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Stock Splits, Broker Promotion, and Decimalization

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Abstract

Stock split ex-dates are associated with both an increased intensity of small investor buying and a positive abnormal return. The broker promotion hypothesis suggests that the increase in relative spread after a split induces brokers to promote splitting stocks to small investors. The trading inconvenience hypothesis ascribes the ex-split effects to inconveniences such as investors' aversion to dealing with due bills, which is unrelated to relative spreads. The reduction in the bid-ask spread due to decimalization allows us to disentangle these two hypotheses. During the 1/8th pricing period, we show that after the ex-date, the relative spread increases significantly. The average buy order size decreases and the frequency of small transactions increases after the split. After decimalization, these changes are smaller in magnitude. We observe significant positive abnormal returns around the ex-date during the 1/8th pricing period, but not in the decimal pricing period. These results support the broker promotion hypothesis.

I. Introduction

Stock splits are cosmetic events that do not impact the underlying cash flows of the firm. Surveys of managers indicate that a major objective of a split is to broaden the firm's shareholder base by attracting small investors (e.g., Baker and Gallagher (1980)). Angel (1997) and Schultz (2000) argue that the higher spread resulting after a split provides an incentive for brokers to promote the post-split stock to small investors. Consistent with the argument that broker promotion plays an important role in attracting small shareholders after a split, Schultz (2000) documents a significant increase in the number of small buy orders after a split.[1] However, decimalization has decreased bid-ask spreads and consequently reduced the incentives for brokers to promote a stock after it is split. In this paper,

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[1]Other researchers find similar results. Dhar, Goetzmann, and Zhu (2003) find that during 1991–1996, new, less sophisticated, small investors accounted for a large fraction of the buying activity

we test the broker promotion explanation for stock splits by examining whether decimalization alters investor trading patterns around ex-split dates.

While there is no new information associated with the ex-date (ED) and splits are rarely canceled, several studies document a significantly positive return in the three-day period around the ex-split date. For instance, Grinblatt, Masulis, and Titman (1984) find that the three-day cumulative abnormal return (CAR $(-1, 1)$) is 1.52% around the ED.[2] Prior literature has advanced two competing hypotheses to explain the significant abnormal return (AR) around ex-split dates. Under the first hypothesis, the positive ex-split return is a result of broker promotion, with the higher relative spread that results after a split providing an incentive for brokers to promote the stock, especially to small investors. If broker promotion is effective, closing prices on or after the ED would be closer to ask rather than bid prices (Maloney and Mulherin (1992) provide supporting evidence). Hence, biases due to increased small investor buying and a higher spread could account for the measured ex-split return.

In contrast, an alternative explanation attributes the ex-split return to trading inconveniences. Nayar and Rozeff (2001) suggest that trades of unsplit shares that occur after the record date and before the ED include a due bill that the sellers provide to the buyers. The due bill legally obligates the seller to deliver the post-split shares to the buyer. Under this scenario, investors prefer to avoid the inconvenience of dealing with due bills and therefore do not buy shares between the record date and the ED. Instead, investors either transact in the when-issued market, which eliminates the need for due bills, or wait to buy after the ED. Consequently, prices are depressed on the record date but they rebound on the ED, resulting in a positive return.

In this paper, we test the validity of these two competing hypotheses by examining ex-split trading patterns and returns using a sample of splits during 1995–2002. During this time period, decimalization took effect reducing the tick size and resulting in narrower bid-ask spreads and price discreteness.[3] If higher spreads after a split are the result of price discreteness, we should expect a smaller change in spreads after a split during the decimal pricing period. This would reduce the economic incentives for brokers to promote splitting stocks to small investors. Besides, the narrower spread leads to smaller biases in measuring returns. Under the broker promotion hypothesis, the ED effects, i.e., changes in investor trading behavior and ex-split returns, should be much smaller after decimalization. However, the trading inconvenience hypothesis, which is unrelated to microstructure effects such as price discreteness and the bid-ask spread, predicts that decimalization would have no impact on ex-split trading patterns and returns.

To examine the impact of decimalization on ex-split effects, we analyze trading patterns and returns around ex-split days during three time periods: 1/8th pricing period (1995–1996), 1/16th pricing period (1998–1999), and decimal pricing

after a split. Muscarella and Vetsuypens (1996) show that the frequency and volume of small trades increases following American Depositary Receipt (ADR) solo-splits, where the foreign firm splits only the ADR and not the home country stock.

[2]Maloney and Mulherin (1992) document a three-day CAR $(0, 2)$ of 2.2%. Nayar and Rozeff (2001) also document a three-day CAR $(-1, 1)$ of about 1.25%.

[3]For example, Bessembinder (2003a) documents that bid-ask spreads for both NYSE and Nasdaq stocks declined after decimalization.

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period (2001–2002). During the 1/8th pricing period, we find that the relative spread almost doubles, increasing by about 78% after the ED. The relative spread increases by an economically significant 67 basis points (bps). This increase in spread should provide incentives for brokers to promote the stock to small investors. We find evidence consistent with the increased intensity of small investor trading after a split. The frequency of small trades (one-lot trades, split-adjusted) almost doubles after a split, increasing by 89%. Also, after a split, transaction prices are closer to the ask price and the order imbalance (OIM) is biased toward the buy side.

When the minimum tick size is reduced, the change in the relative spread following a split is smaller compared to the 1/8th pricing period. The relative spread during the decimal period increases by about 50%; however, the magnitude of the spread increase is only about 20 bps. Consistent with reduced incentives for broker promotion, the increase in the frequency of small trades is significantly smaller in the decimal pricing period. The location of the transaction price within the spread does not change after the ED, and there is little evidence of OIM.

We also examine the cross-sectional implications of the broker promotion hypothesis. If changes in relative spread motivate brokers to promote a stock to small investors, we should observe a positive cross-sectional relation between changes in the spread and changes in the frequency of small trades around the ex-split dates. Furthermore, this hypothesis suggests that after decimalization this relation should be attenuated. We find a statistically significant and positive relation between the change in the spread and the change in the frequency of small trades. This shows that the higher spread following a split provides incentives to brokers to promote splitting stocks to their customers. Importantly, we find that this effect is attenuated in the 1/16th and decimal pricing periods. This finding is new to the literature and supports the broker promotion hypothesis.

We observe similar supporting evidence while examining ex-split returns. During the 1/8th pricing period of 1995–1996, the returns we calculate using closing prices around the ex-split dates are significantly positive. When we use bid prices to remove spread-induced effects, the returns decline but remain statistically significant. For example, the three-day CAR $(-1, +1)$ is 2.60% using closing prices and 2.03% using bid prices. During the latter two time periods with lower tick sizes, the three-day CARs decline significantly, and they are no longer significantly different from zero during the decimal pricing period. Again, these results support the broker promotion explanation for ex-split effects.

These results have broader implications for empirical research that investigates the impact of small investor trading and ownership. For example, Kumar and Lee (2004) show that individual investor trades are highly correlated with each other, and that the individual investor trading imbalance is correlated with returns, after including market excess return, size, book-to-market (BM) and momentum factors as control variables. Dhar, Goetzmann, and Zhu (2003) document that the three-month AR after a split is positively correlated with the increase in the percentage of unsophisticated investors. These results suggest that trading by relatively unsophisticated individual investors significantly affects returns, at least in the short run.

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Our results complement these findings in that they indicate that small investor trading may be at least partly attributed to bid-ask spread-induced broker promotion. As these spreads have declined since decimalization, so have the incentives for brokers to promote these stocks to small investors. Hence, to the extent that small investor interest is influenced by broker promotion, other effects related to small investor trading are also likely to be less significant after decimalization.

The rest of the paper is organized as follows. In Section II, we discuss the prior literature and develop our hypotheses. In Section III, we describe our sample selection process and provide summary statistics for our sample firms. Section IV presents the results on changes in liquidity and trading characteristics around the split EDs. In Section V, we document the pattern of ED returns and we conclude the paper in Section VI.

II. Prior Literature and Hypotheses

In this section, we discuss the prior literature and develop testable hypotheses about trading patterns and returns around the ex-split date under both the broker promotion and trading inconvenience hypotheses. For each of these explanations, we also develop implications about how trading patterns and returns would be affected by a reduction in the minimum permissible tick size.

