J Econ Finan
DOI 10.1007/s12197-013-9250-6

The effects of stock splits on stock liquidity

Gow-Cheng Huang · Kartono Liano · Ming-Shiun Pan

Abstract This study examines the effects of stock splits on stock liquidity. We find that most liquidity measures increase substantially around the stock split announcement. After the announcement date, split firms' liquidity declines, but is still above the pre-split level. However, after the ex-date, the liquidity drops below the pre-split level. Thus, the impact of stock splits on stock liquidity appears to be short-lived. We also find that the change in liquidity can significantly explain the announcement effect, but not the ex-date effect. Overall, our results seem to be more consistent with the signaling hypothesis and/or the attention-grabbing hypothesis than with the improved liquidity hypothesis.

Keywords Stock splits · Liquidity · Signaling · Attention-grabbing

JEL Classifications G14 · G30

1 Introduction

Stock splits appear to be an interesting corporate event to analyze. While stock splits do not affect a firm's financial fundamentals, the market tends to react to them positively. The literature suggests that stock splits are to improve the liquidity of trading by realigning stock prices to an "optimal" trading range (Copeland (1979)), to

G.-C. Huang
Department of Accounting and Finance, Alabama State University, Montgomery, AL 36101-0271, USA
e-mail: ghuang@alasu.edu

K. Liano (✉)
Department of Finance and Economics, Mississippi State University, Mississippi State, MS 39762, USA
e-mail: kliano@cobilan.msstate.edu

M.-S. Pan
Department of Finance and Supply Chain Management, Shippensburg University, Shippensburg, PA 17257, USA
e-mail: mspan@ship.edu

Published online: 23 February 2013

draw attention to the stock (Grinblatt et al. (1984)), or to signal management's private information about the firm's future performance (Brennan and Copeland (1988)). Indeed, the popular explanations for stock splits all imply an improvement in liquidity. The survey conducted by Baker and Powell (1992) also reports that firms undertake stock splits mainly to move stock prices to a desired trading range and to improve the stock liquidity. 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 in order to minimize 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.

However, the empirical evidence regarding the effects of stock splits on stock liquidity is mixed. While several studies (e.g., Powell and Baker (1993/1994), Desai et al. (1998), Easley et al. (2001), and Dhar et al. (2004)) document an enlarged ownership base after stock splits and an increase in trading activity, other studies (e.g., Conroy et al. (1990) and Gray et al. (2003)) show an increase in relative bid-ask spreads after the split ex-date,[1] suggesting that stocks become less liquid after stock splits.

In this paper, we examine the effects of stock splits on stock liquidity. Unlike prior studies that mostly focus on bid-ask spreads as liquidity measures, we consider five 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.

Prior studies tend to confine their analyses to liquidity changes after the split ex-date. The impact of stock splits on liquidity over short periods, especially the period between the announcement date and the ex-date, has not been examined in detail in the literature.[2] It is noteworthy that the popular explanations for stock splits all imply an increase in trading liquidity. However, they have different implications on when the increase in trading liquidity will occur and also on whether the increase in trading liquidity is a short- or long-term phenomenon. If stock splits are made to draw investors' attention or to signal a firm's prospects, then we should expect an increase in the demand for the stock when the split announcement is made. Thus, a stock split announcement will induce a positive market reaction and an increase in liquidity. However, the market efficiency suggests that both the positive market reaction and the liquidity improvement do not last long. That is, the attention-grabbing and signaling hypotheses imply a short-term improvement in liquidity. In contrast, if the target range/improved liquidity hypothesis holds, a positive market reaction and improved liquidity may not occur until the ex-date when the new share replaces the unsplit share in trading. Moreover, the improvement in trading liquidity should be a long-term, not a transitory, phenomenon.

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

[2] Goyenko et al. (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.

In summary, whether the impact of stock splits on liquidity is a short- or long-term effect and when the change occurs have different implications on the validity of the various hypotheses. To this end, we examine liquidity changes between the pre-announcement period and various event windows that surround the announcement date and the ex-date, including the announcement, the post-announcement to pre-ex, the ex-date, and the post-ex periods.

Using 6,463 stock splits for the period 1960–2010, we find that stock liquidity increases significantly in the split announcement period relative to the pre-announcement period. After the announcement date, the stock liquidity declines but remains above its pre-split level. Several days after the ex-date, the stock liquidity returns back to its pre-split level. However, the stock liquidity declines significantly over a one-year period after the ex-date. Our results are robust to different liquidity measures. Similar results also hold when we compare liquidity measures of split firms to control firms. In short, stock splits improve stock liquidity, but the improvement in liquidity is a short-term phenomenon that is observed only in the period between the split announcement date and the ex-date. In the long run, stock liquidity actually declines. We also find that stock liquidity can significantly explain the abnormal return in the announcement period, but not in the ex-date period. Overall, our results are more consistent with the view that stock splits are made to draw attention or to signal rather than to improve stock liquidity in the long run.

The rest of the paper is organized as follows. Section 2 reviews related studies and develops research questions. Section 3 describes our measures of stock liquidity and the testing method. Section 4 describes the stock split sample and their abnormal stock returns around the split announcement date and the ex-date. In section 5, we report the impact of stock splits on various stock liquidity measures. Section 5 also analyzes whether the change in stock liquidity can help explain the announcement and ex-date effects. Section 6 concludes the paper.

