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The Effects of Stock Splits on Bid-Ask Spreads

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ABSTRACT

This paper examines the effects of stock splits on bid-ask spreads for NYSE-listed companies. Percentage spreads increase after splits, representing a liquidity cost to investors. These spread increases are directly related to decreases in share prices following splits and can explain part, but not all, of the observed increase in return variability after splits. The evidence thus suggests a liquidity cost of stock splits that must be weighed against any other perceived benefits of splits. Such a liquidity cost may validate that stock splits are a signal of favorable information about the firm.

STOCK SPLITS HAVE LONG been a prominent feature in U.S. financial markets; five to ten percent of all AMEX and NYSE firms split in a typical year (Lakonishok and Lev (1987)). Two potentially conflicting explanations for splits are frequently given. First, most managers believe (Baker and Gallagher (1980)) that splits return share prices to some optimal trading range and improve shareholder liquidity. The second explanation is that splits are a costly signal of favorable future prospects for the firm. For instance, Brennan and Copeland (1988a) show that, if stock splits increase liquidity costs to investors, such splits can serve as valid signals.

Most empirical studies of the liquidity effects of splits use trading volume. Copeland (1979), Lamoureux and Poon (1987), and Murray (1985) all conclude that shareholder liquidity decreases after a split based on finding dollar trading volume decreases after splits. On the other hand, Lakonishok and Lev (1987) find abnormally high volume in the year preceding a split and, abstracting from this abnormal volume, that splits are not associated with a change in trading volume. The use of volume to measure liquidity is largely motivated by empirical findings of a negative relationship between volume and the bid-ask spread (e.g., Demsetz (1968), Benston and Hagerman (1974), and Tinic (1972), among others). This spread is a direct measure of the cost of liquidity when liquidity is defined (Hicks (1946)) as the ease or rapidity with which a financial instrument can be exchanged for currency.

Despite the importance of the bid-ask spread as a liquidity measure, only two studies provide evidence on splits and bid-ask spreads, and they yield conflicting conclusions. Copeland (1979) studies 162 OTC firms for the period 1968–1976 and finds a statistically significant increase in percentage spreads comparing days before and after the ex-date. Murray (1985) studies 100 OTC splitting firms for the period 1972–1976 and finds no evidence of a change in percentage spreads relative to a control group.

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This paper provides new evidence on the relationship between stock splits and shareholder liquidity as measured by bid-ask spreads. While Copeland (1979) and Murray (1985) both use representative bid-ask quotes, which measure the most commonly quoted bid and ask prices by dealers, we employ higher quality inside quotes, which capture the lowest ask and highest bid that would have been available to an investor. In addition, we examine bid-ask spreads for NYSE-listed companies, which generally are larger and have more active markets than OTC stocks.

Our use of spread data also allows us to test whether changes in return variance around splits are the result of changes in the "true" variance or changes in the spread. Ohlson and Penman (1985) study 1,257 splits in the period 1962–1981 and report a substantial and permanent increase in return variability following a split. Dravid (1987) confirms these results for splits and finds reverse splits associated with decreases in return variability. While both studies note that observed return variability captures "true" variability and oscillation between bid and ask prices (French and Roll (1986) and Amihud and Mendelson (1987)), they do not use bid-ask data and hence cannot discriminate between the two components.

Section I provides a description of our methodology and sample. Empirical results are presented in Section II, followed by a summary and concluding remarks.

I. Sample and Methodology

We compare NYSE stocks that split with a random sample of nonsplitting NYSE stocks. The random sample allows control for any changes in the general level of spreads not attributable to splits. We use two measures of the bid-ask spread: the absolute dollar spread between the ask and bid prices and the percentage spread (defined as the absolute spread divided by the closing price of the stock). We focus primarily on percentage spreads because they represent the liquidity cost per dollar invested and can be used for comparison across stocks and before and after splits.[1]