One stream of literature suggests that the changes in investor trading patterns and the AR around stock split EDs are artifacts of microstructure effects such as bid-ask spreads and price discreteness. Several researchers document systematic increases in relative spread around the stock split ED. For example, Conroy, Harris, and Benet (1990) show that the relative spread increases from 0.95% to 1.23% after a split. While the source of this increase is not documented clearly in the prior literature, price discreteness induced by minimum tick size rules may at least provide a partial explanation.

Angel (1997) and Schultz (2000) suggest that the increase in the relative spread subsequent to splits may provide an incentive for brokers to promote the splitting stock to small customers after a split. Schultz (2000) finds that there is a significant increase in the number of small buy orders following a split, supporting this conjecture. If there are more buy orders after a split, closing prices are more likely to be ask prices, in which case the increased buy orders should result in a positive ED return due to price pressure and/or price discreteness induced by the bid-ask spread. These changes in trading patterns should be observed around the ex-split date, when the spreads increase.[4]

Decimalization has lowered price discreteness and reduced the minimum tick size, which should result in lower bid-ask spreads. Hence, the change in bid-ask spread around the split date may be more in line with the change in stock

[4]Even if the possibility of increased small investor buying is known in advance, risk arbitrageurs may not completely arbitrage it away. Beneish and Whaley (1996) show that when the effective date is more than one day after the announcement that a particular stock will be added to the S&P 500 index, the ED return is significantly positive. The AR from the close of the announcement date (AD) to the opening price on the next date is a significant 2.46%. The AR is 2.52% from (AD+1 close to ED close) and a significant 1.44% on the ED. Thus, the valuation impact is spread over the period between the announcement and EDs.

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price, leading to little or no change in relative spreads following the ED. The following example clarifies this issue. Suppose that a stock trading at \$50–\$50.125 (with a 1/8th spread, the minimum allowed spread until 1997) executes a two-for-one split. The post-split price should be \$25–\$25.0625, but would end up at \$25–\$25.125 with a minimum 1/8th spread. The relative spread thus increases from 0.25% to 0.50%. Under decimal pricing, the price could end up at \$25–\$25.06, so that the relative spread does not change significantly after the split.[5] Empirically, Bessembinder (2003a) shows that quoted and effective spreads, both in absolute terms and as a percentage of the stock price, declined for NYSE and Nasdaq stocks after decimalization. Chung, Chuwonganant, and McCormick (2004) find similar results for Nasdaq stocks.

To the extent that the ex-split effects are due to broker promotion induced by increases in the relative spread that arise from price discreteness, we expect these changes to be moderated after decimalization. However, under the trading inconvenience explanation, the lower spreads and more continuous prices following decimalization should not diminish the undesirability of trading with attached due bills between the record and the EDs. Hence, the trading inconvenience explanation predicts that there will be no changes in investors' trading patterns and/or ED returns when comparing the pre-and post-decimalization periods. Next, we elaborate on the implications of each hypothesis for various measures of trading behavior as well as stock returns around the ex-split date.

A. Impact of Decimalization on Spreads, Order Size, and Order Flow Effects

The trading inconvenience explanation suggests that investors find it undesirable to trade the regular stock with attached due bills during the period between the record and EDs. Since the trading inconvenience is more pronounced for buyers, a related dearth of buy orders prior to the ED would bias the OIM and location parameter (i.e., location of the transaction price within the bid-ask spread) toward the bid price. As investors resume normal trading activities, the bias in OIM would disappear. This explanation also predicts a corresponding increase in aggregate volume after the ED. However, it makes no predictions about the average order size or the frequency of small trades. More importantly, irrespective of changes in the minimum tick size resulting from decimalization, investors would still face similar inconveniences trading regular stock before the ED. Thus, the trading inconvenience explanation suggests that these effects should not change due to decimalization.

Hypothesis 1a. Under the trading inconvenience explanation, prior to a stock split, we expect i) a location parameter below 0.5, indicating that transaction prices are closer to the bid price, ii) an OIM less than zero, indicating fewer buy orders than sell orders, and iii) lower trading volume. These measures would revert to normal levels after the split.

[5]Christie and Schultz (1999) show that Nasdaq market makers that avoided the use of odd-eighth quotes when prices increased did not reinstate them even when prices declined after a split. Hence, we may still observe increases in relative spreads after a split. However, to the extent that price discreteness plays a role, we expect the increase to be moderated after decimalization.

Hypothesis 1b. Under the trading inconvenience explanation, we do not expect any of these effects to be mitigated after decimalization.

In contrast, and as we discuss earlier, the broker promotion explanation makes several predictions about how various trading characteristics change, both across the ED and subsequent to decimalization. First, since small investors commonly trade in smaller amounts, we expect an increase in the frequency of small trades and a decrease in the average order size for buy transactions. Moreover, if there is an increase in small buy orders after the ED, then transaction prices would be more likely to be ask prices. We formalize these arguments in the hypothesis below.

Hypothesis 2a. Under the broker promotion explanation, after a stock split we expect i) a smaller average buy order size, ii) a higher frequency of small trades, iii) a location parameter above 0.5, indicating that transaction prices are closer to the ask price, and iv) an OIM greater than zero, indicating more buy orders than sell orders.

If the documented increase in relative spreads after a split is at least partially the result of a rounding up of prices due to price discreteness, we should expect little or no increase in spreads after decimalization, which would lower the incentives for brokers to promote splitting stocks to small investors and result in smaller changes in order sizes and order flow effects after decimalization.

Hypothesis 2b. Under the broker promotion explanation, we expect the changes in order flow effects to be mitigated after decimalization.

B. Ex-Split Returns

Under the trading inconvenience hypothesis, we do not expect ex-split returns to change in any significant manner after decimalization, since it still remains inconvenient for investors to trade unsplit shares after the record date. On the other hand, the broker promotion hypothesis explains the positive ex-split returns as arising primarily from price pressure. Specifically, if brokers promote splitting stocks to their small customers, there would be an increase in the number of small buy orders. If the demand curve is downward sloping, this may result in a price pressure that increases the price on the ED. Besides, the increased likelihood of closing prices being at the ask could result in a positive return due to bid-ask bounce. If market makers increase the spread in response to the higher inventory requirements (Conrad and Conroy (1994)), this may exacerbate the effect of the bid-ask bounce. These biases would show up as a positive ED return when closing prices are used to compute returns. If the ED return is primarily due to bid-ask bounce, the measurement error would be smaller when returns are computed using bid prices. Thus, the ED return computed using bid prices should be smaller or insignificantly different from zero. Furthermore, since the increase in relative spread would be smaller after decimalization, this would lower the incentives for brokers to promote splitting stocks to small investors. Hence, after decimalization, we expect the ED return to be smaller or insignificant.

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Hypothesis 3. Under the broker promotion explanation (but not under the trading inconvenience explanation), the ED return should be smaller after decimalization.

III. Data and Summary Statistics

We examine the ED effects of stock splits on both NYSE and Nasdaq stocks during the 1/8th, 1/16th, and decimal pricing periods. Until June 1997, the minimum tick size on the NYSE was 1/8th. All NYSE stocks adopted \$1/16 ticks in June 1997, and the move to decimal pricing occurred in January 2001. As of October 1997, all Nasdaq stocks used \$1/16 ticks. By April 2001, Nasdaq had instituted decimal pricing for all stocks. Hence, for both NYSE and Nasdaq stocks, we consider the period from January 2, 1995 through December 31, 1996 as the 1/8th pricing era (Period 1). The 1/16th pricing period is from January 2, 1998 to December 31, 1999 for both NYSE and Nasdaq stocks (Period 2). We designate the period from February 1, 2001 to December 31, 2002 as the decimal pricing era for NYSE stocks and from May 1, 2001 to December 31, 2002 as the decimal pricing era for Nasdaq stocks (Period 3). We also note that during 1997, a period we exclude from our study, Nasdaq implemented the Order Handling Rules (OHRs) to enhance price efficiency and make market makers more responsive to the needs of investors. The OHRs also resulted in changing Nasdaq from being a competitive dealer market closer to more of an order auction market like the NYSE (e.g., Barclay, Christie, Harris, Kandel, and Schultz (1999)).

