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The effect of stock splits on clientele: Is tick size relevant? ☆

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Abstract

We explore whether the relation between stock splits and clientele is driven by binding tick sizes. We find little evidence that firms adjusted prices to maintain similarly binding tick sizes as the NYSE reduced tick sizes. Furthermore, though splits that increase the extent to which tick sizes are binding are associated with greater increases in spreads, these splits experience similar changes in measures related to clientele, including trade size, breadth of individual and institutional ownership, and analyst following. We find little evidence supporting theories, such as spread-induced sponsorship, that rely on binding tick sizes to link splits and clientele.

JEL classification: G30; G10
Keywords: Stock splits; Tick size; Clientele

1. Introduction

Tick sizes are a feature of most organized exchanges, but whether tick sizes are simply an impediment to negotiation or exert some other influence on trading is regularly debated. Similarly, while stock splits are capable of altering the composition of a firm's investment clientele (the individuals, institutions, and analysts who regularly follow a firm) the mechanism by which a split induces these changes is not well understood. A number of papers have

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addressed both these puzzles by emphasizing a link between stock splits and clientele. Specifically, that stock splits alter the extent to which tick sizes are binding and binding tick sizes influence clientele.

Binding tick sizes can influence clientele a number of ways. An optimally binding tick size can maximize liquidity and attract a broader clientele.[2] A more binding tick size may also increase spread revenue to brokers who then promote the stock to a larger set of potential traders.[3] On the other hand, tick size may be irrelevant. Since stock splits increase share volume, they will increase commission revenue to brokers and brokers will be motivated, as with spread revenues, to promote the stock. Stock splits may also return prices to a trading range most comfortable for a firm's investors. Finally, it may simply be the case that some change in firm characteristics induces both a stock split and a change in clientele. Our empirical tests exploit the fact that theories tying stock splits to clientele rely on stock splits leading to more binding tick sizes.

Assuming binding tick sizes help establish a firm's clientele, if equity markets reduce their tick sizes we should see a temporary upsurge in stock splits and a permanent reduction in post-split prices. These splits would be undertaken to retain the firm's previously chosen clientele by ensuring tick sizes are equally binding before and after the tick size change. Looking at stock split activity, we find that post-split prices are no different across tick size regimes even though tick sizes differ substantially. Furthermore, in regressions explaining split activity, we find that indicators for either tick size regimes or time periods immediately subsequent to a tick size reduction provide little additional explanatory power beyond market returns. Thus, while our results confirm previous studies documenting a price rise before stock splits, we find little evidence to suggest tick sizes affect the timing or magnitude of these events.

If binding tick sizes drive the link between stock splits and clientele, the magnitude of clientele changes around splits will depend on whether a split actually changes the degree to which the tick size is binding. Furthermore, since tick size theories typically assume a binding tick size affects profits to liquidity providers, the change in these profits should likewise depend on whether a split actually changes the degree to which the tick size is binding. We compare samples of stock splits that increase the extent to which tick sizes are binding with a sample of splits where tick sizes do not become more binding.[4] While we observe significant changes in clientele associated with stock splits in our samples, we find no differences across samples that suggest these changes are related to tick sizes. In particular, we find few differences across samples in the change in volume, trade size, number of trades, order imbalance, number of shareholders owning stock, number of institutions owning stock, or the number of analysts following a stock split. We do, however, find that spreads increase more when tick sizes become

[2] The relation between tick size and liquidity is discussed by Christie and Schultz (1994), Harris (1994), Bessembinder (1997), Angel (1997), Seppi (1997), Anshuman and Kalay (1998), among others. Note that we examine only NYSE listed securities for the following reason. Our method of analysis includes comparisons of split effects across time periods. While the market structure (excluding tick sizes) changed little on the NYSE, the NASDAQ market has experienced some pronounced changes, including those associated with quoting behavior (Christie and Schultz, 1994), and payment for order flow/order routing (Battalio, 1997, Battalio et al., 1997; Easley et al., 1996), that are likely to affect the way spreads are determined on that market.

[3] See Angel (1997), Schultz (2000), and Kadapakkam, Krishnamurthy and Tse (in press).

[4] These samples, described later, are constructed by exploiting changes in tick size regimes on the New York Stock Exchange.

more binding and that this increase is not attributable to changes in order flow characteristics.[5] Taken together, our results suggest that the relation between stock splits and clientele is not generated by tick size effects. In fact, stock splits that increase the extent to which a tick size is binding simply lead to increased gross profits for liquidity providers.

Schultz (2000) argues that stock splits may encourage brokers to promote shares. He suggests that both spread and per-share commission revenues to brokers would motivate this activity. Our results suggest that spread based compensation induced by tick size constraints do not have this effect, though per-share structures may. Kadapakkam, Krishnamurthy and Tse (in press) compare stock splits in various tick size regimes. They find (as we do) that spreads change more in wider tick size regimes and they also find (in contrast to our results) that order size, number of orders and order imbalance differ across tick size regimes. They conclude that stock splits, by increasing spreads, lead to broker promotion of stocks and an expanded clientele. However, they do not look at clientele changes and for this reason they cannot observe that changes in spreads do not, in fact, precipitate changes in clientele.[6]

Angel (1997) argues that there exists an optimal *relative* tick size (tick size as proportion of price), which implies that the optimal trading range is determined by tick sizes. However, since we find no change in stock prices and only weak evidence of an increase in split activity as tick sizes were lowered, our results suggest that this is not the case. Given that we see clientele changes in every sample, our results suggest that a link exists between clientele and stock splits, but that tick sizes are not relevant as either a mechanism driving this link or as a determinant of optimal trading ranges.

The remainder of the paper is organized as follows. Section 2 describes in detail the possible links between tick size and clientele. Section 3 contains a description of the sample, data and methodology, and Section 4 presents our results. Section 5 provides our conclusions.

2. Tick size and clientele

Binding tick sizes can affect the trading behavior of market participants, thereby leading to changes in clientele. For example, binding tick sizes can benefit limit orders by increasing the cost to later orders of stepping ahead of existing limit orders (a strategy known as front running). This benefit encourages limit orders and, as a result, leads to more depth and liquidity (see Harris, 1994). On the other hand, a larger relative tick size also imposes a direct cost on liquidity demanders through higher spreads. Angel (1997) argues that there exists an optimal relative tick size that balances the benefits of increased liquidity against the higher costs paid by liquidity demanders. This optimal relative tick size argument suggests that stock splits will expand

[5] Immediately subsequent to a split, dollar spreads typically decline while relative spreads or split-adjusted spreads (calculated by multiplying the post-split dollar value of a two-for-one split by two) typically increase. The focus of our analysis is not on whether there is an increase or decrease in spreads, but on whether binding tick sizes are an important determinant of resulting microstructure and clientele changes. Thus, we focus on differences in the magnitude of changes between our various samples, not whether the change is positive or negative. Results are similar for all these measures, though we present and discuss our results in terms of split-adjusted dollar spreads only. Furthermore, there is some debate as to what is the relevant measure of spreads around stock splits. Some argue that dollar spreads, and not relative spreads, are relevant for traders around splits and dollar spreads typically decline (Maloney and Mulherin, 1992) even though relative spreads increase.