The splitting firms are a complete set of all NYSE firms that voted a stock split between January 1, 1981 and April 30, 1983 as recorded by the *Daily Price Record* and that satisfied the following screens: the announcement date and the ex-date were available in the *Wall Street Journal Index*; daily closing prices and trading volume were on the *Media General Daily Price History File*; and daily returns were available on the CRSP Daily Returns File. We restrict our analysis to stock splits (1.2-for-1 or greater) and do not analyze stock dividends. Of 193 firms that voted at least one stock split in the period, 133 firms satisfied our

[1] We do not measure other forms of trading costs such as brokerage or transfer fees. At least in the case of brokerage fees, it is difficult to make general statements about how they are affected by splits. Some discount brokers base their fees on the number of shares traded and the price per share, while others charge by the total value of the trade (price per share times number of shares). A split could affect trading costs in the first case but not the second. Brennan and Copeland (1988a) show, however, that, on average, percentage brokerage commissions increase as share prices fall, which would contribute to higher trading costs after splits.

screens. Because 14 firms had two splits, the total is 147 stock splits. Over 80 percent of the splits are either 2-for-1 or 1.5-for-1, with the sample average being 1.75-for-1, which is similar to the 1.85-for-1 average in Lakonishok and Lev's (1987) study of 1,015 splits for the period 1963–1982.

The control group contains 143 NYSE firms that did not split during the sample period. We randomly selected 150 nonsplitting firms from *Media General* because this screen was the most restrictive for the split sample. Of these, 143 had a complete set of daily returns. Announcement and ex-dates from the splitting firms were randomly assigned to stocks in the control group.

To assess the effects of splits, we compare a pre-announcement period, defined as the two months preceding the month of the split announcement, and a post-split period, defined as the two months following the month of the ex-date.[2] The period between the announcement and ex-date (an average of 51 calendar days for our sample) is excluded to avoid transitory effects on the spread that could result from dual trading in both pre-split shares and when-issued shares during this period.

Closing bid-ask quotes for the first five trading days of each month were collected from the *Francis Emory Fitch Daily Quote Sheets.* These inside quotes measure the lowest ask and highest bid from specialists. This procedure yielded ten observations of the bid-ask spread before the announcement date and ten after the ex-date. From the *Media General* file, mean closing price and trading volume were calculated as the average closing price and trading volume for the dates for which we had bid-ask quotes. Equity market value and proportionate volume turnover (volume divided by shares outstanding) were calculated using shares outstanding from the *ISL-Daily Stock Guide.* From CRSP data, the daily return variance was calculated for each stock using the full two months of daily returns in each of the two comparison periods.

We analyze changes in bid-ask spreads using two tests. The first is a t-test comparing the cross-sectional mean from the pre-announcement period to the cross-sectional mean after the split. The second, more powerful test calculates for each stock the difference between the mean spread before the announcement and the mean spread after the ex-date. We then compare the frequencies of increases and decreases between the splitting and nonsplitting firms using a chi-square test under the null hypothesis that the relative frequencies are the same (Gibbons (1976)). If stock splits increase liquidity by lowering bid-ask spreads, there should be more decreases for splitting firms than for the random sample.

II. Results

A. Sample Characteristics

Table I compares splitting and nonsplitting firms before and after the split. Both sets of firms have essentially the same total market value. Prior to the split

[2] We examined the ex-dates and announcement dates in the *Wall Street Journal Index* and found a significant number of information releases around the announcement date. We used the months prior to the announcement date instead of including the announcement month itself to minimize possible contamination by these other information releases.

Table I

Price, Trading Volume, Return Variance, and Bid-Ask Spreads for Splitting and Nonsplitting Stocks

Entries are mean values for individual securities for two months before the announcement of a split and two months after the ex-date of the split. Figures in parentheses are standard deviations. Volume turnover measures proportionate volume and is volume divided by shares outstanding. The t-value compares means of the split and nonsplit samples and is calculated as $(\mu_1 - \mu_2)/SE$, where SE is the square root of $(SD_1^2/N_1 + SD_2^2/N_2)$, μ is the cell mean, SD is the cell standard deviation, N is the number of observations in the cell, 1 denotes the split sample, and 2 denotes the nonsplit sample.