We identify all splits with a split factor greater than or equal to one from the Center for Research in Security Prices (CRSP). A split factor of one means that for every one share, an investor receives an additional one share, i.e., a two-for-one split. Transaction data for all trades and quotes between 9:30AM and 4:00PM are obtained from the NYSE's Trade and Quote (TAQ) database. The TAQ data filter procedures follow Bessembinder (1999), (2000).[6] We only use quotes and trades that originate from the primary market for each security; that is, we only retain NYSE data for NYSE stocks and Nasdaq data for Nasdaq stocks.[7] We match the CRSP and TAQ data using ticker symbols and exchange codes. Stock splits with no transaction data available in the TAQ database are omitted. We also exclude observations if there are no trades or quotes on the ED or the day before the ED. From CRSP, we gather data on firm return, market return, number of outstanding shares, and trading volume turnover. We require that the firm be listed on CRSP at least 150 days before the ED. Further, to restrict contamination by other significant corporate events, we omit observations if the absolute value of the ED market-adjusted AR exceeds 15%.[8] This filter allows greater confidence that outliers do not drive the results.

[6] In particular, we use positive and normal quotes and prices, and spreads that are less than \$4.

[7] Many trades for NYSE stocks reflect activity at regional exchanges or Nasdaq. In recent years, many trades in Nasdaq stocks are completed on electronic communications networks (ECNs) (see, e.g., Barclay, Hendershott, and McCormick (2003)). However, in the TAQ database, ECN trades are reported as Nasdaq trades.

[8] We report our event-study results in Table 9 using market-adjusted returns. We replicate the analysis measuring ARs using a market model estimated during days -150 to -51 relative to the ED. We obtain identical conclusions.

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As Table 1 shows, there are 189 splits of NYSE stocks during the 1/8th pricing period. During the same period, 272 splits are announced by firms that traded on Nasdaq. During the 1/16th and decimal pricing periods, the NYSE (Nasdaq) samples consist of 267 and 70 splits (379 and 71), respectively. Table 1 also reports that the average relative spread on the ED declines monotonically across these three dates. The relative spread for stock i at time j is defined as

$$S_{ij} = (A_{ij} - B_{ij})/M_{ij}, \tag{1}$$

where A_{ij} and B_{ij} are the quoted ask and bid prices, and M_{ij} is the midpoint of the bid and ask prices. We calculate the average relative spread by weighting all quotes on a given day equally. The results are similar if we use only the relative spread at the time of the trades, rather than all relative spreads.

As the minimum tick size reduces progressively from 1/8th to 1/16th to 1/100th, we observe a corresponding decline in the relative spread. For NYSE stocks during the 1/8th pricing period, the average spread on the ED is 0.71%. This declines to 0.54% during the 1/16th pricing period and declines further to 0.27% during the decimal pricing period. Within each period, Nasdaq firms have greater spreads than NYSE firms. The average spread for Nasdaq firms during these three periods is 2.56%, 1.60%, and 1.02%, respectively. The higher spreads for Nasdaq stocks as compared to NYSE stocks could be due to their higher volatility and smaller size. These results are widely reported in the literature (e.g., Bessembinder (1999), (2003a)).

TABLE 1
Summary Statistics

	1/8th Pricing Era	1/16th Pricing Era	Decimal Pricing Era
	01/1995–12/1996	01/1998–12/1999	02/2001–12/2002 (NYSE) 05/2001–12/2002 (Nasdaq)
	Period 1	Period 2	Period 3
Panel A. NYSE			
Sample size	189	267	70
Split factor	1.085	1.198	1.080
Pre-split price	67.21	79.64	62.90
Post-split price	32.29	37.22	30.79
Relative spread on ex-date (%)	0.709	0.535	0.267
Panel B. Nasdaq			
Sample size	272	379	71
Split factor	1.084	1.133	1.099
Pre-split price	56.48	78.36	49.83
Post-split price	27.83	37.44	24.21
Relative spread on ex-date (%)	2.562	1.604	1.015

The sample includes all stock splits with a split factor greater than or equal to 1.0 during the three pricing periods. A split factor of 1.0 means a two-for-one split. Results for the NYSE and Nasdaq stocks are presented in Panels A and B, respectively. The pre-split price (post-split price) is the closing price on day -1 (day 0). The relative spread at time j is defined as $S_j = (A_j - B_j)/M_j$, where A_j and B_j are the quoted bid and ask prices, and M_j is the midpoint of the bid and ask prices.

The broker promotion explanation not only has implications for ex-split effects, but also provides an explanation for why firms split their stock.[9] Angel

[9]We thank the referee for this suggestion.

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(1997) suggests that a split is designed to restore the relative tick size to its optimum level after share price increases result in a smaller relative tick size. A higher relative tick size provides incentives to market makers and/or limit order traders to provide liquidity. Additionally, if market makers are associated with brokerage firms, the higher spread may also induce them to promote the stock to investors. This improved investor recognition may reduce the firm's cost of capital (Merton (1987)). However, a higher relative tick size also results in a higher bid-ask spread, thus increasing transactions costs for traders. The optimum relative tick size results from a trade-off between these benefits and costs. Since the reduced tick size of decimalization, one consequence of this explanation is that the optimum relative tick size should now obtain at a lower price level. We find little support for this implication. For both NYSE and Nasdaq splits, the mean post-split price is lower during the decimal pricing period ($30.79 and $24.21) than during the 1/16th period ($37.22 and $37.44). However, the mean post-split price during the 1/16th era is higher than that during the 1/8th pricing period ($32.29 and $27.83).

IV. Liquidity and Trading Characteristics

We begin our empirical analysis by documenting the patterns of various liquidity and OIM measures around the stock split ED. The evidence suggests that for the 1/8th pricing era, there is a statistically significant and economically large increase in the relative spread after the ED. The average buy order size decreases across the ED, and this is reflected in a significant increase in the frequency of small trades. Both the location parameter and OIM measures indicate an increase in buy orders in the post-split period. All these effects are much smaller after decimalization. These findings are consistent with the broker promotion hypothesis that we now discuss in detail.

A. Relative Spreads

We compute the relative spread as in equation (1). In all subsequent tables, we label the split date (the ED of the split) as day 0. The pre-split period is the period prior to the ED and consists day -5 through day -1. The post-split period runs from day 0 to day +5, relative to the split date. The results in Panel A of Table 2 show that in the 1/8th pricing period (1995–1996), the relative spread increases significantly after stock splits. Similar to Conrad and Conroy (1994), the *t*-statistic tests the hypothesis that the mean of the relative spread on a given day is significantly different from the overall mean of the relative spread during the pre-event period. The *t*-statistics in the post-event period are all uniformly greater than 10, suggesting that there is a significant and sustained increase in the relative spread after a split. Comparing firm averages, the relative spread increases by 67 bps from the pre-split to the post-split period, on average.

The changes are more modest during the 1/16th pricing era (1998–1999). Again comparing firm averages, the relative spread in the post-split period is higher than that in the pre-split period by about 33 bps. This increase is smaller

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than that in the 1/8th pricing era. The changes are further diminished in the decimal pricing period 2001–2002. While the relative spread remains statistically higher after the split, the increase of about 20 bps is smaller in magnitude than during both the 1/16th and 1/8th eras.

