the split firms increases from 1.099 before the split to 1.262 after the split. The split firms also have higher

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[6] Betas are estimated by regressing daily stock returns on contemporaneous returns of the CRSP equally-weighted index.

systematic risk than the control firms. This higher systematic risk is more pronounced in the post-split period. Panel C shows that the split firms experience an increase in systematic risk ratio after the split, which is the ratio between systematic risk (calculated as beta squared times the variance of the CRSP equally-weighted index returns) and total risk. The splitting firms have higher systematic risk ratio than the matching firms in both periods, although the difference in systematic risk ratios between the two periods is not significantly from zero. Overall, our findings in Table 4 suggest that the post-split increase in return variance is due to the increase in equity beta after the split.

C. Abnormal Returns and Changes in Liquidity

Another analysis that we perform is to evaluate the determinants of abnormal returns for the two intervals that show abnormal returns; i.e., the five-day period that surrounds the announcement and ex dates. To this end, we employ a regression analysis. Our main purpose here is to see whether the abnormal returns in the two periods can be explained by change in liquidity. Specifically, we regress cumulative market-adjusted abnormal returns in the two periods on change in the Amihud illiquidity and some control variables. The regression model is:

$$\text{CAR} = \beta_0 + \beta_1\Delta\text{ILLIQ} + \beta_2\text{PO\_PRICE} + \beta_3\Delta\text{VAR} + \beta_4\text{INTF} + \beta_5\text{EXCH} + \varepsilon_t. \tag{1}$$

CAR is the cumulative market-adjusted abnormal return as reported in Table 1. ΔILLIQ is the change in the Amihud illiquidity ratios between the pre-announcement period and one of the two post-announcement periods (i.e., the announcement and ex-date periods),[7] of which a negative change means an improvement in liquidity. Improved liquidity after the announcement date could be due to a better prospectus of a firm's operating performance or to enhanced attention paid to the firm. On the other hand, improved liquidity after the ex date could result from more "affordable" stock prices to investors, especially individual investors. In either case, the improved liquidity hypothesis suggests that the

[7] Similar results are obtained when other liquidity measures are used and hence are not reported to save space.

coefficient of ΔILLIQ should be negative. PO_PRICE is share price after the split and is calculated as the share price five trading days before the split divided by (1 + split factor). If the primary motivation behind a split is to return the share price to a lower range, we should observe a negative coefficient for PO_PRICE, meaning that the market reacts more positively to lower price after the split. ΔVAR is the change in return variance between the pre-split period and the post-split period as reported in Table 4. We use return volatility as a proxy for the stock price elasticity of demand.[8] Since abnormal returns in both periods are positive, we expect ΔVAR to have a positive relation with them. INTF is a dummy variable with a value of 0 for non-integer splits (e.g., 5 for 4) and a value of 1 for integer splits (e.g., 2 for 1). The INTF dummy variable is to capture the case that non-integer splits will result a round lot holder of 100 shares to receive a fraction of a round lot. In the case that investors prefer holding round lots, then abnormal return should be smaller for non-integer splits. If this relation holds, then CAR in the announcement period will be positively related to INTF. EXCH is a dummy variable with a value of 0 for NYSE/AMEX stocks and a value of 1 for NASDAQ stocks. The exchange dummy variable is included as an additional variable to control for information asymmetry.

The results reported in Table 5 (column 1) show that the abnormal return in the five-day announcement period is significantly related to all the variables. The estimated coefficient of ΔILLIQ is negative and highly significant, suggesting that lower illiquidity leads to higher stock returns in the five-day announcement period. As expected, the split announcement effect is negatively related to the post-split stock price. ΔVAR is significantly positive, meaning that stocks with higher variance tend to have higher returns. INTF is positive and significant. The positive sign on INTF indicates that some investors may avoid trading stocks with non-integer splits. EXCH is also positive and significant, suggesting that the existence of information asymmetry between NYSE/AMEX and NASDAQ stocks.