[6] Our differences related to measure of trading may be methodological. We look at longer windows to capture permanent changes in clientele; they look at days immediately surrounding the ex-date which may reflect temporary behavior. We also use matched samples to control for market factors and we employ a larger set of regression controls.

clientele as they return relative tick sizes to their optimal levels. In effect, optimized liquidity attracts more traders (individuals and institutions). Furthermore, since analysts prefer to follow more active stocks, optimized liquidity also leads to more analyst following.[7]

Tick sizes may also create a link between stock splits and clientele since brokers and brokerage firm analysts will promote trading in stocks in which they make relatively higher profits from investor trading activity.[8] Specifically, when a stock split increases the relative tick size, stock splits can raise the profits of brokerage firms who make markets in that stock. This will induce greater sponsorship of the stock and lead to an expanded clientele.

On the other hand, tick size may be irrelevant. First, sponsorship of individual stocks by brokers may be induced by per-share commission structures (see Goldstein et al., 2005). In effect, a stock split increases the number of shares needed to establish the same position value, and this increases total commissions on an otherwise equivalent transaction. Second, stock splits may simply restore prices to a trading range in which traders feel most comfortable.[9] This is particularly true for retail customers, who trade in smaller sizes. In this case, a stock split will lead to an expanded clientele regardless of any tick size effect.

Appendix A presents an overview of the theories just discussed and their implications for stock splits. In the case of sponsorship, there are two distinct cases. If spread revenues drive sponsorship, the implications are identical to the optimal tick size theories. On the other hand, if per share commission structures drive sponsorship, the implications are identical to the trading range hypotheses. Thus, our analysis can only distinguish relative tick size and spread-induced sponsorship from trading range and commission-induced sponsorship.[10]

The tick size arguments rely on the fact that a binding tick size will affect liquidity provision. As we explore the clientele effects of tick sizes, we also document corroborating changes in liquidity. Specifically, we examine the effect of tick sizes on spreads and the spread component (the realized spread) that reflects gross trading profits to liquidity providers. Given the structure of our samples, we should observe larger increases in the spread and, in particular, the realized spread for the binding tick size samples than for the decimals sample.

3. Samples and data

We examine all NYSE listed firms that have declared a two for one stock split between 1993 and 2003. The sample is selected from CRSP by selecting all firms with a three digit distribution code of 552 and a share code of 10 or 11. Each of our pre- and post-event windows is comprised of the 200 trading days immediately before the 25 days preceding the declaration date, and the 200 trading days immediately following the 25 days after the ex-date. We exclude the 25 days before the declaration date through the 25 days after the ex-date in order to avoid confounding effects related to the predictability of the split and trading patterns immediately after the ex-date.

[7] Analyst following also attracts more trading, which would reinforce the increase in trading that initially attracted an analyst.

[8] This effect is discussed in Angel (1997), Schultz (2000), and Brennan and Hughes (1991), and additional empirical evidence can be found in Lamoureux and Poon (1987), Desai, Nimalendran and Venkataraman (1998), and Easley, O'Hara and Saar (2001).

[9] Brennan and Hughes (1991), Baker and Gallagher (1980), Baker and Powell (1993), and Lakonishok and Lev (1987) discuss this relation.

[10] If there were notable regime changes in commission structures, one might be able to further distinguish between theories. However, commissions have changed only slightly since the major commission deregulation event in May of 1975.

To ensure data availability for the study periods, the sample beginning and ending dates are set so that the start of pre-event window and the end of the post-event window are between January 1, 1993 and December 31, 2003. Finally, we require that the firms trade during at least 100 days in each window.

We partition the splits into four samples. One sample corresponds to the period when firms traded in eighths, another when firms traded in sixteenths, and another when firms traded in decimals. We separately examine the sample of splits around the time the NYSE moved from eighths to sixteenths. This period is unique because a two for one stock split would have the exact same relative tick size before and after the tick size change. We refer to the first three samples by their tick sizes (*eighths*, *sixteenths*, and *decimals*), and refer to the latter sample as the *transition* sample. Appendix B presents a time line identifying the tick size regimes and time periods associated with these four samples. The eighths sample includes all splits with a post-event end date earlier than May 24, 1997, one month before the tick size change. The sixteenths sample includes all stock splits with windows between July 24, 1997 and December 29, 2000. Analogously, the decimals sample includes firms with a pre-event window start date greater than February 28, 2001.[11]

The transition sample includes stock splits with an ex-date that is within 50 days of the tick size change to sixteenths (June 24, 1997). Thus, we require that the ex-date be between April 14 and September 4, 1997. In order to capture the effect of stock splits where the relative tick size remains unchanged, we ensure that the windows do not coincide with the 51 days surrounding the tick size change. Specifically, we use the earliest of the "regular" pre-event window or the 200 days preceding May 19, 1997. The post-event window is the latest of the "regular" window or the 200 days following July 30, 1997. Our total sample consists of 342 stock splits.

Trading data are obtained from TAQ. The quotes are the National Best Bid Offer (NBBO). We filter data for reporting errors.[12] Trades are classified as buyer or seller initiated using the Lee and Ready (1991) algorithm.[13] The quoted spread is defined as $\text{Ask}_t - \text{Bid}_t$ and the effective spread is defined as $2^*|Price_t - \frac{Ask_t+Bid_t}{2}|$, where Ask_t and Bid_t are the prevailing ask and bid quotes at the time, t, that a trade executes at price Price_t. Relative quoted and effective spreads are measured as a percentage of the prevailing mid-quote at the time the spread is measured. For each sample window, we compute the time-weighted average of the quoted spreads and the volume-weighted average of the effective spreads.

We use a control sample to adjust for the effects of trends in trading costs and clientele. Given that many of our hypotheses are related to spreads and prices, we match each firm on

[11] The NYSE switched to trading in sixteenths from eighths on June 24, 1997. While the transition to sixteenths was prompt, the transition to decimals was done in three stages. The NYSE lowered the tick size to a penny for seven securities on August 28, 2000, for 57 more securities on September 25, 2000, and an additional 94 securities on December 5, 2000. The remaining securities began trading in decimals on January 29, 2001. We avoid these transition periods. We also make sure that none of the post-event windows, in the sixteenths sample, coincide with the date on which a firm moved to decimals, which could happen if any of the firms in the sample had switched to decimals during one of the three pilot periods.