TABLE 2

Daily Relative Spread

Panel A. Average Relative Spread

	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	Spread (%)	*t*-Stat	Spread (%)	*t*-Stat	Spread (%)	*t*-Stat
−5	1.019	3.47	0.617	−0.01	0.323	0.07
−4	0.951	−0.43	0.623	−1.00	0.434	1.64
−3	1.013	−0.21	0.633	−0.10	0.405	0.46
−2	0.956	−1.46	0.682	0.55	0.361	−1.49
−1	1.112	−0.44	0.725	0.46	0.368	−1.05
0	1.802	17.32	1.162	9.00	0.644	5.27
1	1.706	14.52	1.052	8.78	0.570	3.79
2	1.704	13.57	0.966	10.19	0.606	2.25
3	1.608	14.98	0.962	10.62	0.476	1.47
4	1.655	17.97	0.967	9.27	0.534	3.99
5	1.724	15.06	0.947	8.90	0.696	2.21

Panel B. Regression Results

Change in relative spread	=	0.745	+	0.124∗Splitf	−	0.261∗Period2	−	0.286∗Period3	−	0.163∗NASDAQ
		(22.19)***		(5.60)***		(−10.65)***		(−7.39)***		(−7.07)***

Adj. $R^2 = 13.67\%$, $N = 1{,}248$ observations

The relative spread at time j is defined as $S_j = (A_j - B_j)/M_j$, where A_j and B_j are the quoted bid and ask prices, and M_j is the midpoint of the bid and ask prices. In Panel A, the *t*-statistics test the hypothesis that the mean of the spread on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in the cross-sectional analysis in Panel B is the change in relative spread {(Relative $\text{Spread}_{\text{postsplit}}$ − Relative $\text{Spread}_{\text{presplit}}$)/Relative $\text{Spread}_{\text{presplit}}$}. Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

Thus, the increase in the relative spread has become progressively smaller (67 bps to 33 bps to about 20 bps) as the tick size has been reduced. To investigate this formally, we estimate cross-sectional regressions using the change in the relative spread {(post-split relative spread−pre-split relative spread)/pre-split relative spread} as the dependent variable and two time period dummy variables as our primary explanatory variables.[10] The two time period dummy variables, Period2 and Period3, take the value one for 1998–1999 and 2001–2002, respectively, and zero otherwise. We include the split factor and a dummy variable for Nasdaq-traded firms as control variables.[11] Table 2, Panel B presents the results. The coefficient on the split factor is positive and significant (*t*-value of 5.60), suggesting that, ceteris paribus, the choice of a lower post-split price results in a larger increase in the relative spread. The coefficient on the Nasdaq dummy variable is significantly negative (*t*-value of −7.07). Importantly, consistent with the univariate results, the coefficients on the two time period dummy variables

[10]We use scaled changes since an increase of, for instance, 0.3% is more significant for a firm whose characteristics determine a pre-split spread of 0.5% compared to another firm whose characteristics dictate a pre-split spread of 2.5%.

[11]We estimate all of the regressions in the paper excluding these control variables, and our inferences are unaltered.

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are significantly negative (t-values of −10.65 for Period 2 and −7.39 for Period 3). The post-split increase in relative spread is smaller in both Periods 2 and 3, suggesting that the incentives for brokers to promote splitting stocks to small investors may be reduced after the decreases in tick size.

B. Turnover

In Table 3, we report changes in volume turnover around the split date. The trading inconvenience hypothesis predicts an increase in turnover after a split (Hypothesis 1a). The broker promotion explanation does not make any specific predictions about turnover. While it predicts an increase in small buy orders that would increase turnover, it makes no predictions about the impact of the split on larger trades. We compute turnover as trading volume divided by the number of outstanding shares. To minimize the impact of extreme observations, we transform the turnover to the logarithmic form in

$$\text{Turnover} = 100 * \log(1 + (\text{Trading Volume/Number of Shares Outstanding})). \quad (2)$$

TABLE 3

Daily Turnover

Panel A. Average Daily Turnover

	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	Turnover	t-Stat	Turnover	t-Stat	Turnover	t-Stat
−5	1.178	−3.50	1.530	−3.03	1.270	0.19
−4	1.322	−0.68	1.812	0.70	1.203	−0.83
−3	1.247	−2.28	1.664	−1.80	1.289	0.12
−2	1.427	1.57	1.820	1.40	1.177	−2.25
−1	1.479	3.07	1.804	1.32	1.413	1.38
0	1.299	0.04	1.420	−2.35	1.047	−2.88
1	1.177	−2.21	1.381	−2.43	1.091	−1.60
2	1.140	−2.32	1.284	−2.91	1.009	−2.33
3	1.071	−3.29	1.219	−3.92	1.025	−2.10
4	1.069	−4.46	1.159	−4.38	0.987	−2.69
5	0.994	−4.17	1.101	−3.98	0.989	−2.71

Panel B. Regression Results

Change in turnover	=	−0.089 (−0.40)	+	0.199∗Splitf (1.35)	−	0.205∗Period2 (−1.26)	−	0.247∗Period3 (−0.96)	+	0.243∗NASDAQ (1.58)

Adj. $R^2 = 0.16\%$, $N = 1{,}248$ observations

We calculate the turnover as Turnover = 100∗Log (1+Trading Volume/Number of Shares Outstanding). In Panel A, the t-statistics test the hypothesis that the mean of the turnover on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in Panel B is the change in turnover $\{(\text{Turnover}_{\text{postsplit}} - \text{Turnover}_{\text{presplit}})/\text{Turnover}_{\text{presplit}}\}$. Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

We find that there is a modest decline in turnover after a split in all three time periods. The t-statistics in the post-event period are negative and significant, suggesting that there is a significant decrease in turnover after the split. Comparing firm averages, the turnover in the 1/8th period declines from a mean of about 1.30 in the pre-split period to about 1.12 after the split. There is evidence of similar declines during both the 1/16th period and the more recent decimal pricing

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period. These results do not support the prediction of the trading inconvenience explanation that investors prefer not to trade in the regular stock before the ED (Hypothesis 1a). On the contrary, we observe that the turnover prior to the ED is actually higher than the turnover in the post-split period. In Panel B, we report the results of regressions where the dependent variable is the change in turnover {(post-split turnover−pre-split turnover)/pre-split turnover}, and the explanatory variables are the split factor, the two time period dummy variables, and the Nasdaq dummy variable. In contrast to our significant results for the relative spread in the earlier section, none of the coefficients is significant. This is expected since, as stated earlier, the broker promotion explanation does not make any specific predictions about turnover.

C. Order Size and Small Trades

The broker promotion hypothesis suggests an increase in the frequency of small transactions due to an increase in the relative spread after the split. If the higher relative spread induces brokers to promote these stocks to their small customers, the primary impact should be evident in smaller trades. We investigate this issue by examining the patterns of average order sizes and the frequency of small trades around EDs.

1. Average Order Size

We classify trades as buy or sell orders using the Lee and Ready (1991) algorithm. Lee and Ready suggest comparing trades to quotes five seconds before the trade report time to allow for reporting delays. Results are qualitatively the same if contemporaneous quotes are used instead.[12] We calculate the dollar order size as the trade size in shares multiplied by the share price. It is possible that traders may split their orders into smaller trades if the depth at the prevailing quote is small. We address this issue using the same approach as in Heidle and Huang (2002). Specifically, we cumulate all trades in the same direction within five seconds into a single order if these trades are at the same price and there are no intervening quote revisions. During the 1/8th pricing period, we find that the average order size for buy orders decreases after the ED (*t*-statistics greater than 10, Panel A of Table 4). Comparing firm averages, the mean buy order is about $79,000 in the pre-split period, and a significantly smaller $49,000 in the post-split period. This is consistent with the broker promotion explanation that predicts more buying by small investors. As the tick size is reduced to 1/16th, we observe that while the average size of buy orders is reduced after the ED, the reduction is smaller in magnitude compared to the 1/8th pricing era. Again comparing firm averages, the buy order size in the pre-split period is about $76,000, declining to about $53,000 after the split. In the decimal pricing period, the decline in buy order size averages $6,000.

The broker promotion explanation predicts that the decline in buy order size should be smaller during the later time periods with lower tick sizes. We present the results of cross-sectional regressions explaining the change in buy order size

[12] Bessembinder (2003b) shows that contemporaneous quotes provide a better measure of transaction costs for recent TAQ data.