2 Related studies and research questions

The stock market tends to react positively to stock split announcements. The positive market reaction implies buying pressure from investors around the split announcement date. Several explanations have been proposed to explain the positive market reaction, including the signaling hypothesis (Brennan and Copeland (1988)), the attention-grabbing hypothesis (Grinblatt et al. (1984)), and the trading range/improved liquidity hypothesis (Copeland (1979)). While these explanations are not mutually exclusive, they all imply an improvement in stock trading liquidity. However, the three hypotheses have different implications on when the stock trading liquidity will improve and whether the improvement in the stock trading liquidity is a short- or long-term phenomenon. In this study, we analyze the effects of stock splits on the trading liquidity.

According to the signaling hypothesis (Brennan and Copeland (1988)), stock splits are associated with positive announcement abnormal returns because management of firms uses stock splits to convey favorable private information about their firm's future prospects. The positive signal induces buying pressure from investors and hence an increase in the stock price. Lakonishok and Lev (1987) provide some

support for the signaling hypothesis. They find that splitting firms exhibit a higher growth in earnings than non-splitting firms in the first post-split year. McNichols and Dravid (1990) find that analysts' one-year-ahead earnings forecast errors are positively correlated with the announcement abnormal return.

Thus, the signaling hypothesis implies an increase in the demand of the stock shares of splitting firms around the split announcement date. However, if the market is efficient, the increase in trading activity due to the positive split signal should not last long and should be limited to the announcement period. Accordingly, we expect the following hypothesis to hold:

> H1: The signaling theory predicts that the trading liquidity of a split stock will increase around the announcement date, but not in any periods after the announcement.

Instead of signaling, Grinblatt et al. (1984) argue that splits can reduce information asymmetry by attracting attention paid to a firm. Grinblatt et al.'s argument is consistent with the attention-grabbing hypothesis of Barber and Odean (2008). The attention-grabbing hypothesis posits that individual investors have limited attention and tend to buy a stock that they currently do not own if some news grabs their attention. Under the attention-grabbing hypothesis, firms use stock splits to attract more trading, especially from small investors. The empirical literature suggests an enlarged ownership base after stock splits (Schultz (2000) and Easley et al. (2001)) and more analysts following the stock (Brennan and Hughes (1991)). Similar to the signaling explanation, if stock splits are made to attract attention, any increase in trading should last for only a short-term period around the split announcement date. Our second hypothesis is as follows:

> H2: The attention-grabbing theory predicts that the trading liquidity of a split stock will increase around the announcement date, but not in any periods after the announcement.

The third explanation for stock splits is that firms use them to reverse their stock prices to a certain trading range in order to improve the liquidity of trading (Copeland (1979)). This hypothesis suggests that investors, particularly small investors, prefer to trade stocks with a price that is within a certain range. When the price of a stock is "too high," small investors might be reluctant to trade the stock because of higher brokerage fees relative to the value traded. A stock split can minimize brokerage costs and hence will improve the trading liquidity (Muscarella and Vetsuypens (1996)).[3] Stock splits can also create trading liquidity when there are minimum tick size restrictions (Anshuman and Kalay (2002)). In addition, 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 stock price to an optimal trading range as

[3] Angel (1997) argues that stock splits are undertaken in order to move the tick size relative to the stock price to a desired level. Angel's idea is that a large tick size provides 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 stock splits, which is consistent with Angel's broker promotion argument.

the main reason for the split. Lakonishok and Lev (1987) find that stock splits are mainly made to lower prices to a normal range. Easley et al. (2001) find an increase in the number of uninformed trades following stock splits. They interpret their finding to be consistent with the trading range hypothesis. Dhar et al. (2004) find that individual investors trade more after stock splits with smaller trade sizes.

Unlike the other two hypotheses, the trading range/improved liquidity hypothesis implies that the improvement in the trading liquidity will not occur until the split ex-date when the new share replaces the unsplit share in trading. Furthermore, the effect of stock splits on the trading liquidity of a stock should be a long-term phenomenon. Thus, we have the following:

> H3: The trading range/improved liquidity hypothesis predicts that the trading liquidity of a split stock will improve after the ex-date and the improvement is long lasting.

3 Empirical methods

If stock splits convey positive information on a firm's future profitability to the market, then trading liquidity of the 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 is the primary purpose of stock splits, then trading liquidity likely will not increase before the ex-date because the share price will not change until this date. Thus, the signaling hypothesis implies an improvement in liquidity right after the announcement date, while the trading range hypothesis suggests an improvement in liquidity after the ex-date. To investigate which hypothesis between the two explanations better explains the stock split decision, we examine the change in stock trading liquidity over a two-year window surrounding the split announcement date (AD) and the ex-date (ED). Specifically, we examine six periods: the pre-announcement (from AD−252 to AD−3), the announcement (from AD−2 to AD+2), the announcement-to-ex-date (from AD+3 to ED −1), the ex-date (from ED0 to ED+4), the short-term post-ex (from ED+5 to ED+10), and the post-ex (from ED+11 to ED+260) periods. For each of our liquidity measures, we compare their mean value to the pre-announcement period to examine whether or not the stock liquidity improves following stock splits.