[12] Specifically, we exclude the following observations: (1) non positive prices or quotes, (2) negative quoted spreads, (3) if mid-quote is less than or equal to \$100, we exclude observations with a dollar spread (quoted, effective, or realized) greater than \$5; if mid-quote is greater than or equal to \$100, we exclude observations with a spread greater than \$10, (4) we exclude bid and ask quotes as well as transaction prices if they move by more than 25% from previous values, (5) quotes and transactions are excluded if they are outside of regular trading hours 9:30 through 16:00, (6) finally, we exclude opening trades.

[13] Trades closer to the ask are classified as buys, and those closer to the bid as sells. Trades at the midpoint are classified using the tick test rule. Trades on an up-tick are classified as buyer initiated, those on a down-tick as seller initiated.

relative quoted spreads and price. Our control sample is from a group of NYSE listed firms with a share code number of 10 or 11 and no stock distributions during the firm's study window. Furthermore, as with the study sample, the matched firm must trade in at least 100 days per window. We measure the average relative quoted spreads and prices during the quarter of the first day of the pre-event window. We then round the relative spread in percentage terms to the first decimal digit, and pick from those firms with the closest relative spreads the one that is the closest in price (rounding often leads to multiple firms with the same closest spread).

Table 1 presents summary statistics (medians) for our four samples along with their controls. We note that the pre-split stock price is comparable across all samples (an observation confirmed in formal tests not reported). We also see that spreads have declined over time. Though we match first on spreads and then on price, the splitting firms have statistically significantly lower spreads for two of the samples and higher prices for three of the samples. The differences in relative spreads are small, however, at most 0.02 percentage points (7.4 percent difference relative to the splitting firms) and 3 to 4 dollars for prices (a roughly 6% to 8% difference relative to the splitting firms). Koski (1998) and Kamara and Koski (2001) study stock split effects using this same approach to matching, and find similar differences. This is due to the fact that the population of splitting firms has higher prices (and therefore lower relative spreads) than the

Table 1
Sample summary statistics

	Eighths	Transition	Sixteenths	Decimals
Number of splits	157	51	99	35
Splitting firms				
Pre-split price	45.31	60.47	59.89	52.70
Quoted spread (%)	0.51	0.35	0.25	0.18
Equity value ($millions)	1385	4533	7840	1722
Shares outstanding (1000s)	32,374	72,278	100,662	36,309
Matched control firms				
Pre-split price	42.09	54.79	55.86	48.15
Quoted spread (%)	0.50	0.36	0.27	0.20
Equity value ($millions)	2060	4503	7689	1453
Shares outstanding (1000s)	47,198	81,500	104,880	34,014
Difference				
Pre-split price	2.99***	1.56	4.15***	3.79***
Quoted spread (%)	−0.02***	−0.01***	0.00	−0.01
Equity value ($millions)	−128	733**	−16	−14
Proportional difference (%)				
Pre-split price	6.50***	2.38	7.99***	7.06***
Quoted spread	−4.60***	−3.07	−1.31***	−7.40**
Equity value	−11.50***	20.15*	−4.12***	−1.18

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.
The sample contains NYSE listed firms that declared a two-for-one stock split between 1993 and 2003. The sample is grouped in four samples. The eighths, sixteenths and decimals samples contain splits that occurred while the tick size was in eighths, sixteenths and decimals, respectively. The transition sample contains stock splits that occurred around the transition from eighths to sixteenths. Each of the variables below is measured during a pre-event period from 225 to 25 days before the split's declaration date. We present the cross-sectional medians. Control firms are matched with the splitting firms on pre-announcement relative quoted spreads and price levels. Inference is based on Wilcoxon signed rank test for the null hypothesis that the paired difference between the sample and the corresponding match value is zero.

population of firms from which to draw matches, precisely because firms typically split after their prices increase. We note that the purpose of the control sample is to capture broad market trends.

4. Results

4.1. Stock splits over time

If firms have a desired clientele and tick sizes influence clientele, then we expect tick size reductions to be accompanied by a drop in target prices and consequently an increase in splitting activity. Conversely, if firms split simply to bring prices to an optimal trading range that is more appealing to retail investors, or to increase sponsorship motivated by per-share commissions, then we expect splitting activity to be affected by previous price changes, but unaffected by any changes in tick size.

Table 2 presents the number of two-for-one stock splits by year starting in 1990 and provides some basic characteristics of the splits. Splitting activity generally increased over time and reached a high in 1997, after which it steadily declined. Despite the substantial variation in splitting activity, the pre-split price levels remain remarkably constant. Looking at market adjusted returns for the month and year prior to the split, we find returns are quite large. These results suggest split activity is not related to tick size changes and may simply reflect a return to normal price ranges after a price increase.

Table 2
Split activity over time

Year	Number of splits	Pre-split price	Market adjusted returns (%)		Value weighted market return (%)	Abnormal returns (%)	
			One month prior	One year prior		Declaration window	Effective window
1990	49	56.94	1.97	19.13	−6.08	0.25	0.67
1991	42	49.49	3.15	40.26	33.64	1.39**	1.40**
1992	84	46.74	1.70	43.97	9.06	1.32***	−0.45
1993	80	47.32	4.24	53.85	11.59	0.67	−0.46
1994	55	53.26	0.11	27.53	−0.76	1.21**	−0.04
1995	73	47.51	4.72	32.94	35.67	1.39***	0.02
1996	96	50.61	2.00	30.53	21.16	1.43***	0.61
1997	149	57.31	2.14	24.33	30.35	1.37***	−0.23
1998	132	56.56	1.50	24.95	22.30	0.07	−0.10
1999	80	64.66	3.68	40.37	25.26	1.19**	−0.65
2000	70	58.46	4.99	80.53	−11.04	1.03	0.54
2001	36	62.63	6.63	83.38	−11.27	0.43	0.19
2002	40	55.45	5.36	56.53	−20.85	0.38	−1.35*
2003	21	52.15	3.89	39.36	33.15	4.00***	−1.01*
2004	64	59.96	4.99	19.73	13.01	1.36***	−0.50

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.
This table presents all two-for-one stock splits executed between 1990 and 2004 for NYSE listed firms with a share code of 10 or 11. Pre-Split price is the average price during the −225 to −25 day window before the declaration date. Returns listed as One Month Prior and One Year Prior are the returns for the indicated length of time ending 25 days before the declaration date. Market Adjusted Returns are the raw returns less the CRSP value weighted return during the same period. The Value Weighted Market Return is for the calendar year in which the splits were executed. Abnormal Returns are calculated for the event date through the next two days (a three day window) using a market model with parameters determined during the −225 to −25 day window. *T*-statistics are used to measure the significance of abnormal returns.