TABLE 4

Dollar Order Size

Panel A. Average Order Size

	Buy Orders						Sell Orders					
	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002		Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	Size	*t*-Stat	Size	*t*-Stat	Size	*t*-Stat	Size	*t*-Stat	Size	*t*-Stat	Size	*t*-Stat
−5	81.0	−0.83	76.6	−1.38	35.4	0.31	98.9	0.92	82.8	−1.22	35.2	−0.58
−4	85.0	0.85	85.5	1.76	34.4	−0.15	99.2	0.78	86.0	0.35	34.3	−1.44
−3	82.1	0.25	75.6	−2.19	34.9	−0.13	95.7	0.21	85.9	0.78	37.3	0.55
−2	82.2	−0.45	77.3	−0.12	35.4	0.33	94.9	−0.73	87.3	1.46	34.9	−1.46
−1	79.9	0.15	75.2	−0.72	34.7	−0.28	90.1	−1.63	80.7	−1.39	38.8	0.99
0	45.1	−19.01	49.9	−15.06	32.7	−0.21	61.7	−11.56	55.7	−15.68	25.9	−5.92
1	46.6	−16.73	53.1	−13.29	27.4	−4.43	68.7	−6.81	60.9	−9.52	25.6	−6.86
2	50.9	−12.66	53.3	−12.31	25.7	−5.90	68.0	−9.14	59.6	−13.30	27.1	−4.55
3	50.2	−14.86	54.7	−11.89	29.9	−2.82	66.3	−10.48	60.2	−11.13	29.7	−2.94
4	52.5	−13.75	57.0	−11.35	28.5	−4.16	73.1	−3.61	62.1	−11.61	28.5	−3.77
5	50.3	−15.19	54.9	−13.17	29.2	−2.64	63.5	−10.94	62.9	−10.03	26.4	−6.04

Panel B. Regression Results

Change in buy order size = $\underset{(-5.69)^{***}}{-0.200} - \underset{(-2.03)^{**}}{0.047*\text{Splitf}} + \underset{(2.02)^{**}}{0.052*\text{Period2}} + \underset{(1.94)^{*}}{0.079*\text{Period3}} - \underset{(-4.26)^{***}}{0.103*\text{NASDAQ}}$

Adj. $R^2 = 1.88\%$, $N = 1{,}247$ observations

Change in sell order size = $\underset{(-0.76)}{-0.031} - \underset{(-3.01)^{***}}{0.080*\text{Splitf}} - \underset{(-1.65)^{*}}{0.049*\text{Period2}} - \underset{(-1.46)}{0.068*\text{Period3}} - \underset{(-3.86)^{***}}{0.107*\text{NASDAQ}}$

Adj. $R^2 = 1.83\%$, $N = 1{,}242$ observations

The average order size is reported in thousand dollars for buy and sell orders. We classify trades as buy or sell orders using the Lee and Ready (1991) algorithm. We cumulate all trades in the same direction that are within five seconds into a single order if these trades are at the same price and there are no intervening quote revisions. In Panel A, the *t*-statistics test the hypothesis that the mean order size on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in the cross-sectional analysis in Panel B is the change in order size (either buy order size or sell order size), calculated as $\{(\text{Order Size}_{\text{postsplit}} - \text{Order Size}_{\text{presplit}})/\text{Order Size}_{\text{presplit}}\}$. Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

{(post-split buy order size−pre-split buy order size)/pre-split buy order size} around the ex-split date in Panel B of Table 4. We find that the coefficients on the two time period dummy variables are significantly positive (*t*-values of 2.02 and 1.94). Thus, the average buy order size declines by a significantly smaller amount after the tick sizes are reduced, consistent with the broker promotion explanation (Hypotheses 2a and 2b). Specifically, because the increase in the relative spread after the split ED becomes smaller as the tick size is reduced, the incentives for brokers to promote splitting stocks to small investors weaken, leading to smaller declines in average buy order sizes.

However, we also document a decrease in the average size of sell orders. In columns 8–13 of Panel A, Table 4, we document that during the 1/8th pricing period, the size of the sell orders decreases after the split. The *t*-statistics range from −2.94 to −15.68. Comparing firm averages, the sell orders decline from about $94,000 to about $67,000, on average. The average declines in the size of sell orders in the 1/16th and decimal pricing eras are about $23,000 (from $82,000 to $59,000) and $9,000 (from $36,000 to $27,000), respectively. The results of the regressions in Panel B show that the coefficients on the two time period dummy variables are negative, but only the coefficient for Period 2 is significant (*t*-value

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of −1.65). Thus, there is weak evidence that the decline in the average sell order size occurs more in the latter time periods than during Period 1, suggesting that the broker promotion explanation does not explain all the changes in trading patterns around the stock split ED.

2. Frequency of Small Trades

Since this evidence of a decline in the average order size indicates an increase in the number of small transactions, we report the frequency of small trades for the different time periods in Table 5. We compare the frequency of one-lot trades before and after the split on a split-adjusted basis. For example, for a two-for-one split, we compare the frequency of one-lot trades before the split with the cumulative frequency of one- and two-lot trades after the split. Similarly, for a four-for-one split, we compare one-lot trades before the split with the sum of one-, two-, three-, and four-lot trades after the split. The broker promotion explanation predicts an increase in small trades after the split. Since the increased relative spread after a split provides the economic incentives for broker promotion, we expect the change in small trades to be positively related to the change in the relative spread. Moreover, after the tick sizes are reduced, the change in relative spread is smaller, thus reducing the incentive for broker promotion. Hence, the relation between the change in relative spread and the change in the frequency of small trades should be weakened after reduction of tick sizes.

We find that during the 1/8th pricing period, one-lot trades make up 18.3% of all transactions on day −5 in the pre-split period (Panel A, Table 5). This increases to 29.4% on the ED. The *t*-statistics in the post-split period are all over 15, suggesting that benchmarked to the pre-split period, one-lot trades increase significantly after a split. Comparing firm averages in the pre-split period, one-lot trades comprise 18.3% of all trades, on average. In the post-split period, this averages 29.8%, a change of 11.6%. In contrast, the corresponding changes in the 1/16th pricing period and the decimal pricing period are smaller. In the 1/16th period, the frequency of small trades increases from 26.7% pre-split to 36.5% post-split, an increase of 9.7%. In the decimal pricing period, the frequency of small trades goes up by 8.2% after the split increasing from 43.5% pre-split to 51.7% post-split. Consistent with the broker promotion hypothesis, the frequency of small (one-lot) trades increases after the split date. However, this increase is smaller after decimalization, which weakened the incentives for broker promotion.

In Panel B, we report the results of two regressions where the dependent variable is the change in the frequency of small trades {(post-split frequency of small trades−pre-split frequency of small trades)/pre-split frequency of small trades}. In the first regression (Model 1), we include two time period dummy variables to establish whether the split-induced change in the frequency of small trades is different during the later time periods. We include the split factor and a dummy variable for Nasdaq firms as control variables. The coefficients on the two time period dummy variables are significantly negative (*t*-values of −10.38 and −9.74). Thus, in the later time periods with lower tick sizes, i.e., 1998–1999 and 2001–2002, the increase in the frequency of small trades is smaller.

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TABLE 5

Frequency of Small Trades (Split-Adjusted)

Panel A. Average % of Small Trades

	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	% Small	*t*-Stat	% Small	*t*-Stat	% Small	*t*-Stat
−5	18.281	0.00	27.215	1.43	41.371	−2.74
−4	18.947	0.95	26.697	0.32	42.820	−0.80
−3	17.528	−2.41	26.464	−0.37	44.752	1.38
−2	19.057	1.61	26.495	−1.18	44.949	2.08
−1	18.059	−0.59	26.651	−0.29	43.360	−0.26
0	29.442	21.37	38.044	22.04	51.725	9.63
1	30.978	22.12	37.002	20.26	51.305	9.75
2	30.528	21.85	36.297	19.31	51.771	9.22
3	29.751	19.37	36.063	19.78	51.650	8.87
4	29.261	18.91	35.538	17.34	51.726	8.90
5	29.795	16.87	35.416	16.44	52.224	9.57

Panel B. Regression Results

Model 1

$$\underset{}{\text{Change in small trades}} = \underset{(12.39)^{***}}{0.745} + \underset{(2.22)^{**}}{0.088*\text{Splitf}} - \underset{(-10.38)^{***}}{0.457*\text{Period2}} - \underset{(-9.74)^{***}}{0.674*\text{Period3}} + \underset{(2.08)^{**}}{0.086*\text{NASDAQ}}$$

Adj. $R^2 = 10.96\%$, $N = 1{,}238$ observations

Model 2

$$\underset{}{\text{Change in small trades}} = \underset{(4.45)^{***}}{0.275} + \underset{(1.29)}{0.051*\text{Splitf}} + \underset{(2.41)^{**}}{0.101*\text{NASDAQ}} + \underset{(11.28)^{***}}{0.598*\text{ChgSpread}}$$

$$- \underset{(-8.66)^{***}}{0.497*(\text{ChgSpread}*\text{Period2})} - \underset{(-8.07)^{***}}{0.800*(\text{ChgSpread}*\text{Period3})}$$