We employ five variables to measure stock trading liquidity. These five liquidity variables represent measures on trade, stock price impact, and bid-ask spread. Unlike prior studies that use intraday trade and quote data from the Trades and Quotes (TAQ) database, we use daily data to calculate these liquidity measures. Using daily data allows us to conduct our analysis for a much longer sample period, rather than after 1993 when the TAQ database becomes available. The five stock trading liquidity measures include:

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 (e.g., Datar et al. (1998) and Banerjee et al. (2007)) have used the turnover ratio as a proxy for trading liquidity because turnover is negatively correlated

with the bid-ask spread. A higher turnover ratio means an improvement in liquidity.

2. Amihud illiquidity ratio: This illiquidity measure is proposed by Amihud (2002) and is calculated as $\frac{1}{N}\sum\frac{|R_t|}{VOLD_t}$, where $|R_t|$ is the absolute return on day t, and $VOLD_t$ is dollar trading volume on day t, and N is the number of days for which data are available (i.e., trading volume is not zero). As Amihud points out, this ratio measures how daily stock price reacts to a dollar of trading volume and 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 calculated from microstructure data.
3. 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 et al. (1999) as a proxy for transaction costs, which can be seen as the sum of the bid-ask spread and the commission. They propose a 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 use the observed incidence of zero returns to infer the liquidity of a security.
4. Dollar spread: Following Holden (2009), we estimate the dollar spread of a stock using the time series of daily stock returns. Holden develops an estimate of the dollar spread based on price clustering. In his model with a fractional tick size, the dollar spread can be inferred by checking the frequency of transactions that occur on odd 1/16 s, odd 1/8 s, odd 1/4 s, odd 1/2 s, and whole dollars. Similarly, for a decimal pricing, the dollar spread can be inferred by checking the frequency of transactions that occur on off pennies, off nickels, off dimes, off quarters, off half dollars, and whole dollars. Note that Holden's estimation of dollar spread requires only time series of daily stock trading prices, but not continuously quoted bid-ask spreads. Therefore, we are able to perform the analysis for time periods that intraday data are not available. Goyenko et al. (2009) sample various proxies for liquidity based on daily data and compare them with those calculated from the TAQ database. They find that Holden's dollar spread and price impact proxies are the best monthly liquidity measures.
5. Relative spread: The relative spread is calculated by dividing the dollar spread with the average daily trading price.

4 Data and descriptive statistics

We employ the CRSP daily return file to identify all NYSE, AMEX, and NASDAQ firms that have stock splits. We exclude ADRs, SBIs, REITs, and closed-end funds from our analysis. To be included in the sample, a firm has to meet the following criteria: (1) it announced a stock split; (2) the split factor is at least 0.25, which is equivalent to a 5-for-

4 split; (3) at least 60 % of daily stock prices, trading volume, and return data are available in the CRSP daily file from 252 days before the split announcement date to 260 days after the ex-date. We also require a split firm to wait for 2 years before it can reenter the final sample to avoid dependence in overlapping data. Our final sample consists of 6,463 split announcements made during the period 1960–2010.

Table 1 presents the frequency distribution of our sample observations. Our sample starts in 1960 because stock splits become more popular after that year. We observe more stock splits in the late 1990s during the dotcom boom.

Table 2, Panel A reports the number of stock splits by split ratio. Similar to prior research, certain split ratios are more common than others. About 53 % (3,418 observations) of the sample have a 2-for-1 stock split; another 32 % are for a 3-for-2 split.

Table 2, Panel B reports the price run-up before the split announcement and cumulative market-adjusted abnormal returns for various windows. The mean price run-up is 64.570 % over the pre-announcement period (AD−252, AD−3). Similarly, the mean

Table 1 Frequency of sample by year

Year	Number	Year	Number
1960	23	1986	295
1961	28	1987	211
1962	24	1988	95
1963	42	1989	178
1964	82	1990	105
1965	94	1991	146
1966	93	1992	212
1967	98	1993	224
1968	141	1994	154
1969	100	1995	245
1970	33	1996	276
1971	69	1997	280
1972	75	1998	235
1973	60	1999	221
1974	23	2000	181
1975	48	2001	110
1976	107	2002	119
1977	103	2003	124
1978	128	2004	194
1979	102	2005	204
1980	170	2006	136
1981	135	2007	97
1982	92	2008	42
1983	191	2009	6
1984	89	2010	37
1985	186	All	6,463

This table contains the frequency of stock splits by year

Table 2 Summary statistics

Panel A: By Split Ratio		
Split Ratio	Number of Splits	
Three-for-One	297 (4.6 %)	
Two-for-One	3,418 (52.9 %)	
Three-for-Two	2,065 (31.9 %)	
Four-for-Three	159 (2.5 %)	
Five-for-Four	394 (6.1 %)	
Other	130 (2.0 %)	
All	6,463 (100 %)	
Panel B: Market Performance		
	Mean	Median
RUNUP (%)	64.570***	42.056***
Cumulative Market-Adjusted Return (%):		
Pre-Announcement Period	29.199***	20.918***
Announcement Period	3.164***	2.357***
Announcement-to-Ex Period	0.278**	−0.032
Ex-Date Period	1.292***	0.764***
Short-Term Post-Ex Period	0.057	−0.282**
Long-Term Post-Ex Period	−3.110***	−2.868