	Pre-Announcement			Post-Split		
	Split	Nonsplit	t-Value	Split	Nonsplit	t-Value
Price (Average Daily Closing)	$39.67	$24.46	7.90	$26.60	$25.37	0.74
	(17.98)	(14.67)		(9.71)	(17.29)	
Equity Market Value (Millions)	$1,059	$1,089	−0.08	$1,145	$1,092	0.16
	(3,288)	(2,738)		(2,901)	(2,670)	
Volume (Hundreds of Shares)	394	801	−3.10	604	781	−1.51
	(599)	(1453)		(812)	(1156)	
Volume Turnover (in Percent)	0.234	0.323	−1.35	0.224	0.282	−1.53
	(0.195)	(0.766)		(0.247)	(0.384)	
Daily Return Variance (in Percent)	0.0461	0.0740	−2.39	0.0634	0.0580	0.66
	(0.0332)	(0.1360)		(0.0432)	(0.0883)	
Absolute Spread (in ⅛s)	2.533	2.041	7.00	2.311	2.041	3.14
	(0.592)	(0.605)		(0.518)	(0.894)	
Percentage Spread (% of Average Closing Price)	0.951	1.456	−5.50	1.229	1.452	−1.91
	(0.437)	(1.010)		(0.498)	(1.308)	

announcement, splitting stocks have higher share prices (\$39.67 vs. \$24.40), but this price difference is essentially eliminated after the ex-date. Furthermore, larger splits accompany larger share prices: the correlation coefficient between the size of the split and the pre-announcement share price is 0.53—significantly different from zero at the 0.0001 level. This evidence is consistent with Lakonishok and Lev's (1987) finding that splits return prices to a "normal" trading range.

Prior to the split announcement, splitting firms have lower share volume than those in the control group. Share volume for splitting firms is higher after the split, whereas there is no change in volume for the random sample. While volume turnover is lower for splitting firms than for the control group in the pre-split period, the difference is not significant. Furthermore, no significant change in volume turnover is shown for either splitting or nonsplitting stocks. Thus, there is no evidence of improved liquidity from split-induced increases in proportionate volume.[3]

Table I also shows that return variances for splitting stocks are lower before the split when compared with the random sample. After the split, variances increase for the splitting firms and are essentially the same as for nonsplitting firms. Our data thus show increases in return variance as found by Ohlson and Penman (1985).

B. Bid-Ask Spreads

The last two rows of Table I show that both absolute and percentage spreads are essentially unchanged for the control group. Splitting stocks, however, have significant shifts in both measures of the bid-ask spread. For splitting firms, mean absolute spreads decrease significantly from 2.53 to 2.31 (t-value = −3.42). In contrast, for these same firms, percentage spreads increase significantly from 0.951 to 1.229 percent (t-value = 5.08). Even after the split, however, splitting stocks have lower percentage spreads than the control group.

Table II shows these same patterns in terms of frequencies of spread changes. For splitting stocks, absolute spreads tend to decrease, but percentage spreads increase. The changes in spreads are even more pronounced for larger splits. For example, for splits greater than 1.5-for-1, 56 of 75 cases have a decrease in absolute spread, while only 7 of 75 have a decrease in percentage spread. Furthermore, the increase in percentage spreads cannot be attributed to absolute spreads being bounded from below by the minimum spread of ⅛. For instance,

[3] To analyze volume further, we calculated the ratio of post-split volume to pre-announcement volume for each firm after adjusting all shares for the split factor. For example, in a 2-for-1 split, we divided all post-split shares by 2 to convert them to a pre-split basis. We also calculated similar ratios based on the dollar value of trading. The results indicate a decrease in proportionate share volume associated with splits; the mean ratio for splitting stocks (1.155) is significantly less than the mean for nonsplitting firms (1.400). A t-value comparing the two means is 2.10, and a chi-square test indicates that the two distributions are different at the 0.024 level of significance. Furthermore, the median ratio (0.88) of adjusted shares for the split sample is less than unity. On the other hand, there is practically no difference between the split and nonsplit groups in terms of changes in dollar volume. The different results on share and dollar volume probably reflect the wealth gains associated with splits (Grinblatt, Masulis, and Titman (1984) and Eades, Hess, and Kim (1984)).