Adj. $R^2 = 12.47\%$, $N = 1{,}238$ observations

In the pre-split period, one-lot trades are considered small trades. In the post-split period, small trades are split adjusted, i.e., cumulative one- and two-lot trades for a two-for-one split (or cumulative one-, two-, and three-lot trades for a three-for-one split). In Panel A, the *t*-statistics test the hypothesis that the frequency of small trades on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in the cross-sectional analysis in Panel B is the change in the frequency of small trades $\{(\text{Small trades}_{\text{postsplit}} - \text{Small trades}_{\text{presplit}})/\text{Small trades}_{\text{presplit}}\}$. Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0. ChgSpread is the change in relative spread $\{(\text{Relative Spread}_{\text{postsplit}} - \text{Relative Spread}_{\text{presplit}})/\text{Relative Spread}_{\text{presplit}}\}$.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

In the second regression (Model 2), we include the change in relative spread {(post-split relative spread−pre-split relative spread)/pre-split relative spread} and two interaction terms (change in relative spread∗time period dummy variables) as the main explanatory variables. If the increase in the relative spread motivates broker promotion, we expect a positive relation between the change in the relative spread and the change in the frequency of small trades. Furthermore, if a reduction in tick size weakens the incentives for broker promotion, we expect the interaction terms to be negative. The coefficient on the change in the relative spread is significantly positive (*t*-value of 11.28), indicating that the change in the frequency of small trades around the ex-split date is positively related to the change in the relative spread. This is consistent with the conjecture of a higher relative spread inducing broker promotion. The coefficients on the two interaction terms are negative and significant (*t*-values of −8.66 and −8.07). The smaller increases in the relative spread during 1998–1999 and 2001–2002 lowered the incentives for brokers to promote the stocks to small investors, resulting in a lower sensitivity of changes in small trades to changes in the relative spread. This evidence, which is new to the literature, supports the broker promotion hypothesis.

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While the above results are robust, we are aware of two potentially confounding factors in this analysis. Specifically, TAQ data do not include odd-lot trades of less than 100 shares. Thus, the increase that we document above could arise as a mechanical consequence of including trades that are greater than 100 shares in the post-split period (and would be reported on the TAQ database), but that would constitute odd-lot trades in the pre-split period (and thus would not be reported on the TAQ database). Furthermore, a mixed trade of say 150 shares would be reported on TAQ as one round-lot trade of 100 shares and an unreported (on TAQ) odd-lot trade of 50 shares. Consequently, the reported trade sizes are rounded down to the nearest round-lot size. To address these issues, we reestimate the cross-sectional regressions for a restricted sample including only two-for-one splits. In all cases, we consider one-lot trades as small trades in the pre-split period. We use three different specifications for post-split small trades. First, we use only two-lot trades in the post-split period as small trades. However, due to the rounding down of reported trades to the nearest lower round-lot size, a one-lot trade in the pre-split period represents intended trades of between 100 to 199 shares. After a two-for-one split, these trades are equivalent to intended order sizes of between 200 and 398 shares, i.e., the sum of two and three round-lot trades. Thus, in our second specification, we compare the frequency of one-lot pre-split trades to the cumulative frequency of two and three round-lot trades in the post-split period. Finally, it is possible that most small investors naturally gravitate to the smallest round-lot trade (i.e., one-lot). If so, then it would be important to include one-lot trades after the split, since brokers primarily may promote the stock to small investors, who may buy the lowest available round lot, i.e., a one-lot trade. Excluding this data from the analysis therefore may miss the major impact of broker promotion on trades after a split. Thus, we replicate the earlier analysis, except that the post-split small trades include one-, two-, and three-lot trades.

In Table 6, we report the results of the cross-sectional regressions and find that our conclusions are robust. In all three specifications, the coefficients on the two time period dummy variables in Model 1 remain significantly negative. For instance, considering cumulative two- and three-lot trades as small trades in the post-split period, we find that the coefficient for the Period2 dummy variable is -0.314 (t-value of -8.22) and that on the Period3 dummy variable is -0.605 (t-value of -10.20). These results are consistent with the change in the frequency of small trades after the split being significantly smaller when the incentives for broker promotion are weaker. In all three specifications of Model 2, the coefficient for the change in relative spread is significantly positive, and coefficients for both interaction terms (change in relative spread$*$time period dummy variables) are negative and significant. Overall, these results are consistent with those reported in Table 5 for the full sample.

To summarize our results thus far, we find that the relative spread increases and the trading volume declines marginally after a split. This is consistent with a reduction in liquidity following splits, a finding that is widely reported in the literature (e.g., Copeland (1979), Conroy, Harris, and Benet (1990), and Gray, Smith, and Whaley (2003)). Consistent with the broker promotion hypothesis (Angel (1997) and Schultz (2000)), we find evidence of a decrease in the average order

TABLE 6

Regression Results Using Alternative Measures of Small Trades for Two-for-One Splits

	Two-Lot Trades		Cumulative Two- and Three-Lot Trades		Cumulative One-, Two-, and Three-Lot Trades	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Intercept	−0.201 (−8.00)***	−0.478 (−16.05)***	0.210 (5.85)***	−0.193 (−4.56)***	1.220 (23.59)***	0.582 (9.63)***
NASDAQ	0.036 (1.43)	0.045 (1.75)*	0.001 (0.03)	0.019 (0.53)	0.064 (1.23)	0.086 (1.63)
Period2	−0.231 (−8.60)***		−0.314 (−8.22)***		−0.524 (−9.47)***	
Period3	−0.429 (−10.30)***		−0.605 (−10.20)***		−0.836 (−9.76)***	
ChgSpread		0.325 (9.28)***		0.475 (9.56)***		0.791 (11.13)***
ChgSpread∗Period2		−0.238 (−6.27)***		−0.314 (−5.83)***		−0.589 (−7.64)***
ChgSpread∗Period3		−0.515 (−8.36)***		−0.729 (−8.34)***		−1.047 (−8.38)***
Adj. R^2 (%)	10.57	10.39	9.94	10.34	10.67	12.91

Table 6 reports cross-sectional regression coefficients for the subsample of 1,125 firms that executed a two-for-one split; *t*-values are in parentheses. The dependent variable is the change in the frequency of small trades {(Small trades$_{postsplit}$ − Small trades$_{presplit}$)/Small trades$_{presplit}$}. In the pre-split period, one-lot trades are considered small trades. In the post-split period, we use three different measures of small trades: two-lot trades only, cumulative two- and three-lot trades or cumulative one-, two-, and three-lot trades. NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0. ChgSpread is the change in relative spread {(Relative Spread$_{postsplit}$ − Relative Spread$_{presplit}$)/Relative Spread$_{presplit}$}.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

size and an increase in the frequency of small trades after a split. Inconsistent with the trading inconvenience explanation, we do not find evidence of an increase in turnover after a split. We now examine whether these trading patterns result in an increased tendency for post-split trades to congregate at ask prices.

D. Trade Price Location Parameter and Order Imbalance

We compute a location parameter to examine order flow effects around the ED. Following Keim (1989), we define the trade price location parameter, L_{ij}, for firm i and a transaction at time j as

$$L_{ij} = (P_{ij} - B_{ij})/(A_{ij} - B_{ij}), \tag{3}$$

where P_{ij} is the transaction price and B_{ij} and A_{ij} are the prevailing bid and ask prices, respectively. If a trade transacts at or near the ask quote, $0.5 < L_{ij} \leq 1.0$; if it is at or near the bid quote, $0 \leq L_{ij} < 0.5$. The daily trade price location parameter (the location parameter), L_{it}, is the equally weighted average of L_{ij} using all the transactions on day t. On any day, a location parameter larger than 0.5 indicates that more transactions occur nearer the ask than the bid price, suggesting a buy OIM. Correspondingly, a location parameter less than 0.5 suggests a sell OIM. We expect the order flow effects (such as the buying pressure on the ED) to exist throughout the day; hence, we use transaction data to examine this effect. About 3% of the transaction data are excluded because prices are outside the bid and ask quotes, i.e., L_{ij} is beyond the range of zero and one. We also calculate the

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OIM_{it} using equation (4), where NBUY_{it} and NSELL_{it} are the numbers of buy and sell orders on a given day. The OIM_{it}, has a range of -1 to 1, and a positive (negative) value indicates buy (sell) OIM,

$$\text{OIM}_{it} = (\text{NBUY}_{it} - \text{NSELL}_{it})/(\text{NBUY}_{it} + \text{NSELL}_{it}). \quad (4)$$

In Panel A of Table 7, we report the average location parameter around the ED. During the 1/8th era (1995–1996), there is a significant tendency for trades to fall nearer the ask price on and after the ED, compared to before the ED. The location parameter L_{it} increases from 0.550 on day -5 to 0.572 on day -1, and further increases to 0.602 (t-statistic = 6.87) on day 0. In the post-event period $(+1, +5)$, the location parameter remains significantly higher than in the pre-event period $(-1, -5)$, with t-values of two or greater. These results are consistent with Conrad and Conroy (1994) and Schultz (2000).