This table reports stock splits over the period 1960 to 2010. *RUNUP* is rate of return over the window (AD −252, AD−3). The cumulative market-adjusted abnormal return is the return difference between the sample split firm and the CRSP equally-weighted index. The cumulative market-adjusted abnormal returns are calculated for six intervals, including the pre-announcement (AD−252, AD−3), the split announcement (AD−2, AD+2), the announcement-to-ex-date (AD+3, ED−1), the ex-date (ED0, ED+4), the short-term post-ex (ED+5, ED+10), and the long-term post-ex (ED+11, ED+260) periods. The means and medians are calculated using observations that have been winsorized at the first and the 99th percentiles. Significance levels are for testing a zero mean using a *t*-test and a zero median using the Wilcoxon signed rank test. *** and ** denote significant at the 1 % and 5 % levels, respectively

cumulative market-adjusted abnormal return over the pre-split one-year period is 29.199 %, which is highly significant.[4] The results suggest that most firms announce a stock split when they experience a substantial price increase in the year before the announcement. Consistent with the literature, the market reacts positively to the split announcements. The mean cumulative market-adjusted abnormal return is 3.164 % over the announcement period (AD–2, AD+2), indicating a favorable market reaction to the split announcements. The positive market reaction suggests that stock splits lead to a higher demand in the split firms' shares by investors. This greater demand could be due to some sort of information content in signaling, a more "attractive" share price, or both. Either case, the higher demand should lead to improved trading liquidity.

Our sample split firms also exhibit a positive mean cumulative market-adjusted abnormal return of 0.278 % over the announcement-to-ex period (AD+3, ED−1).[5] This finding is inconstant with Nayar and Rozeff (2001), in which they point out that

[4] The market-adjusted return is the return difference between a split firm and the CRSP equally-weighted index.

[5] However, the median return is statistically insignificant.

trading pre-split shares 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 over the ex-date period (ED0, ED+4). The mean abnormal return over this period is 1.292 % and is highly significant. Nayar and Rozeff (2001) argue that the ex-date effect arises because the inconvenience of trading unsplit shares leads to a decrease in the stock price near the record date and an increase in the stock price around the ex-date. On the other hand, Kadapakkam et al. (2005) suggest that the positive ex-date abnormal return is related to brokers' promotion of split stocks to small investors. Regardless of which hypothesis is more appropriate in explaining the rise of stock price near the ex-date, both explanations suggest an ex-date effect.

It is reasonable to expect that market frictions associated with unsplit shares will be resolved quickly after the ex-date since at that time, the problem with a due bill has disappeared. Thus, there will be no abnormal return after the ex-date if the trading inconvenience hypothesis holds. On the other hand, the broker promotion hypothesis implies that larger relative bid-ask spreads after the split will 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 the bid-ask spread remains large. Consequently, abnormal return might continue after the ex-date. We do not find a significant cumulative market-adjusted return over the short-term post-ex period (ED+5, ED+10) (see Table 2). Our results appear to be consistent with the trading inconvenience hypothesis, rather than with the broker promotion hypothesis.

We also examine abnormal returns over a one-year post-split period after the ex-date. The results reported in Table 2 show a negative abnormal return 1 year after the ex-date. This finding is consistent with Boehme and Danielsen (2007), in which they find that the split announcement abnormal return does not persist after the ex-date.

In short, abnormal returns exist only in the window from the split announcement date to the ex-date. No evidence of positive abnormal return is found in the short- and long-term post-split periods.

5 Empirical results

In this section, we report the effects of stock splits on stock liquidity. The results are reported in two parts. The first part evaluates whether or not the split firms' stock liquidity improves after the split. Specifically, we compare the liquidity measures between the pre-split period and various post-announcement periods and test whether these liquidity changes are significant. The second part shows whether the change in stock liquidity can help explain the split announcement and the ex-date effects.

5.1 Change in stock liquidity

Table 3 reports the stock liquidity measures during six periods, including the pre-announcement period (AD−252, AD−3), the announcement period (AD–2, AD+2),

Table 3 Liquidity measures around stock splits

Intervals	Liquidity measures	Change
Panel A: Trading Turnover (%)		
Pre-Announcement Period	0.391	
Announcement Period	0.552	0.160***
Announcement-to-Ex Period	0.445	0.054***
Ex-Date Period	0.404	0.012***
Short-Term Post-Ex Period	0.391	0.000
Long-Term Post-Ex Period	0.384	−0.008***
Panel B: Amihud Illiquidity ($\times 10^{-6}$)		
Pre-Announcement Period	0.288	
Announcement Period	0.130	−0.158***
Announcement-to-Ex Period	0.169	−0.119***
Ex-Date Period	0.257	−0.031***
Short-Term Post-Ex Period	0.255	−0.034***
Long-Term Post-Ex Period	0.309	0.020***
Panel C: Zeros (%)		
Pre-Announcement Period	11.096	
Announcement Period	8.112	−2.984***
Announcement-to-Ex Period	9.724	−1.371***
Ex-Date Period	8.832	−2.264***
Short-Term Post-Ex Period	10.700	−0.395**
Long-Term Post-Ex Period	11.408	0.312***
Panel D: Dollar Spread ($)		
Pre-Announcement Period	0.187	
Announcement Period	0.221	0.034***
Announcement-to-Ex Period	0.208	0.021***
Ex-Date Period	0.222	0.036***
Short-Term Post-Ex Period	0.209	0.022***
Long-Term Post-Ex Period	0.184	−0.003***
Panel E: Relative Spread (%)		
Pre-Announcement Period	0.766	
Announcement Period	0.628	−0.138***
Announcement-to-Ex Period	0.577	−0.189***
Ex-Date Period	1.041	0.276***
Short-Term Post-Ex Period	0.974	0.209***
Long-Term Post-Ex Period	0.824	0.059***