Table II

Frequency Distribution of Changes in Bid-Ask Spreads Accompanying Stock Splits

Entries are the number of firms experiencing increases or decreases in average daily spread from before the split announcement to after the ex-date of the split. The chi-square value tests the null hypothesis that the relative frequencies are the same for the splitting and nonsplitting stocks.

A. Changes in Absolute Spread			
	Split	Nonsplit	
Increase	44	61	Chi-square = 6.76
Constant	12	14	Prob. = 0.034
Decrease	91	66	
B. Changes in Percentage Spread			
	Split	Nonsplit	
Increase	123	64	Chi-square = 46.32
Decrease	24	77	Prob. = 0.0001

in 59 cases of 2-for-1 splits, the absolute spread exceeds ⅜ before the split. In only one of these 59 cases is the absolute spread after the split less than or equal to half the pre-split spread.

Table III highlights the patterns for absolute spreads even more powerfully by looking at all the daily spreads. Nonsplitting stocks have no significant shift in absolute spreads. The splitting firms start out with higher absolute spreads, which decline but still remain higher than those for the control group.

The association of splits with decreases in absolute spreads but increases in percentage spreads is a direct result of the share-price effect of splits. As shown in Table I, there is a substantial drop in share price when a split occurs, as expected. This drop in price is more than sufficient to offset the decrease in absolute spread and leads to an increase in the percentage bid-ask spread. This spread increase represents a liquidity cost to shareholders.

C. Patterns of Changes in Percentage Spreads

The failure of absolute spreads to drop proportionally with share prices is consistent with prior work on cross-sectional differences in percentage spreads. Ho and Stoll (1981), Copeland and Galai (1983), and others have demonstrated that, in theory, the bid-ask spread is related to a stock's trading characteristics including price, volume, and volatility. These links have been demonstrated empirically using cross-sectional data by Tinic (1972) and Benston and Hagerman (1974), who found that percentage bid-ask spreads are negatively linked to share price and volume and positively linked to a stock's risk. To see whether these same patterns hold in explaining changes in percentage spreads in our sample, we estimate regression (1):

$$\Delta S_i = \alpha_0 + \alpha_1 D_i + \alpha_2 \Delta P_i + \alpha_3 \Delta(\ln V_i) + \alpha_4 \Delta(TV_i) + \mu_i, \qquad (1)$$

Table III

Absolute Spreads for Splitting and Nonsplitting Stocks

This table records each daily spread for each firm as a separate observation and compares spreads from before the split announcement to those after the ex-date of the split. Spreads are daily observations, and the chi-square value tests the null hypothesis that the relative frequencies are the same for the two groups.

A. Percentage of Sample with a Given Absolute Spread

	Pre-Announcement		Post-Split	
Spread in ⅛s	(1) Nonsplit	(2) Split	(3) Nonsplit	(4) Split
1	29.5	12.3	29.1	17.0
2	43.7	39.9	46.8	44.6
3	21.4	32.3	19.8	29.8
4	5.1	15.0	3.7	8.6
≥5	0.4	0.6	0.7	0.1
	$N = 1385$	$N = 1460$	$N = 1387$	$N = 1427$

B. Comparison of Absolute Spreads Using Data from Panel A

	Chi-Square	Probability
Pre-Announcement Nonsplit (1) vs. Split (2)	204.8	0.000
Post-Split Nonsplit (3) vs. Split (4)	106.9	0.000
Split Pre-Announcement (2) vs. Post-Split (4)	47.0	0.000
Nonsplit Pre-Announcement (1) vs. Post-Split (3)	6.6	0.162

where

Δ = the change from the pre-announcement to post-split period,
S_i = the mean percentage spread for a stock,
D_i = 1 if the firm split its stock, 0 otherwise,
P_i = the mean closing price for a stock,
$\ln V_i$ = the natural logarithm of the mean number of shares traded per day for a stock,
TV_i = the "true" variance in daily returns after adjusting for the effects of the bid-ask spread,[4] and
μ_i = a random error term with zero mean.