The second column of Table 5 shows the regression results for the abnormal return in the ex-date period. ΔILLIQ, PO_PRICE, and ΔVAR can significantly explain the ex-date CAR. While ΔILLIQ can

[8] Hodrick (1999) suggests that return volatility is a good measure of the stock price elasticity of demand (defined as the percentage change in quantity demanded given a percentage change in price). He finds that higher return volatility is associated with higher elasticity.

explain the ex-date CAR, its impact on the abnormal return is only about half of that of the announcement CAR. This is probably due to the smaller improvement in liquidity based on the Amihud illiquidity for the ex-date period (−0.118) than for the announcement period (−0.334).

5. Conclusion

In this study, we examine whether liquidity improves upon firms that undertake stock splits. Using a sample of 5,497 stock splits over the period 1927-2004, we find that most liquidity measures improve following stock splits. This improved liquidity is particularly significant over the five-day interval that surrounds the split announcement date. After the announcement date but before the ex date, our liquidity measures appear to decline, although they are still greater than the pre-split level. After the ex date, liquidity has reverted to the level before the split. We obtain similar results when compare split firms to control firms. Therefore, the improvement of liquidity appears to be only a short-term phenomenon, which is limited to the period between the split announcement date and the ex date. While the signaling/attention and the target range/improved liquidity explanations of stock split actions both imply improvement in liquidity, our evidence of short-lived improved liquidity seems to be more consistent with the former story than the latter one. We also find significant increase in return volatility after the split. This post-split increase in return variance apparently is due to the increase in systematic risk after the split. Moreover, we find that changes in liquidity can significantly explain both the stock split announcement and the ex-date effects.

Appendix

This appendix presents the method developed by Holden (2007) for the purpose of estimating effective spreads using daily data. Holden develops an estimate of the effective spread that is based on price clustering. His method of calculating the effective spread does not require intraday data and hence allows researchers to estimate spread measures going back to 1926—the year that the CRSP daily database begins. The effective spread models assumes that each day the effective spread jumps randomly among multiple spread sizes and that each spread size leads to a daily trade price based on corresponding round increments. For instance, on a fractional price grid the effective spread might jump each day between \$1/16, \$⅛, \$¼, \$½, and \$1. When the spread is \$1/16, then each of the sixteen price increments (\$1/16, \$⅛, \$3/16, . . . , \$15/16, and \$1) are equally likely. When the spread is \$⅛, then each of the eight rounder price increments (\$⅛, \$¼, \$⅜, . . ., \$⅞, and \$1) is assumed to happen equally likely and odd 1/16s are not used. Thus, one can observe the frequency of odd 1/16 prices to infer the probability of a \$1/16 spread. The probability of a \$⅛ spread can be inferred by observing the difference in frequency between odd ⅛s and odd 1/16s. And so on.

The details of calculating the effective spread can be described by considering a fractional price grid with a minimum tick size of \$1/16. Let *N*(odd 1/16s), *N*(odd ⅛s), *N*(odd ¼s), *N*(odd ½s), and *N*(wholes) be the number of odd 1/16 prices, the number odd ⅛ prices, the number of odd ¼ prices, the number of odd ½ prices, and the number of whole dollar prices, respectively. The probability of each price cluster can be calculated as

$$\Pr(\text{Odd } 1/16\text{s}) = N(\text{odd } 1/16\text{s})/N(\text{Positive}),$$

$$\Pr(\text{Odd } 1/8\text{s}) = N(\text{odd } 1/8\text{s})/N(\text{Positive}),$$

$$\Pr(\text{Odd } 1/4\text{s}) = N(\text{odd } 1/4\text{s})/N(\text{Positive}),$$

$$\Pr(\text{Odd } 1/2\text{s}) = N(\text{odd } 1/2\text{s})/N(\text{Positive}), \text{ and}$$

$$\Pr(\text{Wholes}) = N(\text{Wholes})/N(\text{Positive}),$$

where *N*(Positive) is the number of positive volume days.