Table 3
Determinants of split activity and post-split price levels

	(1) Post-split price level	(2) Number of splits	(3) Number of splits
Intercept	1.186***	2.948***	2.945***
	[0.000]	[0.000]	[0.000]
Indicator sixteenths	0.007		0.068
	[0.797]		[0.662]
Indicator decimals	0.013		0.004
	[0.745]		[0.983]
Indicator year after sixteenths		0.562***	
		[0.000]	
Indicator year after decimals		0.043	
		[0.881]	
Return prior year		2.613***	2.749***
		[0.000]	[0.000]
Return 2 years prior		0.788**	0.861
		[0.0171]	[0.105]
Ln (pre-split equity value)	0.159***		
	[0.000]		
Decimals vs. sixteenths	0.006	−0.519*	−0.064
	[0.878]	[0.092]	[0.816]
Adjusted R^2	0.317	0.729	0.674
No. obs.	1007	30	30

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.
OLS regressions of the number of splits per semester and post split price level. The sample contains two-for-one stock splits by NYSE listed firms with a share code of 10 or 11 occurring between 1990 and 2004. We take the natural log of the dependent variables. Post-split price is the average price during the period from 25 to 225 days after the ex-date. In regression (1) we look at individual splits, while in regressions (2) and (3) we look at the number of splits in 6 month blocks of time. For regression (1), Indicator Sixteenths takes the value of 1 if the split occurred between June 24, 1997 and January 28, 2001, and Indicator Decimals takes the value of 1 if the split occurred after January 29, 2001. In regression (2), Indicator Year After Sixteenths takes the value of 1 for the period between July 1, 1997 and June 30, 1998 and Indicator Year After Decimals takes the value of one for the period between January 1, 2001 and December 31, 2001. In regression (3), Indicator Sixteenths takes the value of 1 for the period between July 1, 1997 and December 31, 2001 and Indicator Decimals takes the value of one for the period after January 1, 2001. Return Prior Year is the value weighted return during the year prior to the six month block in which we count splits and Return 2 Years Prior is the value weighted return during the year ending one year prior to the 6 month period in which we count splits. Finally, the pre-split equity value is the firm's market capitalization during a window from 225 to 25 days before declaration date. In the latter part of the table, we present the difference between the coefficients on the indicator variables. The numbers in brackets are p-values, which are robust to heteroscedasticity, and test the null hypothesis that the coefficients (or the difference in coefficients) are equal to zero.

Table 2 also presents cumulative abnormal (market model adjusted) returns around the declaration and effective dates.[14] As in most other studies, stock split announcements are associated with positive abnormal returns. As for the effective date, there appears to be little price reaction. In fact, we find significant returns for only three years and results are mixed —

[14] This approach follows Maloney and Mulherin (1992). The event windows are the event date through two days following the event date. The period for establishing market model parameters is 225 through 25 days before the declaration date.

one of the three is positive and the other two negative.[15] These results indicate that stock splits are viewed similarly across different tick size regimes.

In Table 3 we present multivariate tests as to whether target share prices declined along with tick sizes and whether the tick size changes were accompanied by an increase in stock splits as firms lowered share prices to maintain an optimal relative tick size. We estimate OLS regressions explaining the log of post-split price levels and number of stock splits per six month period.[16]

Since larger firms typically have higher share prices, in the regression explaining the post-split price levels, we include the size of the firm (natural log of market capitalization measured during the pre-event study window). Since stock splits are typically motivated by prior price increases, in the regression explaining the number of splits we include the market return over the year immediately prior to the six month period in which we count the number of splits (Return Prior Year) and the market return over the year preceding that one (Return 2 Years Prior).

We include indicator variables as follows. For the regression explaining price levels, we include an indicator for the sixteenths and decimals time periods. These will reflect any differences between these time periods and the eighths time period. If firms take relative tick sizes into consideration when splitting their stock, then we expect price levels to decline with the reduction in tick sizes, which should be reflected in negative coefficients. We also study the difference between the sixteenths and decimals time periods by checking if the indicator coefficients are different from each other (in the row labeled *Decimals* vs. *Sixteenths*). Since the reduction to decimals is a larger proportional change than the reduction to sixteenths, we expect the coefficient on decimals to be larger in magnitude than the coefficient for sixteenths.

Immediately following a tick size reduction, some firms that had relative tick sizes in a comfortable trading range will now find that their relative tick sizes are too small. We would expect these firms to split their shares not long after the tick size change. Thus, in the first regression, we include an indicator variable for the one year period immediately following each of the two tick size reductions.[17] Of course, firms may not choose to immediately split their shares to reach their optimal relative tick size. To account for this possibility, in the second regression we include indicator variables for the whole tick size regime.[18] In each regression we also present results for tests as to whether there is a difference between the sixteenths and decimals indicators or the two indicators for the year following the tick size changes.

As expected, in the regression explaining price levels we find that larger firms have higher post-split prices. More importantly, the indicator variables, which should have negative values if prices are lowered along with tick sizes, are insignificant and insignificantly different from each other. Thus, post-split stock prices have remained constant across these three tick size regimes once firm size has been accounted for. These results suggest that a firm's preferred normal trading range is not determined by the magnitude of the relative tick size. In both regressions explaining

[15] These results differ from other studies on price changes around effective dates. This difference is due to the fact that we examine only NYSE-listed firms and other studies combine both Nasdaq-listed and NYSE-listed firms. We have verified that for Nasdaq-listed firms during our sample periods, effective date returns are generally positive.

[16] We examine six month time periods in this analysis because it allows us (1) to more carefully match time periods to the changes in regimes, (2) to link split activity to price changes not too far removed from the time periods being examined, and (3) to increase the number of observations in the regressions.

[17] Since we are looking at six month blocks of time, these indicators correspond to the second half of 1997 through the first half of 1998 (*Indicator Year After Sixteenths*) and the calendar year 2001 (*Indicator Year After Decimals*).

[18] In this case, the indicators correspond to the second half of 1997 through the end of 2000 (sixteenths) and the calendar year of 2001 through the end of our study period (decimals).

the number of splits, we find that the prior year market return is a significant determinant of the number of splits. Once again, the coefficients on the indicator variables, which should be positive if tick size changes induce splits, are mostly insignificant and insignificantly different from each other. In only one case is there a significant indicator (for the year after sixteenths) consistent with a tick size effect. Thus, we find only weak evidence that firms choose to split their shares after a tick size reduction in order to lower their relative tick size to a value closer to the pre-change level. In general, our results suggest that stock split activity is unrelated to declines in tick size and, therefore, that relative tick sizes are irrelevant to firms making stock split decisions. Instead, these results suggest that firms split shares to return price levels to a typical trading range, perhaps one more comfortable for the firm's preferred clientele.