[4] Because the measured return variance is itself a function of the bid-ask spread (Amihud and Mendelson (1987)), we adjusted the calculated daily return variance for the effect of the bid-ask spread. French and Roll (1986) indirectly and Glosten (1984) directly indicate that, under the appropriate assumptions, the relationship between the calculated (observed) return variance (OV) and the true return variance (TV) is

$$TV = OV + 2SCOV,$$

where $SCOV$ is the serial covariance of the returns for times t and $t + 1$. This covariance term is meant to adjust for the impact of the bid-ask spread. Both OV and $SCOV$ were calculated using the CRSP daily returns file.

If splits exert an effect on the bid-ask spread independent of changes in price, volume, and risk, we would expect α_1 to be significantly different from zero. The regression results are as follows (t-values in parentheses):

$$\Delta S = \underset{(0.50)}{0.0239} + \underset{(1.24)}{0.0982D} - \underset{(-5.48)}{0.0160\Delta P} - \underset{(-2.28)}{0.1128\Delta(\ln V)} + \underset{(0.276)}{0.1035\Delta TV},$$

$$R^2 = 0.1468.$$

While the coefficient on the split dummy, D, is positive, it is not significantly different from zero at the 0.10 level. Increases in percentage spreads around stock splits thus appear primarily related to changes in the stock's trading characteristics (price and volume), as shown by the significantly negative coefficients.

D. Changes in Return Variance and Bid-Ask Spreads

As shown by Ohlson and Penman (1985) and Dravid (1987) and confirmed by our data in Table I, stock splits are associated with increases in measured return variance. Such an increase could, however, be the result of the increase in percentage spreads after splits. Amihud and Mendelson (1987) demonstrate that measured return variance is a biased estimator of "true" return variance because of noise in prices, including oscillations between the bid and ask prices. They further demonstrate that this bias is empirically significant and an increasing function of the percentage spread.

Not having spread data, Ohlson and Penman employ an indirect control for the effects of spreads by examining variance calculated on weekly (vs. daily) returns and noting that bid-ask spreads should be less influential as the length of the holding period increases. Using weekly returns,[5] we find that splitting stocks still show an increase in return variance from a mean of 0.2638 percent in the pre-announcement period to a mean of 0.3267 percent after the split. A t-test comparing means is statistically significant at the 0.10 level, and 55 percent of the splitting firms experience increases in variance. In contrast, the weekly return variance for nonsplitting stocks is essentially unchanged (0.3002% vs. 0.3055%). The weekly results thus show a split-induced increase in variance similar to the results of Ohlson and Penman (1985).

Since we have data on spreads, we explore the effects of spreads directly by using a special case of Amihud and Mendelson's results, shown in equation (2):

$$\Delta OV = \Delta TV + \tfrac{1}{2}\Delta S^2, \tag{2}$$

where

OV = observed variance of return,
TV = "true" variance of return, and
S = the percentage bid-ask spread.

[5] We used nonoverlapping 5-day holding periods during the 2 months prior to the split announcement and the 2 months after the split. We repeated the analysis using 2-day, 3-day, and 4-day returns with qualitatively similar conclusions: the increase in return variance for splitting stocks is less pronounced for longer holding periods, reflecting the diminished role of spreads. For instance, the increase in weekly variance of 23.8 percent (0.3267 vs. 0.2638) is less pronounced than the 37.5 percent change when daily returns are used.

In this equation, true return variance (TV) is based on a true price centered between the bid and ask. Actual transactions prices used to estimate observed variances (OV) are assumed to occur at the bid or ask, with equal probability.[6]

From equation (2), an estimate of the change in true variance is the difference between the change in observed variance and half of the change in the squared percentage spread. For the split sample, 59 percent of these differences are positive. This proportion is significantly different[7] from 0.50 ($Z = 2.23$), indicating an increase in true variance for splitting stocks. In contrast, only 46 percent of the nonsplitting stocks have positive differences, a proportion not significantly different from one half.