Next step is to calculate the inferred probability of each spread size from the price cluster probabilities. That is,

$$\Pr(1/16\text{ Spread}) = \mathit{Min}[2\cdot \Pr(\text{Odd }1/16\text{s}), 1],$$

$$\Pr(⅛\text{ Spread}) = \mathit{Min}[\mathit{Max}\{2\cdot \Pr(\text{Odd ⅛s}) - \Pr(\text{Odd }1/16\text{s}), 0\}, 1 - \Pr(1/16\text{ Spread})],$$

$$\Pr(¼\text{ Spread}) = \mathit{Min}[\mathit{Max}\{2\cdot \Pr(\text{Odd ¼s}) - \Pr(\text{Odd ⅛s}), 0\}, 1 - \Pr(1/16\text{ Spread}) - \Pr(⅛\text{ Spread})],$$

$$\Pr(½\text{ Spread}) = \mathit{Min}[\mathit{Max}\{2\cdot \Pr(\text{Odd ½s}) - \Pr(\text{Odd ¼s}), 0\}, 1 - \Pr(1/16\text{ Spread}) - \Pr(⅛\text{ Spread}) - \Pr(¼\text{ Spread})],$$

$$\Pr(1\text{ Spread}) = \mathit{Min}[\mathit{Max}\{\Pr(\text{Wholes}) - \Pr(\text{Odd ½s}), 0\}, 1 - \Pr(1/16\text{ Spread}) - \Pr(⅛\text{ Spread}) - \Pr(¼\text{ Spread}) - \Pr(½\text{ Spread})].$$

Given the inferred probability of each spread size, our fifth liquidity measure, the dollar spread (or the dollar effective tick) can be calculated as a weighted average of each spread size

$$\text{Dollar Spread} = \Pr(1/16\text{ Spread})\cdot(1/16) + \Pr(⅛\text{ Spread})\cdot(⅛) + \Pr(¼\text{ Spread})\cdot(¼) + \Pr(½\text{ Spread})\cdot(½) + \Pr(1\text{ Spread})\cdot(1).$$

Our sixth liquidity measure, the relative spread can be calculated as

$$\text{Relative Spread} = \text{Dollar Spread}/\mathit{Price},$$

where *Price* is average daily trading price.

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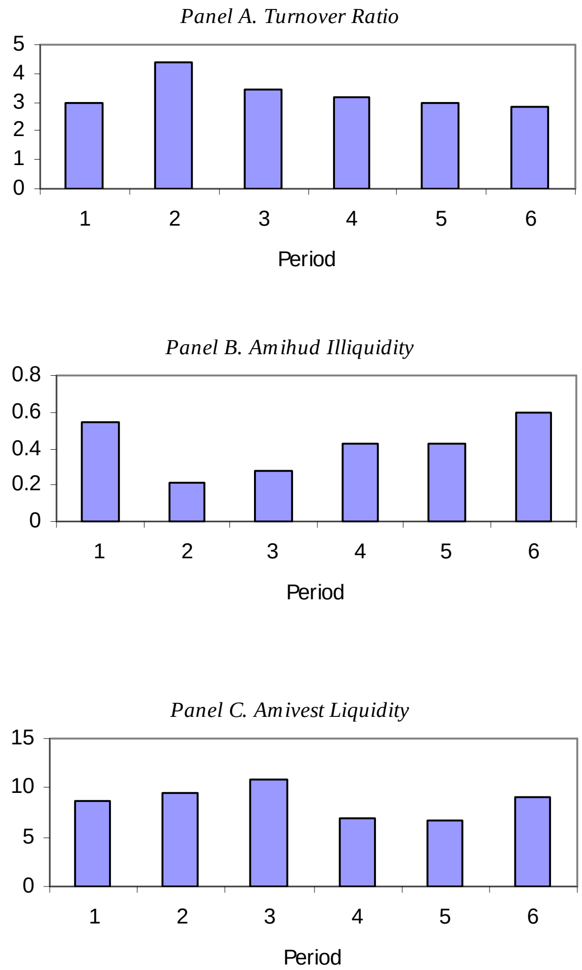