This table provides the mean liquidity measures of the split firms for six intervals, including the pre-announcement (AD−252, AD−3), the split announcement (AD−2, AD+2), the announcement-to-ex-date (AD+3, ED−1), the ex-date (ED0, ED+4), the short-term post-ex (ED+5, ED+10), and the long-term post-ex (ED+11, ED+260) periods. The liquidity measures include trading turnover, Amihud illiquidity 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 in a liquidity measure from the pre-announcement period to a post-announcement period. The significance levels are for testing a zero mean using a *t*-test. *** and ** denote significant at the 1 % and 5 % levels, respectively

the announcement-to-ex period (AD+3, ED−1), the ex-date period (ED0, ED+4), the short-term post-ex period (ED+5, ED+10), and the long-term post-ex period (ED+11, ED+260). Panel A shows that the turnover ratio of the split firms increases substantially from the pre-announcement period to the announcement period, and then declines monotonically in the subsequent four periods following the announcement. After the ex-date, the turnover ratio appears to revert back to its pre-split level. Specifically, the mean turnover ratio increases from 0.391 % in the pre-announcement period to 0.552 % in the announcement period. After the split announcement, the mean falls to 0.445 % in the announcement-to-ex period, 0.404 % in the ex-date period, 0.391 % in the short-term post-ex period, and 0.384 % in the long-term post-ex period. That the turnover ratio peaks in the split announcement period may reflect the optimism on the split firms' operating performance shared by investors or the increased attention paid to the firms upon the announcement.

To test whether or not stock liquidity improves, we use a *t*-test. Statistically, the turnover ratio increases significantly in the announcement period, the announcement-to-ex period, and the ex-date period. In the long-term post-ex period, the trading turnover ratio drops significantly below its pre-announcement level. In summary, our results show that the trading turnover does increase after stock splits. However, the increase in the trading turnover is limited only to the period between the announcement date and the ex-date.

Table 3, Panel B shows the Amihud illiquidity ratios,[6] which measure the price impact of order flow. The Amihud illiquidity ratios follow a similar trend over time as that of the turnover ratio. The mean Amihud illiquidity ratio declines substantially from 0.288 in the one-year pre-announcement period to 0.130 in the five-day announcement period. After the announcement, the mean Amihud illiquidity ratio increases monotonically. In the one-year post-ex period, the mean Amihud illiquidity ratio increases to 0.309, which is higher than the pre-announcement level. Similar to the turnover ratio, the Amihud illiquidity ratio suggests an improvement in trading liquidity, but the improved liquidity also occurs only in the period between the announcement date and the ex-date.

In Panel C of Table 3, we report the proportion of days with a zero return, which is to proxy for transaction costs as proposed by Lesmond et al. (1999). This measure suggests that liquidity has improved around the split announcement, given that the mean zero-return day declines from 11.096 % prior to the announcement to 8.112 % in the announcement period. The ex-date period also shows a low percentage of zero returns relative to other windows. In the long-term ex-date period, there are more trading days with a zero price change than all other periods, suggesting that the improved liquidity has disappeared in the long run after the split.[7]

Panels D and E of Table 3 show the mean dollar and relative spreads, respectively.[8] After the split announcement, the mean dollar spreads, ranging from $0.222 in the ex-

[6] All Amihud illiquidity ratios have been multiplied by 10^6.

[7] Lin et al. (2009) also find a decrease in the incidence of no trading after stock split announcements. However, they do not examine the liquidity effect between the announcement date and the ex-date and hence it is not clear whether the improvement in liquidity is a short- or long-term phenomenon.

[8] Note that our estimate of dollar spread is closely related to the minimum tick size. The minimum tick size reduced 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 and relative spreads only if the two-year interval from AD−252 to ED+260 falls into one of the three minimum tick size regimes.

date period to $0.208 in the announcement-to-ex period, increase significantly from the pre-split level of $0.187. In the post-ex period, the dollar spread drops to $0.184, which is significantly lower than its pre-split level. In contrast, the relative spread results show 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 higher than the pre-split level. Specifically, the mean relative spreads increase from the pre-split level of 0.766 % to 1.041 %, 0.974 %, and 0.824 % in the ex-date, short-term post-ex, and long-term post-ex periods, respectively. This finding of an increase in relative spreads is 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)).

5.2 Adjusted change in stock liquidity

To further evaluate whether split firms' stock liquidity improves after the split, we also compare split firms' liquidity measures to those of control firms. We select control firms based on the exchange, share price, and trading liquidity. Our intention is to select control firms that do not split, but have similar pre-split share price and liquidity as the split firms. Specifically, we select control firms that do not split their stock over a two-year period prior to the announcement date of a sample split firm using the following procedure: (1) firms that are from the same exchange and (2) the share price is within ±10 % of the split firm's share price three trading days before the announcement date. From the firms that meet these two characteristics, we choose the firm with the closest Amihud illiquidity ratio in the one-year pre-split period (AD−252, AD−3). Just like the sample split firms, we require that the daily CRSP database contains information on the matching firm's stock prices, trading volume, and returns over the two-year period (AD−252, ED+260).