As a further adaptation of equation (2), we estimate regression (3):

$$\Delta OV_i = b_0 + b_1 D_i + b_2 \Delta S_i^2 + b_3 (D_i \times \Delta S_i^2) + \varepsilon_i, \tag{3}$$

where

Δ = change from the pre-announcement to post-split period,
$D_i = 1$ if the firm split its stock, 0 otherwise, and
ε_i = a random error term with zero mean.[8]

The dummy variable, D, allows detection of whether changes in observed return variance are different for splitting stocks than for the control group. A positive value for b_1 would indicate an increase in true variance for splitting stocks (relative to the control group). A nonzero value for b_3 would indicate that effects of spread changes on measured variances differ for splitting and nonsplitting stocks.

The regression results are as follows (t-values in parentheses):

$$\begin{array}{l} \Delta OV = \underset{(-2.45)}{-0.00021} + \underset{(2.65)}{0.00034D} + \underset{(7.45)}{0.6779\Delta S^2} - \underset{(-0.05)}{0.0353(D \times \Delta S^2)}, \end{array}$$

$$R^2 = 0.1760.$$

The significant positive coefficient on D suggests that splitting stocks experience increases in true return variance relative to the control sample after controlling for the effects of spreads. As found by Amihud and Mendelson, spreads also affect measured return variance, as shown by the significant positive coefficient of 0.6779 on ΔS^2. Furthermore, this coefficient value is not significantly (0.05 level) different from the theoretical value of 0.50 shown in equation (2). The

[6] Equation (2) can be derived directly from Amihud and Mendelson's (1987) equation (8.6) (p. 550) by assuming that transactions prices adjust fully (although with noise) to changes in the true value (see p. 536) and then taking first differences. Amihud and Mendelson discuss the relationship between measured and "true" variance in detail.

[7] We test this proportion assuming a binomial distribution, with equal probability of a firm having an increase or decrease in true variance.

[8] Following Johnston (1972, p. 220), to test for heteroscedasticity, we examined the Spearman rank correlation of the absolute values of the ε_i with each of four variables: pre-split share price, pre-split return variance, pre-split percentage spread, and post-split percentage spread. The only significant correlations (0.05 level) were for the spread variables, and the highest correlation (with pre-split spread) was less than 0.20. Following Amemiya (1977), we then regressed the squared ε_i on pre-split percentage spread and found no significant relationship. Heteroscedasticity then does not appear to be a problem in estimating equation (3) using these data.

results also indicate that changes in spreads have the same effect on observed variance for both splitting and nonsplitting stocks; the coefficient on the interaction term ($D \times \Delta S^2$) is not significantly different from zero.

Our findings thus suggest that a part of the split-induced increase in return variance can be attributed to bid-ask spreads but that there is also an increase in true variance. This conclusion is consistent with Ohlson and Penman's (1985) that "a partial (but not complete) explanation of the volatility increase" is to be found in institutional factors such as the bid-ask spread.[9]

III. Summary and Conclusion

The most frequently cited motive for stock splits is to improve shareholder liquidity by returning stock prices to some optimal trading range. We show in this paper that, as measured by the percentage bid-ask spread, shareholder liquidity is actually worse after stock splits. Percentage spreads increase after splits, and these increases are directly related to decreases in share prices following splits. We also show that the observed increase in return variability after splits is, in part but not entirely, the result of increases in spreads.

[9] While Ohlson and Penman (1985) use different time periods to measure pre- and post-split return variability, our analysis of variance increases has direct bearing for interpreting their results. Our results are also consistent with Brennan and Copeland's (1988b) finding that splits are associated with increases in beta coefficients. To the extent that specialists accommodate market movements, they would more likely buy (at the bid) as the market goes down and sell (at the ask) as the market goes up. This pattern would make closing prices likely to be bids in down markets and asks in up markets. Increases in bid-ask spreads accompanying splits would thus be associated with increases in measured betas.

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