Figure 1. Liquidity measures around stock splits. This figure reports means of the six liquidity measures for the sample splitting firms. To be included in the sample, a splitting firm needs to meet the following criteria: (i) the split factor is at least 0.25, which is equivalent to a 5-for-4 split; (ii) the splitting shares are not ADRs, SBIs, REITs, and closed-end funds; (iii) a splitting firm needs to wait for two years before it can reenter the stock split sample; and (iv) stock prices, number of shares outstanding, trading volume, and return data are available in the CRSP daily return file from 252 days prior to the split announcement date to 260 days after the ex date. The sample period is 1927-2004. The liquidity measures include turnover, Amihud's illiquidity ratio ($\times 10^6$), the Amivest liquidity ratio ($\times 10^{-8}$), zeros, dollar spread, and effective spread ($\times 10^2$). The means are calculated using observations that have been Winsorized at the first and the 99th percentiles. Six periods are reported including the pre-announcement (Period 1, $t_{announce}-252$ to $t_{announce}-3$), the split announcement (Period 2, $t_{announce}-2$ to $t_{announce}+2$), the announcement-to-ex-date (Period 3, $t_{announce}+3$ to $t_{ex}-1$), the ex-date (Period 4, $t_{ex}0$ to $t_{ex}+4$), the short-term post-ex (Period 5, $t_{ex}+5$ to $t_{ex}+10$), and the post-ex (Period 6, $t_{ex}+11$ to $t_{ex}+260$) periods.

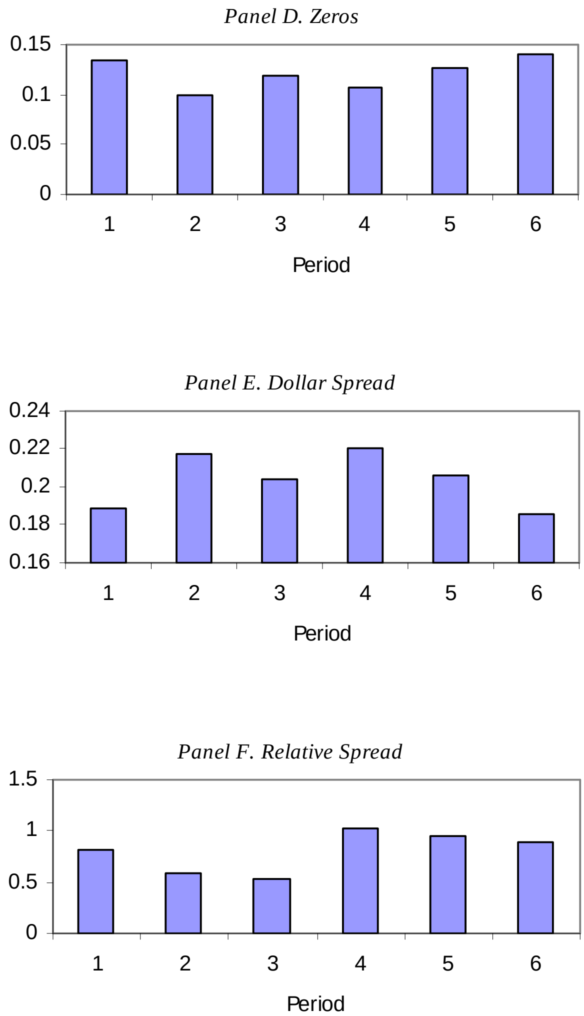

Figure 1 (*continued*)

Table 1 Description of Sample

This table describes the stock split sample used in the current study. To be included in the sample, a splitting firm needs to meet the following criteria: (i) the split factor is at least 0.25, which is equivalent to a 5-for-4 split; (ii) the splitting shares are not ADRs, SBIs, REITs, and closded-end funds; (iii) a splitting firm needs to wait for two years before it can reenter the stock split sample; and (iv) stock prices, number of shares outstanding, trading volume, and return data are available in the CRSP daily return file from 252 days prior to the split announcement date to 260 days after the ex date. The sample period is 1927-2004. *RUNUP* is rate of return calculated using the price of a firm's stock five trading days prior to the split announcement and the price one year before the split announcement. The cumulative market-adjusted abnormal return is calculated using the CRSP equally-weighted index as a proxy for the market portfolio. $t_{announce}$ is the split announcement date. t_{ex} is the split ex date. The means and medians are calculated using observations that have been Winsorized at the first and the 99th percentiles. Significance levels are based on a *t*-test for the means and the Wilcoxon signed rank test for the medians. ***, **, and * denote significant at the 1 percent, 5 percent, and 10 percent levels, respectively. All the numbers are in percentage.