Table 4 reports the mean liquidity measures for the split and control firms, their differences, and the adjusted changes in liquidity measures from the pre-announcement period to one of the five post-announcement periods. We test statistical significance of the mean difference using a *t*-statistic. The split firms exhibit a higher change in the trading turnover ratios than the control firms in all the periods, except for the long-term post-ex period (see Panel A). In the one-year period after the ex-date, investors appear to trade the split firms' stocks less frequently than the control non-split firms with an adjusted change of −0.009 %.

The Amihud illiquidity ratio results suggest that the split firms are more liquid than the control firms only in the announcement and announcement-to-ex periods (see Panel B). Around the ex-date and also in the one-year post-ex period, the split firms become less liquid when compared to the control firms.

Panel C of Table 4 shows the results for Zeros. The split firms experience a smaller proportion of trading days with a zero return than the control firms. The mean adjusted changes in Zeros are −2.914 %, −1.383 %, and −2.326 % in the announcement, announcement-to-ex, and ex-date periods, respectively. These adjusted changes are all highly significant, indicating that the split firms become more liquid than the control firms. However, in the long-term post-ex period, the split firms become less liquid than the control firms given that the mean adjusted change in Zeros is 0.296, which is highly significant.

Table 4 Liquidity measures for the split firms and control non-split firms

Intervals	Splitting firms	Control firms	Difference	Adjusted change
Panel A: Trading Turnover (%)				
Pre-Announcement Period	0.391	0.326	0.066***	
Announcement Period	0.552	0.325	0.227***	0.162***
Announcement-to-Ex Period	0.445	0.320	0.125***	0.060***
Ex-Date Period	0.404	0.313	0.091***	0.025***
Short-Term Post-Ex Period	0.391	0.315	0.076***	0.010**
Long-Term Post-Ex Period	0.384	0.327	0.057***	−0.009***
Panel B: Amihud Illiquidity ($\times 10^6$)				
Pre-Announcement Period	0.288	0.283	0.005	
Announcement Period	0.130	0.227	−0.096***	−0.102***
Announcement-to-Ex Period	0.169	0.251	−0.082***	−0.087***
Ex-Date Period	0.257	0.231	0.026***	0.021***
Short-Term Post-Ex Period	0.255	0.243	0.011	0.006
Long-Term Post-Ex Period	0.309	0.291	0.118**	0.012***
Panel C: Zeros (%)				
Pre-Announcement Period	11.096	11.140	−0.044	
Announcement Period	8.112	11.070	−2.958***	−2.914***
Announcement-to-Ex Period	9.724	11.151	−1.427***	−1.383***
Ex-Date Period	8.832	11.202	−2.370***	−2.326***
Short-Term Post-Ex Period	10.700	11.077	−0.377	−0.333
Long-Term Post-Ex Period	11.408	11.156	0.252***	0.296***
Panel D: Dollar Spread ($)				
Pre-Announcement Period	0.187	0.195	−0.009***	
Announcement Period	0.221	0.223	−0.002	0.007***
Announcement-to-Ex Period	0.208	0.211	−0.003***	0.005***
Ex-Date Period	0.222	0.222	0.000	0.009***
Short-Term Post-Ex Period	0.209	0.210	−0.001	0.008***
Long-Term Post-Ex Period	0.184	0.194	−0.010***	−0.002***
Panel E: Relative Spread (%)				
Pre-Announcement Period	0.766	0.573	0.193***	
Announcement Period	0.628	0.650	−0.022***	−0.215***
Announcement-to-Ex Period	0.577	0.621	−0.044***	−0.237***
Ex-Date Period	1.041	0.662	0.380***	0.187***
Short-Term Post-Ex Period	0.974	0.629	0.345***	0.152***
Long-Term Post-Ex Period	0.824	0.571	0.253***	0.060***

This table compares the mean liquidity measures between split firms and their matched non-split firms for six intervals, including the pre-announcement (AD−252, AD−3), the split announcement (AD−2, AD+2), the announcement-to-ex-date (AD+3, ED−1), the ex-date (ED0, ED+4), the short-term post-ex (ED+5, ED+10), and the long-term post-ex (ED+11, ED+260) periods. The liquidity measures include turnover, Amihud illiquidity ratio, Zeros, dollar spread, and relative spread. Matched non-split firms are chosen based on the exchange, stock price on day −3 before the split announcement, and Amihud illiquidity ratio. The means are calculated using observations that have been winsorized at the first and the 99th percentiles. Difference is the difference between the split firms and the control firms. Adjusted change is the change in a liquidity measure from the pre-announcement period to a post-announcement period for the split firms minus the change in the liquidity measure for the control non-split firms. The significance levels are for testing a zero mean using a *t*-test. *** and ** denote significant at the 1 % and 5 % levels, respectively

Panel D of Table 4 shows the results for the dollar spreads. While the split firms appear to have smaller dollar spreads than the control firms, the differences seem to be small. For instance, the difference in the dollar spreads between the split and control firms is −$0.009 before the announcement and is −$0.010 after the ex-date. The liquidity of the split firms relative to the control firms declines in the periods up to 10 days after the ex-date. Nevertheless, the results show a significant reduction in the dollar spread in the post-ex period. Panel E shows the results for the relative spreads. After the announcement date and before the ex-date, split firms encounter smaller relative spreads than firms that do not split. 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 show that most liquidity measures indicate an improved liquidity after firms splitting their shares. However, the improvement in liquidity is short-lived and is limited to the period between the split announcement date and the ex-date. After the ex-date, the trading liquidity in fact declines.