4.2. Changes in clientele

In this section we examine changes in measures related to clientele, which we define as the number of people actively following a stock.[19] We measure this in various ways, including some relatively direct measures of clientele, such as the number of shareholders and institutions who own shares and the number of analysts following the stock. We begin with summary statistics on changes in our measures, including tests on whether these changes are significant. We follow these with multivariate analyses which compare the control-adjusted changes in the decimal sample (where tick sizes are not likely to be binding before or after the split) with control-adjusted changes in the other three samples, where tick sizes will be more binding (compared to the control sample) after the split.[20]

Table 4 describes the changes in share prices and measures related to clientele for our four samples and their controls. It also presents the control-adjusted changes. All changes are measured as log changes expressed in percentage terms. Share prices are the average of the daily trade-weighted means. Post-split prices and respective changes are adjusted (doubled) to account for the split-induced halving in prices and doubling of shares outstanding. The splitting firm prices increase significantly, with increases ranging from 25% (sixteenths sample) to 46% (transitions sample). It is not surprising that the greatest rise is for the transition sample, since prices were rising significantly over that time period — the control sample prices increased 21%. Looking at the control-adjusted changes, these are more tightly clustered around 20%. These results are consistent with the positive announcement returns documented in Table 2, and the strong pre- and post-split performance documented in earlier papers (Fama et al., 1969, and Desai and Jain, 1997).

Control-adjusted daily share volume (in pre-split shares) remained unchanged for the eighths and transition samples and declines for the sixteenths and decimals.[21] Previous studies have

[19] For example, Merton (1987) discusses the number of people who "know about" a stock and would consider it for their portfolio.

[20] Our analyses focus on the difference between splitting and non-splitting firms (control-adjusted changes) since our long pre- and post-split event windows raise concerns about the potential effects of broad trends on measured changes. If we were to evaluate unadjusted changes, the appropriate comparison would be one between the transition and decimal samples (no change in the extent to which tick sizes are binding) and the other two samples (increasingly binding tick sizes). Conclusions from such a comparison are consistent with the conclusions we describe for control-adjusted changes.

[21] From here on, we focus our discussion on control-adjusted changes and point out those characteristics of unadjusted changes for splitting or control firms we believe are instructive. Furthermore, we postpone discussion of patterns in the differences across samples until our multivariate tests because most of these patterns are not statistically significant or disappear in the multivariate analysis.

found a decline in volume in the short run (Copeland, 1979; Lamoureux and Poon, 1987), but little change when comparing volume well before the split to volume long after the split (Lakonishok and Lev, 1987; Conroy et al., 1990). We look at a long window and our results are mixed, depending on the sample period. As for the number of trades and trade size, our results are consistent with other studies: the number of trades increases while trade size declines. These changes have typically been interpreted as consistent with an increase in trading by individual traders.

We gather data on number of shareholders from Compustat (item 100). In addition, we gathered data on order imbalance, which is the number of trades classified as a buy divided by total number of trades. We expect that while ownership expands, more investors will purchase the stock, suggesting a more positive imbalance. Specifically, we present the imbalance for small trades only (trades of 500 shares or less on a pre-split basis, which is 1000 shares post-split) as these are more likely to reflect trading (and therefore ownership) by individuals (see Schultz, 2000). The number of institutions and proportion of institutional holdings are gathered from 13Fs available through Spectrum. Analyst following is obtained from the IBES dataset.

As in other studies which look for direct or indirect evidence of changes in individual and institutional trading around stock splits (see Maloney and Mulherin, 1992; Desai, Nimalendran and Venkataraman, 1998; Easley et al., 2001), we find that the number of shareholders, the number of institutions, and the daily order imbalance generally increase (significant in three of the four samples). Curiously, despite the increase in the number of institutional owners, institutions do not appear to hold more of the firm after a split. We also find that the number of analysts following a firm also increases in three of the four samples.

Table 5 presents our multivariate tests including comparisons across samples. In particular, given that a binding tick size effect should be observed only in the binding tick size samples and not the decimals sample, we should observe that the decimals sample differs from each of these three other samples. Note that we regress the control-adjusted log changes for each firm (splitting firm minus matched control firm) on the log changes in the control-adjusted explanatory variables.

Merton (1987) develops a model where more visible firms have a greater breadth of ownership and higher market value. This model implies that larger firms tend to be more visible, and therefore any split-induced change in firm visibility should have a lower effect on clientele. Thus, our regressions include the log of the pre-split market capitalization (size of the firm). Lakonishok and Lev (1987) suggest that investors are more likely to be attracted to good performers, and Harris and Raviv (1996) suggest that price volatility reflects uncertainty about firm value, which motivates trading activity. Thus, we include the control adjusted log change in both price and variance. Finally, we include indicator variables for each sample other than the decimals sample. These indicators measure the difference between each sample and the decimals sample once other factors are considered. This specification is particularly convenient since the focus of our analysis is the difference between the decimals sample and other samples.

In our Table 5 regressions, we find few differences across pairs of samples. For example, there are no differences across any samples in trade size, number of shareholders and number of institutions. For share volume the decimals sample does not differ from any of the binding tick size samples (though the sixteenths sample changes are smaller than the changes in the other two samples). Thus, for all these measures, there are no results consistent with a tick size effect.

We do observe some differences between the decimals sample and other samples for the remaining measures: number of trades, imbalance, and number of analysts. For number of trades, the decimals sample differs from the eighths and transition samples. In the case of order