Panel A: By split ratio

Split Ratio	Number of Splits
Three-for-One	339 (6.2%)
Two-for-One	3116 (56.7%)
Three-for-Two	1512 (27.5%)
Four-for-Three	94 (1.7%)
Five-for-Four	271 (4.9%)
Other	165 (3.0%)
Total	5497 (100%)

Panel B: Market performance

	Mean	Median
RUNUP (%)	168.841***	143.652***
Cumulative market-adjusted return (%):		
$t_{announce}-252$ to $t_{announce}-3$	26.871***	18.479***
$t_{announce}-2$ to $t_{announce}+2$	3.044***	2.087***
$t_{announce}+3$ to $t_{ex}-1$	−0.314**	−0.534***
$t_{ex}0$ to $t_{ex}+4$	1.162***	0.601***
$t_{ex}+5$ to $t_{ex}+10$	−0.242***	−0.548***
$t_{ex}+11$ to $t_{ex}+260$	−10.167***	−8.685***

Table 2 Liquidity Measures around Stock Splits

This table compares the mean liquidity measures between splitting firms and their matched firms for six intervals, including the pre-announcement ($t_{announce}-252$ to $t_{announce}-3$), the split announcement ($t_{announce}-2$ to $t_{announce}+2$), the announcement-to-ex-date ($t_{announce}+3$ to $t_{ex}-1$), the ex-date ($t_{ex}0$ to $t_{ex}+4$), the short-term post-ex ($t_{ex}+5$ to $t_{ex}+10$), and the post-ex ($t_{ex}+11$ to $t_{ex}+260$) periods. The liquidity measures include turnover, Amihud's illiquidity ratio, the Amivest liquidity ratio, zeros, dollar spread, and relative spread. The means are calculated using observations that have been Winsorized at the first and the 99th percentiles. Change is the change from the pre-announcement period to a post-announcement period. The significance levels are for testing a zero difference using a *t*-test. ***, **, and * denote significant at the 1 percent, 5 percent, and 10 percent levels, respectively.

Intervals	Liquidity Measures	Change
	Panel A: Turnover Ratio	
Pre-Announcement Period	2.955	
Announcement Period	4.364	1.408***
Announcement-to-Ex Period	3.428	0.473***
Ex-Date Period	3.142	0.186***
Short-Term Post-Ex Period	3.005	0.049
Post-Ex Period	2.861	−0.095***
	Panel B: Amihud Illiquidity ($\times 10^6$)	
Pre-Announcement Period	0.544	
Announcement Period	0.210	−0.334***
Announcement-to-Ex Period	0.278	−0.265***
Ex-Date Period	0.425	−0.118***
Short-Term Post-Ex Period	0.425	−0.118***
Post-Ex Period	0.596	0.053***
	Panel C: Amivest Liquidity ($\times 10^{-8}$)	
Pre-Announcement Period	8.619	
Announcement Period	9.401	0.783***
Announcement-to-Ex Period	10.801	2.183***
Ex-Date Period	6.934	−1.685***
Short-Term Post-Ex Period	6.652	−1.967***
Post-Ex Period	9.005	0.386**
	Panel D: Zeros	
Pre-Announcement Period	0.135	
Announcement Period	0.099	−0.036***
Announcement-to-Ex Period	0.118	−0.017***
Ex-Date Period	0.108	−0.027***
Short-Term Post-Ex Period	0.126	−0.010***
Post-Ex Period	0.140	0.004***
	Panel E: Dollar Spread ($)	
Pre-Announcement Period	0.189	
Announcement Period	0.217	0.028***
Announcement-to-Ex Period	0.204	0.015***
Ex-Date Period	0.220	0.031***
Short-Term Post-Ex Period	0.206	0.017***
Post-Ex Period	0.186	−0.003***
	Panel F: Relative Spread ($\times 10^2$)	
Pre-Announcement Period	0.807	
Announcement Period	0.583	−0.224***
Announcement-to-Ex Period	0.539	−0.268***
Ex-Date Period	1.020	0.213***
Short-Term Post-Ex Period	0.958	0.151***
Post-Ex Period	0.887	0.080***