5.3 Abnormal returns and change in stock liquidity

Another analysis that we perform is to evaluate the determinants of abnormal returns for the announcement and ex-date periods. Our main purpose here is to see whether the change in liquidity can explain the abnormal returns in these two periods. To this end, we employ a regression analysis. Specifically, we regress the cumulative market-adjusted abnormal returns in the two periods on change in the Amihud illiquidity and various control variables. The regression model is:

$$CAR_i = \beta_0 + \beta_1 \Delta ILLIQ_i + \beta_2 PO\_PRICE_i + \beta_3 \Delta STD_i + \beta_4 INTF_i + \beta_5 EXCH_i + \varepsilon_i. \quad (1)$$

CAR is the cumulative market-adjusted abnormal return in the announcement period or in the ex-date period as reported in Table 2. $\Delta ILLIQ$ is the change in the Amihud illiquidity ratios between the pre-announcement period and one of the announcement and ex-date periods as reported in Table 3,[9] of which a negative change means an improvement in liquidity. An improved liquidity in the announcement period could be due to better prospects of a split firm's operating performance or to enhanced attention paid to the firm. On the other hand, an improved liquidity in the ex-date period could be because stock splits make the stocks to be more "affordable" for investors, especially for individual investors. In either case, the coefficient for $\Delta ILLIQ$ should be significantly negative. *PO_PRICE* is the share price after a stock split and is calculated as the share price five trading days before the split announcement divided by (1 + split factor). If the primary motivation behind a stock split is to return the share price to a target range, we should observe a negative coefficient for *PO_PRICE*, meaning that the market reacts more positively to a lower price after the split. ΔSTD is the change in return standard deviation between the pre-announcement period and the long-term post-ex period. We use return volatility as a proxy for the stock price elasticity of demand.[10] We expect ΔSTD to have a positive relation with the abnormal return. *INTF* is a dummy variable

[9] Similar results are obtained when other liquidity measures are used and hence are not reported to save space.
[10] 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.

with a value of 1 for integer splits (e.g., 2 for 1) and a value of zero for non-integer splits (e.g., 5 for 4). *INTF* is used 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. If investors prefer holding round lots, then abnormal returns should be smaller for non-integer splits. Thus, a positive relation is expected between the announcement period abnormal return and *INTF*. *EXCH* is a dummy variable with a value of 1 for NASDAQ stocks and a value of zero for NYSE/AMEX. The exchange dummy variable is included as an additional variable to control for information asymmetry.

Table 5 reports the regression estimates of Eq. (1). The results (column 1) show that the abnormal return in the announcement period is significantly related to all the variables, except for ΔSTD. The coefficient estimate for $\Delta ILLIQ$ is negative and highly significant, suggesting that higher liquidity leads to higher stock returns in the announcement period. As expected, the split announcement effect is negatively related to the post-split stock price. The change in return volatility does not affect the announcement effect. *INTF* is positive and significant. The positive sign on *INTF* indicates that some investors may avoid trading stocks with non-integer splits. *EXCH*

Table 5 Announcement-date and ex-date abnormal returns and change in liquidity

	Dependent variables	
	Announcement period CAR	Ex-date period CAR
Intercept	0.053***	0.023***
	(25.29)	(10.42)
ΔILLIQ	−0.325**	−0.087
	(−2.09)	(−0.53)
PO_PRICE ($\times 10^2$)	−0.106***	−0.035***
	(−16.37)	(−5.22)
ΔSTD	0.099	0.224**
	(1.00)	(2.12)
INTF	0.005***	−0.002
	(3.22)	(−1.40)
EXCH ($\times 10^2$)	0.771***	0.015
	(4.55)	(0.08)
Adjusted R^2 (%)	5.450	0.520

This table reports the regression coefficients from regressing CAR (cumulative market-adjusted abnormal return) on the change in liquidity, post-split share price, change in return volatility, and various control variables. The regression model is $\mathrm{CAR_i} = \beta_0 + \beta_1 \Delta\mathrm{ILLIQ_i} + \beta_2 \mathrm{PO\_PRICE_i} + \beta_3 \Delta\mathrm{STD_i} + \beta_4 \mathrm{INTF_i} + \beta_5 \mathrm{EXCH_i} + \varepsilon_i$. CAR is the cumulative market-adjusted abnormal return. 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). PO_PRICE is the share price after the split and is calculated as the share price 5 trading days before the split announcement divided by (1 + split factor). ΔSTD is the change in return standard deviation between the pre-split period (AD−252, AD−3) and the post-split period (ED+11, ED+260). 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 STD have been winsorized at the first and the 99th percentiles. Inside the parentheses are *t*-statistics. *** and ** denote significant at the 1 % and 5 % levels, respectively

is also positive and significant, suggesting that the existence of an 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. While $\Delta ILLIQ$ can explain the announcement effect, our results show that $\Delta ILLIQ$ cannot explain the ex-date effect. This is probably due to a smaller improvement in liquidity based on the Amihud illiquidity in the ex-date period (−0.031) than in the announcement period (−0.158). Similar to the announcement effect, the ex-date effect is also negatively related to *PO_PRICE*. ΔSTD is significantly positive, meaning that stocks with a larger increase in volatility after the split tend to have a higher ex-date abnormal return.