During the 1/16th era (1998–1999), we find that the location parameter also increases from 0.534 on day -5 to 0.571 on day 0. However, this effect dissipates over the subsequent week since the location parameter is not significantly higher than during the pre-split period on four of the six days. These effects are also smaller in the post-decimalization period. The location parameter on the ED is 0.558 and is significantly different from that in the pre-split period (t-statistic = 2.55). But, after the ED, the location parameter is not significantly higher than in the pre-split period.

We report the results of regressions that explain the change in location parameter (post-split location parameter−pre-split location parameter) in Panel B of Table 7. The coefficients on the two time period dummy variables are indeed negative and significant, suggesting that the increase in the location parameter is smaller in the later two time periods, consistent with a smaller bias toward the ask price. This complements our earlier results that the intensity of small investor buying is stronger during the 1/8th pricing period and is weaker during 1998–1999 and 2001–2002.

We find similar results for OIM. The results we document in Table 8 show that during the 1/8th era the OIM parameter, OIM_{it}, is 0.208 on day 0, and is significantly higher than that in the pre-split period (t-statistic = 5.36). This buy OIM persists until day 3 after the ED. However, the OIM is smaller during the 1/16th and decimal pricing periods. Moreover, the imbalance dissipates quickly, as there is no evidence of any OIM between days +2 to +5. The regressions in Panel B confirm that the change in OIM (post-split OIM−pre-split OIM) is smaller in Periods 2 and 3, since the coefficients on Period2 and Period3 are negative and significant (t-values of -2.35 and -1.73).

These results complement the evidence in Section IV.C and offer more support for the broker promotion hypothesis. The tendency for trades to execute near the ask price on the ED is significant during 1995–1996. Our finding of significantly higher buy OIMs after the stock split ED strengthens this result. However, as predicted by the broker promotion explanation, these effects have weakened over the latter two time periods.

Our results thus far suggest that broker promotion effects may explain the observed positive ED return. This may be due to a bid-ask bounce and/or price pressure as the number of buy orders increases. During the 1/8th era with the

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TABLE 7

Placement of Transaction Price within the Bid-Ask Spread

Panel A. Average Location Parameter

	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	L_{it}	t-Stat	L_{it}	t-Stat	L_{it}	t-Stat
−5	0.550	−1.73	0.534	−1.16	0.537	0.57
−4	0.554	−0.97	0.536	−1.01	0.523	−1.03
−3	0.552	−2.09	0.539	−0.12	0.514	−2.26
−2	0.571	2.53	0.546	1.28	0.545	0.90
−1	0.572	2.10	0.546	0.87	0.553	1.62
0	0.602	6.87	0.571	5.77	0.558	2.55
1	0.598	6.34	0.557	2.91	0.532	−0.44
2	0.579	3.05	0.543	0.25	0.523	−1.44
3	0.581	3.35	0.545	0.86	0.529	−0.70
4	0.575	2.51	0.537	−0.83	0.528	−0.75
5	0.573	2.00	0.533	−1.77	0.540	0.23

Panel B. Regression Results

Change in location parameter	=	0.014	+	0.006∗Splitf	−	0.017∗Period2	−	0.023∗Period3	+	0.002∗NASDAQ
		(1.76)*		(1.25)		(−3.03)***		(−2.54)**		(0.38)

Adj. $R^2 = 0.71\%$, $N = 1{,}248$ observations

Following Keim (1989), we define the location parameter L_{ij} for firm i and transaction at time j as $L_{ij} = (P_{ij} - B_{ij})/(A_{ij} - B_{ij})$, where P_{ij} is the transaction price and B_{ij} and A_{ij} are the prevailing bid and ask prices, respectively. If a trade transacts at or near the ask quote, $0.5 < L_{ij} \leq 1.0$; if it is at or near the bid quote, $0 \leq L_{ij} < 0.5$. The daily location parameter, L_{it}, is the equally weighted average of L_{ij} using all transactions on day t. On any day, a location parameter larger (smaller) than 0.5 indicates that more transactions occur nearer the ask price than the bid price, suggesting a buy (sell) OIM. The t-statistics in Panel A test the hypothesis that the mean of the location parameter on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in the cross-sectional analysis in Panel B is the change in location parameter ($L_{\text{postsplit}} - L_{\text{presplit}}$). Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

largest tick size and relative spread, this microstructure effect should be more severe and, accordingly, the measured ED return should be higher. By the same token, during the decimal era with the smallest tick size and smallest changes in the relative spread after the ED, the ED return should be smaller or insignificant. Additionally, if the ED return is primarily the result of bid-ask spreads, returns calculated using bid prices (rather than closing prices or transaction prices) should be smaller or insignificant. We turn to these issues now.

V. Ex-Date Returns

In Table 9, we report the market-adjusted ARs for days −5 through +5, measured using both closing and bid prices. In estimating the AR, we use the value-weighted index return corresponding to the exchange on which the stock is listed as the market return. Thus, for instance, for Nasdaq firms we use the CRSP Nasdaq value-weighted index return as the market return. Panel A shows that the abnormal ED return using closing transaction prices is 1.06% in the 1/8th era, 0.36% in the 1/16th era, and 0.62% in the decimal era. Examining the CARs over the intervals $(0, 1)$, $(-1, 0)$, or $(-1, +1)$ reported in Panel B, we find that the mean CARs are significantly positive for the 1/8th pricing era. During this period, using closing prices, the mean CAR $(0, 1)$ is 1.77% and is significant at the 1% level of significance. The average CAR $(-1, 0)$ is 1.89%, and the three-day CAR

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TABLE 8

Order Imbalance

Panel A. Average Order Imbalance

	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	OIM_{it}	*t*-Stat	OIM_{it}	*t*-Stat	OIM_{it}	*t*-Stat
−5	0.098	−2.36	0.072	−1.54	0.074	0.46
−4	0.119	−0.62	0.080	−1.00	0.042	−1.24
−3	0.110	−2.18	0.080	−0.72	0.031	−2.10
−2	0.156	2.54	0.109	1.74	0.091	0.84
−1	0.159	2.34	0.107	1.24	0.113	1.75
0	0.208	5.36	0.146	4.70	0.120	2.40
1	0.205	5.56	0.119	2.17	0.066	−0.35
2	0.161	2.19	0.093	−0.04	0.047	−1.38
3	0.169	2.73	0.093	0.18	0.064	−0.45
4	0.149	1.52	0.083	−0.95	0.060	−0.61
5	0.147	1.22	0.076	−1.69	0.082	0.27

Panel B. Regression Results

$$\text{Change in OIM} = \underset{(2.21)^{**}}{0.040} - \underset{(-0.22)}{0.003}*\text{Splitf} - \underset{(-2.35)^{**}}{0.031}*\text{Period2} - \underset{(-1.73)^{*}}{0.036}*\text{Period3} - \underset{(-0.15)}{0.002}*\text{NASDAQ}$$

Adj. $R^2 = 0.20\%$, $N = 1{,}248$ observations

$OIM_{it} = (NBUY_{it} - NSELL_{it})/(NBUY_{it} + NSELL_{it})$, where $NBUY_{it}$ and $NSELL_{it}$ are the numbers of buy and sell orders for firm i on a given day identified using the Lee and Ready (1991) algorithm. OIM_{it} has a range of −1 and 1, and a positive (negative) value will indicate buy (sell) OIM. In Panel A, the *t*-statistics test the hypothesis that the mean of the OIM on a given day is significantly different from the overall mean during the pre-event period. As in Conrad and Conroy (1994), the event day (or the ex-date of the split) is specified as day 0, the pre-event period as day −5 through −1, and the post-event period as day 0 through +5. The dependent variable in the cross-sectional analysis in Panel B is the change in OIM ($OIM_{postsplit} - OIM_{presplit}$). Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

$(-1, 1)$ averages 2.60%. Both are significant at the 1% level. In the 1/16th pricing period, the three CARs are smaller in magnitude (0.53%, 0.82%, and 1.00%, respectively), but remain statistically significant. None of the three CARs in the decimal pricing period is significantly different from zero at conventional levels. In Panel C, the regression coefficients of the two time period dummy variables are significantly negative at the 1% significance level, indicating that the CARs in these periods are lower.