Table 3 Liquidity Measures for the Stock Split Firms and Matching Non-Split Firms

This table compares the mean liquidity measures between splitting firms and their matched firms for six intervals, including the pre-announcement ($t_{announce}$−252 to $t_{announce}$−3), the split announcement ($t_{announce}$−2 to $t_{announce}$+2), the announcement-to-ex-date ($t_{announce}$+3 to t_{ex}−1), the ex-date (t_{ex}0 to t_{ex}+4), the short-term post-ex (t_{ex}+5 to t_{ex}+10), and the post-ex (t_{ex}+11 to t_{ex}+260) periods. The liquidity measures include turnover, Amihud's illiquidity ratio, the Amivest liquidity ratio, zeros, dollar spread, and relative spread. Matching non-split firms are chosen based on the exchange, stock price in day −3 prior to the split announcement, and Amihud's illiquidity ratio. The means are calculated using observations that have been Winsorized at the first and the 99^{th} percentiles. Difference is the difference between the split firms and the control firms. The significance levels are for testing a zero difference using a *t*-test. ***, **, and * denote significant at the 1 percent, 5 percent, and 10 percent levels, respectively.

Intervals	Split Firms	Control Firms	Difference
Panel A: Turnover Ratio			
Pre-Announcement Period	2.955	2.477	0.479***
Announcement Period	4.364	2.419	1.944***
Announcement-to-Ex Period	3.428	2.439	0.989***
Ex-Date Period	3.142	2.383	0.759***
Short-Term Post-Ex Period	3.005	2.441	0.564***
Post-Ex Period	2.861	2.368	0.393***
Panel B: Amihud Illiquidity ($\times 10^6$)			
Pre-Announcement Period	0.544	0.437	0.107***
Announcement Period	0.210	0.346	−0.137***
Announcement-to-Ex Period	0.278	0.387	−0.109***
Ex-Date Period	0.425	0.345	0.080***
Short-Term Post-Ex Period	0.425	0.377	0.049***
Post-Ex Period	0.596	0.452	0.144***
Panel C: Amivest Liquidity ($\times 10^{-8}$)			
Pre-Announcement Period	8.619	12.631	−4.012***
Announcement Period	9.401	9.188	0.213
Announcement-to-Ex Period	10.801	10.093	0.708**
Ex-Date Period	6.934	9.061	−2.127***
Short-Term Post-Ex Period	6.652	8.970	−2.318***
Post-Ex Period	9.005	11.894	−2.890***
Panel D: Zeros			
Pre-Announcement Period	0.135	0.133	0.003***
Announcement Period	0.099	0.133	−0.034***
Announcement-to-Ex Period	0.118	0.133	−0.014***
Ex-Date Period	0.108	0.136	−0.028***
Short-Term Post-Ex Period	0.126	0.135	−0.009***
Post-Ex Period	0.140	0.133	0.006***
Panel E: Dollar Spread ($)			
Pre-Announcement Period	0.189	0.194	−0.005***
Announcement Period	0.217	0.219	−0.003
Announcement-to-Ex Period	0.204	0.208	−0.004***
Ex-Date Period	0.220	0.220	0.000
Short-Term Post-Ex Period	0.206	0.206	0.000
Post-Ex Period	0.186	0.194	−0.007***
Panel F: Relative Spread ($\times 10^2$)			
Pre-Announcement Period	0.807	0.561	0.246***
Announcement Period	0.583	0.612	−0.030***
Announcement-to-Ex Period	0.539	0.595	−0.056***
Ex-Date Period	1.020	0.634	0.386***
Short-Term Post-Ex Period	0.958	0.597	0.361***
Post-Ex Period	0.887	0.566	0.321***