6 Conclusions

In this study, we examine the impact of stock splits on a stock's trading liquidity. The popular explanations for stock splits (i.e., the signaling, attention-grabbing, and trading range/improved liquidity hypotheses) all imply an improvement in liquidity. However, they have different implications on when the improvement in liquidity will occur and whether the improvement is a short- or long-term phenomenon. The signaling and attention-grabbing hypotheses predict that liquidity will improve around the split announcement date, while the trading range/improved liquidity hypothesis predicts that liquidity will improve around the ex-date. Moreover, the signaling and attention-grabbing theories imply that the impact of stock splits on liquidity is a short-lived effect, but the trading range/improved liquidity theory implies that the impact is long-lived.

Using a sample of 6,463 stock splits over the period 1960–2010, we find that most liquidity measures improve following the stock split announcement. This improved liquidity is particularly significant over a five-day window 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 their pre-split level. After the ex-date, there is a reduction in the liquidity relative to the pre-announcement period. We obtain similar results when we compare split firms to control firms. In short, the improvement in liquidity appears to be only a short-term phenomenon, which is limited to the period between the announcement date and the ex-date. Moreover, we find that the change in liquidity can significantly explain the split announcement effect, but not the ex-date effect. Thus, our results appear to be more consistent with the signaling hypothesis and/or the attention-grabbing hypothesis, than with the improved liquidity hypothesis.

References

Amihud Y (2002) Illiquidity and stock returns: cross-section and time-series effects. J Financ Mark 5:31–56

Angel JJ (1997) Tick size, share prices and stock splits. J Financ 52:655–681

Anshuman VR, Kalay A (2002) Can splits create market liquidity? Theory and evidence. J Financ Mark 5:83–125

Baker HK, Gallagher PL (1980) Management's view of stock splits. Financ Manag 9:73–77

Baker HK, Powell GE (1992) Why companies issue stock splits. Financ Manag 21:11
Banerjee S, Gatchev VA, Spindt PA (2007) Stock market liquidity and firm dividend policy. J Financ Quant Anal 42:369–398
Barber BM, Odean T (2008) All that glitters: the effect of attention and news on the buying behavior of individual and institutional investors. Rev Financ Stud 21:785–818
Boehme RD, Danielsen BR (2007) Stock-split post-announcement returns: underreaction or market friction? Financ Rev 42:485–506
Brennan MJ, Copeland TE (1988) Stock splits, stock prices, and transaction costs. J Financ Econ 22:83–101
Brennan MJ, Hughes PJ (1991) Stock prices and the supply of information. J Financ 46:1665–1691
Conroy JS, Harris RS, Benet BA (1990) The effects of stock splits on bid-ask spreads. J Financ 45:1285–1295
Copeland TE (1979) Liquidity changes following stock splits. J Financ 34:115–141
Datar VT, Naik NY, Radcliffe R (1998) Liquidity and stock returns: an alternative test. J Financ Mark 1:203–219
Desai AS, Nimalendran M, Venkataraman S (1998) Changes in trading activity following stock splits and their effect on volatility and the adverse-information component of the bid-ask spread. J Financ Res 21:159–183
Dhar R, Goetzmann WN, Shepherd S, Zhu N (2004) "The impact of clientele changes: Evidence from stock splits," Working Paper, Yale University
Easley D, O'Hara M, Saar G (2001) How stock splits affect trading: a microstructure approach. J Financ Quant Anal 36:25–51
Goyenko RY, Holden CW, Ukhov AD (2006) "Do stock splits improve liquidity?" Working Paper, Indiana University
Goyenko RY, Holden CW, Trzcinka CA (2009) Do liquidity measures measure liquidity? J Financ Econ 92:153–181
Gray SF, Smith T, Whaley RE (2003) Stock splits: implications for investor trading costs. J Empir Finan 10:271–303
Grinblatt MS, Masulis RW, Titman S (1984) The valuation effects of stock splits and stock dividends. J Financ Econ 13:461–490
Hodrick LS (1999) Does stock price elasticity affect corporate financial decisions? J Financ Econ 52:225–256
Holden CW (2009) New low-frequency spread measures. J Financ Mark 12:778–813
Kadapakkam P-R, Krishnamurthy S, Tse Y (2005) Stock splits, broker promotion, and decimalization. J Financ Quant Anal 40:873–895
Kyle AS (1985) Continuous auctions and insider trading. Econometrica 53:1315–1335
Lakonishok J, Lev B (1987) Stock splits and stock dividends: why, who, and when. J Financ 42:913–932
Lamoureux CG, Poon P (1987) The market reaction to stock splits. J Financ 42:1347–1370
Lesmond DA, Ogden JP, Trzcinka CA (1999) A new estimate of transaction costs. Rev Financ Stud 12:1113–1141
Lin J-C, Singh AK, Yu W (2009) Stock splits, trading continuity, and the cost of equity capital. J Financ Econ 93:474–489
McNichols M, Dravid A (1990) Stock dividends, stock splits, and signaling. J Financ 45:857–879
Muscarella C, Vetsuypens M (1996) Stock splits: signaling or liquidity? The case of ADR 'solo splits'. J Financ Econ 42:3–26
Nayar N, Rozeff MS (2001) Record date, when issued and ex date effects in stock splits. J Financ Quant Anal 36:119–139
Powell GE, Baker HK (1993/1994) The effects of stock splits on the ownership mix of a firm. Rev Financ Econ 3:70–88
Schultz P (2000) Stock splits, tick size, and sponsorship. J Financ 55:429–450