Table 4
Changes in measures describing clientele

	Splitting firms			Control firms			Adjusted
	Before	After	% Change	Before	After	% Change	% Change
Price (split-adjusted $)							
Eighths	45.31	63.13	27.86***	42.09	45.45	8.64***	19.48***
Transition	60.47	99.27	46.70***	54.79	66.26	20.98***	22.78***
Sixteenths	59.89	83.95	25.02***	55.86	49.90	−11.54***	37.56***
Decimals	52.70	59.30	16.12***	48.15	44.51	−11.07***	23.89***
Daily share volume (pre-split shares)							
Eighths	96,411	107,728	11.09***	117,516	117,899	6.67***	4.42
Transition	168,667	231,730	6.91**	183,848	229,554	17.10***	−2.50
Sixteenths	491,038	509,561	1.50	394,986	447,699	15.57***	−17.89***
Decimals	318,300	313,809	−0.64	206,129	195,885	15.36**	−21.77**
Daily number of trades							
Eighths	64	112	53.54***	76	88	11.92***	40.33***
Transition	136	274	73.40***	130	194	34.00***	40.16***
Sixteenths	332	581	51.45***	290	385	23.19***	31.77***
Decimals	440	814	63.56***	306	578	50.31***	11.02***
Trade size shares (pre-split shares)							
Eighths	1339	825	−45.60***	1501	1362	−5.34***	−39.87***
Transition	1341	671	−69.09***	1286	1067	−24.01***	−45.95***
Sixteenths	1234	739	−49.96***	1226	1126	−5.07***	−46.88***
Decimals	681	333	−71.80***	554	399	−36.54***	−30.96***
Number of shareholders							
Eighths	5830	6400	4.66***	10,115	9420	−4.21***	9.59***
Transition	17,764	19,506	3.48***	11,705	11,723	−3.14*	8.33***
Sixteenths	10,483	11,646	3.14***	27,718	26,336	−1.75	3.23*
Decimals	2814	2914	−0.23	5859	5521	−4.92***	5.70
Daily order imbalance — small orders only (%)							
Eighths	50.8	54.8	3.70***	49.7	49.2	−0.45	4.46***
Transition	51.3	54.7	2.79***	51.1	52.8	2.40*	2.06***
Sixteenths	53.8	53.5	0.35	52.6	51.0	−0.39	1.28*
Decimals	54.8	54.6	−0.63	55.2	54.5	−0.58	−0.72
Number of institutions							
Eighths	128	140	9.61***	152	153	0.00	8.11***
Transition	214	240	13.37***	217	228	3.98***	8.83***
Sixteenths	243	299	11.02***	257	251	1.71**	7.84***
Decimals	191	224	9.79***	159	161	4.85**	3.52**
Fraction of firm owned by institutions (%)							
Eighths	59.70	61.13	−0.55	58.48	58.41	0.11	−0.47
Transition	60.14	61.77	1.28	59.48	62.02	4.32***	−2.26
Sixteenths	62.63	63.73	1.91**	59.15	61.69	2.93***	−2.18
Decimals	72.62	73.06	0.93*	69.97	74.35	2.78***	0.19
Number of analysts following the firm							
Eighths	13	14	1.49***	17	16	−6.67***	11.78***
Transition	17	17	2.72**	18	18	0.00	3.80**
Sixteenths	18	20	2.90***	19	19	0.00	8.21***
Decimals	16	15	−4.65	11	12	0.00	−6.90

Table 5
Regressions explaining changes in measures describing clientele

	Share volume	# Trades	Trade size	# Shareholders	Imbalance small	# Institutions	# Analysts
Intercept	0.278	0.167	0.028	0.285	−0.121***	0.387***	0.229
	[0.292]	[0.486]	[0.869]	[0.516]	[0.007]	[0.000]	[0.283]
Ln (Market Value Equity)	−0.030*	−0.003	−0.023**	−0.014	0.008***	−0.023***	−0.018
	[0.080]	[0.856]	[0.038]	[0.612]	[0.010]	[0.000]	[0.186]
Δ Ln (Price)	0.033	0.337***	−0.315***	0.017	0.044***	0.226***	0.172***
	[0.637]	[0.000]	[0.000]	[0.885]	[0.000]	[0.000]	[0.001]
Δ Ln (Variance)	0.046***	0.046***	−0.002	−0.003	0.003***	−0.001	0.000
	[0.000]	[0.000]	[0.603]	[0.764]	[0.000]	[0.510]	[0.994]
Indicator: eighths	0.120	0.179**	−0.040	0.062	0.043***	0.011	0.128*
	[0.161]	[0.022]	[0.464]	[0.671]	[0.003]	[0.687]	[0.092]
Indicator: transition	0.122	0.165*	−0.045	0.073	0.017	0.024	0.091
	[0.228]	[0.073]	[0.480]	[0.672]	[0.308]	[0.478]	[0.299]
Indicator: sixteenths	−0.071	−0.047	−0.015	0.059	−0.010	−0.005	0.049
	[0.452]	[0.586]	[0.801]	[0.714]	[0.523]	[0.861]	[0.548]
Eighths vs. transition	−0.002	0.014	0.005	−0.011	0.026**	−0.013	0.037
	[0.978]	[0.816]	[0.911]	[0.870]	[0.026]	[0.577]	[0.482]
Eighths vs. sixteenths	0.191***	0.226***	−0.025	0.003	0.053***	0.016	0.079*
	[0.003]	[0.000]	[0.512]	[0.971]	[0.000]	[0.472]	[0.092]
Transition vs. sixteenths	0.193**	0.212***	−0.030	0.014	0.027**	0.029	0.042
	[0.011]	[0.001]	[0.533]	[0.876]	[0.013]	[0.274]	[0.445]
Adjusted R^2	0.227	0.295	0.126	−0.019	0.104	0.291	0.043

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

Cross-sectional OLS regressions explaining control-adjusted changes in clientele. We compute the log change in clientele measures for our main and control samples (except for imbalance which is the difference), and then subtract the former by the latter, to minimize the effect of time trends. Market Value of Equity is sample firm's market capitalization before announcement. Changes in Price and Variance are computed and control-adjusted for time trends in identical manner to the dependent variables. Price and volume are split-adjusted: post-split values are multiplied by two in the former and halved in the latter. The three indicator variables take the value of one if the observation is from the eighths, transition or sixteenths samples, respectively. In the latter part of the table we present the differences between the coefficients on indicator variables. The numbers in brackets are p-values (which are robust to heteroscedasticity) and test the null hypothesis that the coefficients (or the differences in coefficients) are equal to zero.

imbalance and number of analysts, the decimals sample only differs from the eighths sample. Given the number of measures examined and the number of pairs of samples, it is not surprising that we see statistically reliable differences in a few cases. Furthermore, in the next section we

Notes to Table 4:

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

Each variable is measured by averaging the values during a 200 day window before declaration and after execution. Price, share volume and trade size are measured in pre-split shares. Number of shareholders (from Compustat) is measured at the first fiscal year end before declaration date and after execution. Order imbalance is computed as the number of buys relative to total number of trades. A trade is classified as small if smaller than 500 pre-split shares (or 1000 post-split shares). Number and fraction of institutions (from 13Fs/Spectrum) are measured at the first available quarter before declaration date and after execution, but within one year from these dates. Number of analysts (from IBES) is the number of different analysts providing forecasts during a 200 day window before declaration and after execution. All changes are the paired log differences between the values before and after, except for order imbalance and the fraction of the firm owned by institutions, which are differences. The control-adjusted change is the paired difference between the variable change for the splitting firm and the control firm. We present cross-sectional medians of these measurements. Inference is based on Wilcoxon signed rank tests.

see very clear patterns in trading costs (not clientele) that may motivate changes in trading strategies, which would then be reflected in the number of trades. Thus, taken together, our results provide little support for theories that link binding tick sizes to clientele.

4.3. Changes in spreads and spread components

Most of the theories linking tick size to clientele rely on the fact that the tick size affects liquidity provision. Specifically, sponsorship theories and some optimal tick size theories rely on the fact that a more binding tick size will increase the revenue to liquidity providers through wider spreads. For this reason, we examine spreads and, in particular, realized spreads which directly measure gross revenues to liquidity providers.