Table 4 Changes in Risk around Stock Splits

This table compares various risk measures between splitting firms and their matched firms for the pre-split ($t_{announce}-252$ to $t_{announce}-3$) and the post-split period ($t_{ex}+11$ to $t_{ex}+260$) periods. Return variance is variance of daily returns. Betas are estimated by regressing daily stock returns on contemporaneous returns of the CRSP equally-weighted index. Systematic risk ratio is the ratio between systematic risk, which is calculated as beta squared times the variance of the CRSP equally-weighted index returns, and total risk. Difference is the change of split firms minus the change of control firms. Matching non-split firms are chosen based on the exchange, stock price in day −3 prior to the split announcement, and Amihud's illiquidity ratio. The means are calculated using observations that have been Winsorized at the first and the 99th percentiles. Change is the change from the pre-split period to the post-split period. Difference is the difference between the split firms and the control firms. The significance levels are for testing a zero difference using a *t*-test. ***, **, and * denote significant at the 1 percent, 5 percent, and 10 percent levels, respectively.

Intervals	Split Firms	Control Firms	Difference
Panel A: Return Variance ($\times 10^2$)			
Pre-Split Period	0.063	0.053	0.010***
Post-Split Period	0.088	0.058	0.030***
Change	0.025***	0.006***	0.020***
Panel B: Beta			
Pre-Split Period	1.091	0.975	0.117***
Post-Split Period	1.262	0.951	0.311***
Change	0.172***	−0.024***	0.194***
Panel C: Systematic Risk Ratio			
Pre-Split Period	0.114	0.112	0.002
Post-Split Period	0.130	0.127	0.003**
Change	0.016***	0.015***	0.001

Table 5 Regressions to Explain Announcement-Date and Ex-Date Abnormal Returns

This table reports the regression coefficients from regressing CAR (cumulative market-adjusted abnormal return) on change in liquidity, post-split share price, change in return volatility, and various control variables. The regression model is

$$\text{CAR} = \beta_0 + \beta_1\Delta\text{ILLIQ} + \beta_2\text{PO\_PRICE} + \beta_3\Delta\text{VAR} + \beta_4\text{INTF} + \beta_5\text{EXCH} + \varepsilon_t.$$

CAR is cumulative market-adjusted abnormal return. ΔILLIQ is difference in the Amihud illiquidity ratios between the split firms and the matching non-split firms for the announcement period or the ex-date period. PO_PRICE is share price after the split and is calculated as the share price 5 trading days before the split announcement divided by (1 + split factor). ΔVAR is change in return variance between the pre-split period and the post-split period. INTF is a dummy variable with a value of 0 for non-integer splits (e.g., 5 for 4) and a value of 1 for integer splits (e.g., 2 for 1). EXCH is a dummy variable with a value of 0 for NYSE/Amex stocks and a value of 1 for Nasdaq stocks. To reduce the effect of outliers, CAR, ILLIQ, and VAR have been Winsorized at the first and the 99th percentiles. Inside the parentheses are *t*-statistics. ***, ** and * denote significant at the 1 percent, 5 percent, and 10 percent levels, respectively.

	Dependent Variables	
	Announcement Period CAR	Ex-Date Period CAR
Intercept	0.056***	0.021***
	(25.390)	(8.983)
ΔILLIQ	−0.049**	−0.020**
	(−2.080)	(−2.470)
PO_PRICE	−0.001***	−0.001***
	(−18.015)	(−5.407)
ΔVAR	2.941**	5.017***
	(2.187)	(3.428)
INTF	0.005***	−0.003
	(2.908)	(−1.377)
EXCH	0.004**	0.002
	(2.348)	(0.891)
Adjusted R^2	0.067	0.010