Using bid prices, we find that the two-day CARs $(-1, 0)$ and $(0, 1)$ during the 1/8th pricing period average 1.42% and 1.29%, respectively. The three-day CAR $(-1, 1)$ averages 2.03%. All are significant at the 1% level. Thus, the positive ARs observed around the ex-split date are not solely attributable to a bid-ask bounce; rather there is an upward adjustment of the bid prices. In the two latter time periods, the CARs based on bid prices are smaller, and none of the average CARs in the decimal pricing period is significantly different from zero. The regression results in Panel C confirm that there is a significant decline in CARs from the 1/8th pricing period to the latter two periods. The coefficients on the two time period dummy variables are negative and statistically significant (*t*-values of −2.51 and −2.41). Thus, the reduction of the minimum tick size reduces ex-split returns even after controlling for any effects of changes in the spread or bid-ask bounce.

Overall, these results provide strong support for the broker promotion explanation of the ED returns. In the decimal pricing era, the returns around the

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TABLE 9

Abnormal Returns around the Ex-Date

Panel A. Average Daily Abnormal Returns

	ARs Using Closing Prices						ARs Using Bid Prices					
	Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002		Period 1 1995–1996		Period 2 1998–1999		Period 3 2001–2002	
Day	Ret	*t*-Stat	Ret	*t*-Stat	Ret	*t*-Stat	Ret	*t*-Stat	Ret	*t*-Stat	Ret	*t*-Stat
−5	0.01	−2.16	0.31	−0.05	0.47	1.47	0.03	−2.15	0.31	−0.04	0.50	1.62
−4	0.19	−0.90	0.27	−0.50	0.13	−0.22	0.21	−0.78	0.32	0.02	0.14	−0.18
−3	0.21	−0.88	0.23	−0.93	0.23	0.41	0.21	−0.88	0.16	−1.37	0.33	0.75
−2	0.27	−0.59	0.38	0.32	−0.03	−0.77	0.31	−0.15	0.33	−0.02	−0.09	−1.33
−1	0.89	3.67	0.47	0.97	−0.05	−0.74	0.80	3.16	0.49	1.20	−0.02	−0.78
0	1.06	3.49	0.36	0.23	0.62	1.81	0.68	1.70	0.18	−0.86	0.49	1.36
1	0.73	1.88	0.18	−0.84	−0.23	−1.25	0.63	1.48	0.24	−0.41	−0.20	−1.28
2	−0.30	−2.59	−0.31	−3.60	0.13	−0.07	−0.10	−2.02	−0.35	−3.79	0.20	0.08
3	0.10	−1.05	0.06	−1.30	−0.08	−0.87	0.04	−1.34	0.11	−0.97	−0.12	−1.14
4	−0.05	−1.83	0.05	−1.66	0.13	−0.09	−0.13	−2.22	0.09	−1.37	0.13	−0.19
5	−0.01	−1.60	−0.24	−3.31	0.00	−0.58	−0.03	−1.70	−0.25	−3.29	0.00	−0.60

Panel B. Average Cumulative Abnormal Returns

	CARs Using Closing Prices			CARs Using Bid Prices		
	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3
CAR (−1, 1)	2.60***	1.00***	0.34	2.03***	0.90***	0.27
CAR (−1, 0)	1.89***	0.82***	0.57	1.42***	0.66***	0.46
CAR (0, 1)	1.77***	0.53**	0.38	1.29***	0.42*	0.29

Panel C. Regression Results

$$\text{CARPRC}(-1,1) = \underset{(3.47)^{***}}{0.021} - \underset{(-0.73)}{0.003}*\text{Splitf} - \underset{(-3.53)^{***}}{0.016}*\text{Period2} - \underset{(-3.05)^{***}}{0.021}*\text{Period3} + \underset{(3.22)^{***}}{0.013}*\text{NASDAQ}$$

Adj. $R^2 = 1.90\%$, $N = 1{,}248$ observations

$$\text{CARBID}(-1,1) = \underset{(2.98)^{***}}{0.018} - \underset{(-0.96)}{0.004}*\text{Splitf} - \underset{(-2.51)^{**}}{0.011}*\text{Period2} - \underset{(-2.41)^{**}}{0.017}*\text{Period3} + \underset{(2.67)^{***}}{0.011}*\text{NASDAQ}$$

Adj. $R^2 = 1.10\%$, $N = 1{,}248$ observations

The ex-split date is specified as day 0. The ARs are measured as the market-adjusted ARs using both closing and bid prices. We use the NYSE value-weighted return (Nasdaq value-weighted return) for NYSE (Nasdaq) stocks. In Panel A, the *t*-statistic tests the hypothesis that the mean of the AR on a given day is significantly different from zero. In Panel B, we test whether the mean of the two- or the three-day CAR is significantly different from zero. Note that in Panel A, we compute the daily average AR using only non-missing returns. Hence, the reported CARs in Panel B will differ from the sum of the daily ARs for the corresponding days in Panel A. The dependent variable in the cross-sectional regressions in Panel C is the three-day CAR calculated using either closing or bid prices (denoted by CARPRC or CARBID). Splitf is the split factor and NASDAQ is a dummy variable equal to 1 for Nasdaq firms and 0 otherwise. Period2 and Period3 are dummy variables set equal to 1 during Periods 2 and 3, respectively; otherwise they are set to 0.

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

ED are not significant, whereas they are significantly positive during the 1/8th pricing era. If the ED returns were related to trading inconveniences such as the undesirability of transacting with attached due bills, then we would not expect the magnitude of the trading characteristics and the ED return to change with changes in the minimum tick size, as we document here.

Our results can be contrasted with those in Graham, Michaely, and Roberts (2003) and Jakob and Ma (2004), who show that the ED return on the cash dividend ED is not an artifact of microstructure effects. Vijh (1994) finds significantly positive returns around the ED for spinoffs. He suggests that investors could require a risk premium if there is significant price discovery about the stand-alone values of the parent and subsidiary stocks that would start trading independently after the ED. However, stock split EDs are not associated with any significant price discovery, because no new claims are created. Since there are no tax-related or price discovery issues associated with stock split EDs, we do not expect a pos-

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itive AR around the ex-split dates when the minimum tick size is reduced. This is indeed what we find, and our findings are consistent with the broker promotion explanation for the ED effects around stock splits rather than with the trading inconvenience explanation.

VI. Conclusions

Previous research documents significant changes in both trading patterns and positive ARs around stock split EDs. The broker promotion hypothesis suggests that the higher relative spreads after a split provide incentives for brokers to promote the splitting stocks to their small customers. This would result in more frequent small buy transactions and a positive ED return due to price pressure effects. The trading inconvenience hypothesis suggests that inconveniences such as investors' aversion to dealing with due bills results in an unwillingness to buy between the record and EDs. Thus, prices before the ED are depressed, resulting in a positive ED return.

The reduction in the bid-ask spread due to decimalization allows us to disentangle these two explanations. Consistent with an increased intensity of small investor trading, we show that after the ED, i) the average buy order size drops, ii) the frequency of small trades increases, and iii) the OIM is biased toward the ask price. All these changes are smaller after decimalization, a period where the incentives for brokers to promote splitting stocks to small investors are smaller (since the split-induced increase in relative spread is smaller). We observe positive ARs around the ED during the 1/8th pricing period, but not in the decimal pricing period. These results support the broker promotion hypothesis.

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