Table 6 describes the changes in spreads and spread components for our samples. The information component (price impact), reflects the costs incurred by liquidity providers from trading with informed traders. We define price impact, at time period t, as $2 * Q_t(M_{t+\tau} - M_t)$, where Q is a trade indicator variable that takes the value of 1 if the transaction is classified as a buy and -1 if it is classified as a sell, M is the mid-quote, and τ is the time period over which we measure the change in prices as a result of the trade. We set τ equal to five minutes.[22] The realized spread is the difference between the current trade price and the mid-quote outstanding five minutes later, once again signed to reflect whether a trade was a buy or a sell. Specifically, we define the realized spread as $2*Q_t(P_t - M_{t+\tau})$. The sum of the realized spread and price impact is equal to the effective spread. We present split-adjusted (pre-split basis) spreads and impact. Thus, we multiply post-split dollar values by two.

Looking at quoted and effective spreads in Table 6, we see that control-adjusted spreads increase for every sample for every measure we examine. These results are consistent with prior studies.[23] It is worth noting that the changes in price impact, which reflects changes in the information environment, are much smaller in magnitude than the changes in other components. In fact, it is clear that the increase in spreads is largely reflecting an increase in the realized spread. In Table 6 we also report the control-adjusted changes in *relative* spreads and components (spread or component divided by mid-quote) since results here, though qualitatively similar, are notably different in magnitude.[24] Our conclusions are identical looking at relative components. Another striking result in this analysis is the large differences in magnitude of the realized spread change between the binding tick size samples and the decimals samples. These differences, which are confirmed in our multivariate tests, illustrate the kind of large effects one expects from a binding tick size.

When looking at the realized spread, it is particularly useful to consider the (unadjusted) changes in the splitting and control firms. First, the change in the realized spread for the transition and decimals samples of 34% and −9% are substantially lower than for the other two binding tick size samples, at 72% and 96%. This is consistent with the fact that for the eighths

[22] The five minute delay to establish the realized spread introduced by Huang and Stoll (1996) is used regularly, and has been adopted in the Securities and Exchange Commission regulation 11Ac-5 which specifies the market quality measures market centers are required to report.

[23] As mentioned, dollar spreads without adjustment for the split typically decline. Maloney and Mulherin (1992) note that the dollar decline in spreads may be especially relevant to traders who wish to rebalance their portfolios by trading the smaller trade sizes that are facilitated by the stock split.

[24] Given that split-adjusted prices increase significantly, we want to be sure the results do not simply reflect the increase in spreads one would expect from an increase in prices.

Table 6
Changes in spreads and spread components

	Spreads and components measured in pennies							Control-adjusted % change with spreads and components measured relative to price
	Splitting firms			Control firms			Control-adjusted % change	
	Before	After	% Change	Before	After	% Change		
Quoted spread (cents)								
Eighths	22.05	36.33	52.14***	20.76	20.51	−3.40***	55.91***	34.01***
Transition	19.80	27.01	37.30***	19.28	16.19	−11.74***	45.65***	20.24***
Sixteenths	15.28	25.66	53.32***	15.46	14.47	−4.41***	57.92***	22.25***
Decimals	9.98	9.27	−1.97	9.33	6.47	−39.23***	36.96***	17.42*
Effective spreads (cents)								
Eighths	14.02	25.24	58.70***	13.20	13.01	−2.65***	61.52***	39.97***
Transition	13.23	19.59	37.96***	12.45	11.23	−9.18***	46.56***	24.99***
Sixteenths	10.91	18.53	53.99***	10.41	9.64	−7.75***	64.26***	29.25***
Decimals	6.96	6.81	1.44	6.46	4.51	−36.39***	39.82***	19.06***
Price impact (cents)								
Eighths	7.91	11.75	42.23***	6.29	7.09	10.95***	27.61***	7.87***
Transition	8.12	13.66	43.60***	8.07	9.31	14.82***	19.93***	−5.70
Sixteenths	8.68	12.46	36.62***	8.13	7.25	−11.76***	50.67***	6.64*
Decimals	5.59	5.73	5.24	5.99	3.95	−25.16***	26.88***	10.97*
Realized spread (cents)								
Eighths	6.49	13.65	72.96***	7.21	6.05	−18.22***	95.51***	77.94***
Transition	4.83	6.86	34.94***	4.78	2.80	−61.08***	119.30***	84.71***
Sixteenths	2.55	6.50	96.60***	2.71	2.71	0.41	101.77***	60.57***
Decimals	0.95	0.85	−9.34	1.08	0.55	−32.65**	52.95*	4.38

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.
Each variable is measured by averaging the values assumed during a 200 day window before declaration and after execution. Quoted spread is the time-weighted difference between ask and bid quotes. Effective spread is twice the absolute value of the difference between trade price and mid-quote. Price impact is twice the change in mid-quote prevailing at the time of the transaction to that prevailing five minutes after. Realized spread is twice the change from the trade price to the mid-quote prevailing five minutes after. Price impact is multiplied by negative one if the transaction is a sell, and realized spread is multiplied by negative one if the transaction is a buy. These variables are measured in cents and are split-adjusted — the post-split values are multiplied by two. The column % Change contains the paired log differences between the values before and after. The control-adjusted change is the paired difference between the variable change for the splitting firm and the control firm. The last column contains the control-adjusted change for the respective variables measured as a proportion of the prevailing mid-quote. We present cross-sectional medians of these measurements. Inference is based on Wilcoxon signed rank test for the null hypothesis that the paired difference value is zero.

and sixteenths samples, the split increases the extent to which a tick size is binding whereas for the transition and decimals samples the relative tick size is essentially unchanged. Second, for the control firms of the transition sample, there is a 61% drop in realized spread, which is consistent with the fact that for these firms the tick size became less binding as the tick size was reduced.

Table 7 presents results of a multivariate analysis of dollar spreads and spread components. In this analysis, we include controls for changes in volume, price level and variance. The greater the trading activity, the more fixed trading costs can be allocated over trades and the more information gets impounded into prices, which reduces average trading costs. Market makers typically take prices into consideration when setting spreads, since holding costs and position risks are related to the dollar level of the commitment. Although, dollar spreads do not move in direct proportion to changes in prices, they will generally rise as share prices increase. Higher

Table 7
Regressions explaining changes in spreads and spread components

	Quoted spread	Effective spread	Price impact	Realized spread
Intercept	0.255***	0.316***	−0.585***	−0.461**
	[0.000]	[0.000]	[0.000]	[0.031]
Δ Ln (Volume)	−0.108***	−0.065***	−0.187***	−0.023
	[0.000]	[0.002]	[0.000]	[0.854]
Δ Ln (Price)	0.361***	0.324***	0.728***	−0.312**
	[0.000]	[0.000]	[0.000]	[0.049]
Δ Ln (Variance)	0.011***	0.012***	0.013***	0.016
	[0.000]	[0.000]	[0.000]	[0.241]
Indicator: eighths	0.194***	0.192***	0.011	0.858***
	[0.000]	[0.000]	[0.828]	[0.000]
Indicator: transition	0.111***	0.054	−0.072	1.215***
	[0.001]	[0.161]	[0.222]	[0.000]
Indicator: sixteenths	0.125***	0.133***	−0.009	1.049***
	[0.000]	[0.000]	[0.863]	[0.000]
Eighths vs. transition	0.083***	0.138***	0.083*	−0.357**
	[0.002]	[0.000]	[0.057]	[0.049]
Eighths vs. sixteenths	0.069***	0.059**	0.020	−0.191
	[0.000]	[0.004]	[0.549]	[0.160]
Transition vs. sixteenths	−0.014	−0.079**	−0.063	0.166
	[0.647]	[0.030]	[0.174]	[0.457]
Adjusted $R2$	0.49	0.42	0.54	0.08

***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.
Cross-sectional OLS regressions explaining control-adjusted changes in trading costs. We compute the log change in trading costs (in cents) for our main and control samples, and then subtract the former by the latter, to minimize the effect of time trends. Changes in share volume, price and variance are computed and control-adjusted in the same manner. All dependent variables, as well as price and share volume, are split-adjusted: post-split values are multiplied by two, except for volume where post-split values are halved. The three indicator variables take the value of one if the observation is from the eighths, transition, or sixteenths samples, respectively. In the latter part of the table we present the differences between the coefficients on indicator variables. The numbers in brackets are p-values, which are robust to heteroscedasticity, and test the null hypothesis that the coefficients (or the differences in coefficients) are equal to zero.

volatility will affect the willingness of market makers to hold inventory and investors to acquire private information, and as a result volatility is expected to be positively related to spreads and components (Demsetz, 1968; Benston and Hagerman, 1974; Stoll, 1978).

Quoted and effective spreads are inversely related to volume and positively related to price levels and variance. These effects seem to be captured in the price impact and not in the realized spreads. Looking at the indicator variables, we see that quoted spreads increase more for all the binding tick size samples than the decimals sample. For effective spread, this is true for the eighths and sixteenths samples. This suggests the binding tick size does impact spreads. There is no difference across samples for price impact, which suggests that the binding tick size is not related to any changes in the information environment. This is consistent with the results on clientele (equivalent changes across all samples) since differences in changes in clientele would likely lead to differences in changes in information generation or trading on information.

Most notably, the realized spreads increase substantially more for all the binding tick size samples than for the decimals sample. The change is greater by 86%, 122%, and 105% for the eighths, transition and sixteenths samples, respectively. These results suggest binding tick sizes influence the extent to which a stock split changes trading costs. Specifically, that by increasing the extent to which a tick size is binding, a stock split generates additional revenue to liquidity providers.

The combined results on spreads and clientele suggest the following. To the extent that a split makes tick sizes more binding, we observe an increase in spread revenues. However, regardless of the impact on spread revenues, the stock split leads to changes in clientele. Thus, binding tick sizes do not appear to be relevant in this context.

5. Conclusion

We provide evidence on the extent to which binding tick sizes drive the well established relation between stock splits and clientele. We do so by examining splitting activity over time and comparing changes in clientele across stock split samples that differ in the extent to which tick size effects would be expected.

In our analysis of stock split activity over time, we find that post-split prices have not declined even though tick sizes were reduced from 12.50 pennies to 6.25 pennies at one point, and from 6.25 pennies to a single penny at another point. Furthermore, these changes were not accompanied by any increase in splitting activity. These results suggest tick sizes are not relevant when firms set trading ranges. Additionally, in our analysis of measures reflecting clientele, we find that changes in these measures are comparable in most instances across all samples. This suggests that tick size effects are not necessary for splits to impact clientele. In general, our results raise questions as to whether a binding tick size can be invoked as a mechanism that links stock splits to clientele, either through the establishment of an optimal tick size (tick size theories) or through promotion by brokers (spread-induced sponsorship).

We do observe a pronounced difference across samples related to gross revenues to liquidity providers (realized spreads). For those samples where the tick size is likely to be more binding after a stock split, the realized spread increases more than for a sample where the tick size is not likely to be more binding. Together with the results on clientele, this suggests that exogenous shocks to trading revenues do not influence clientele, as suggested in some sponsorship research. Our analysis here is particularly beneficial since changes in spreads and clientele are typically negatively related.[25] The likely source of this relation is that an increase in clientele leads to reduced spreads. Our analysis circumvents this endogeneity since most of the change in spreads for our samples are exogenously determined by the stock split.

Taken together, our results suggest that binding tick sizes are irrelevant in most regards and simply raise the gross revenues to liquidity providers. This implies that the search for mechanisms by which stock splits affect trading patterns and clientele should focus elsewhere. One possibility is that per share pricing structures, such as per share broker commissions, may be relevant (commission-induced sponsorship). Another possibility is that traders have a comfortable trading range that is not related to tick sizes (trading range theories). Finally, it may be that changes in other characteristics of the firm induce both a stock split and a change in clientele. Identifying these other characteristics, and providing a better understanding of what drives the decision to split a stock, is a fruitful area for future research.

[25] We have performed this regression and find the expected negative relation in our samples.

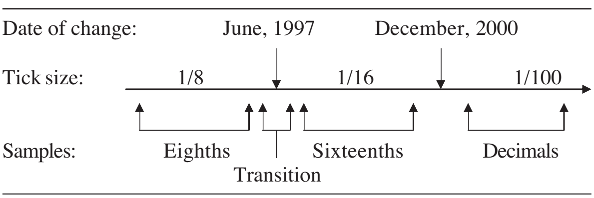
Appendix A. Summary of models linking clientele to stock split

The figure below tabulates tick size models and provides a summary of references relevant to the model and predictions based on the models for both stock splits (activity and price levels) and changes in clientele (the number of individuals, institutions or analysts who follow a stock).

	Category of model			
	Optimal relative tick size	Sponsorship		Trading range
Model	Liquidity-cost tradeoff (realized spread increase)	Spread revenue (realized spread increase)	Commission per share	Individual preferences
References	Harris (1994), Angel (1997)	Brennan and Hughes (1991), Schultz (2000)	Brennan and Hughes (1991), Schultz (2000)	Baker and Gallagher (1980), Baker and Powell (1993)
Change in stock split characteristics accompanying tick size reductions				
Stock split activity (temporary)	More	More	Unchanged	Unchanged
Post-split prices	Lower	Lower	Unchanged	Unchanged
Changes in individuals, institutions, analysts accompanying stock splits				
More binding	More	More	More	More
No more binding	Unchanged	Unchanged	More	More

Appendix B. Time line of stock split events

The figure below illustrates the time periods associated with our various samples and how these relate to tick size regime changes on the New York Stock Exchange (NYSE).



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