Impacts of Tick Size Reduction on Transaction Costs

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Abstract

This study investigates the impact of changes in tick size on transaction costs of different size trades. We use samples drawn from shares with extreme high/low price and high/low trading volume to examine the impact of the 1997 and 2001 reductions in tick size on the New York Stock Exchange. For high-price low-volume NYSE shares the 1997 change from pricing in 1/8s to pricing in 1/16ths clearly increased measures of effective spread and reduced quoted depth for transactions of even the smallest size.

I. Introduction

In 1997, U. S. Congress signed the Common Cents Stock Pricing Act to convert tick size from fractions to decimals. On June 24, 1997 the New York Stock Exchange one of seven domestic stock exchanges, reduced minimum tick size from $1/8 to $1/16, and on January 29, 2001, from $1/16 to $0.01. The spate of reductions in minimum tick size on both domestic and international exchanges has sparked considerable volume of academic literature examining the relationship between minimum tick size and market liquidity. Given the breadth of this research it is striking the divergence that remains in opinion concerning the ultimate impact on market liquidity of these reductions in minimum price variation.

Prior empirical research has reached general agreement that tick size reduction uniformly reduces transaction costs for small transactions, i.e. orders of size less than quoted depth. The impact on transaction costs of traders submitting orders of size greater than quoted depth however is less certain. Jones and Lipson (2001), Goldstein and Kavajecz (2000) demonstrate that reduction in minimum tick size can adversely impact transactions costs for large transactions on the NYSE. This study adds to the growing literature in this area by documenting the relationship between relative tick size, defined as minimum tick size divided by market price, and the impact on market liquidity of the New York Stock Exchange's program of reductions in minimum tick size. We find that the 1997 and 2001 tick size reductions induced a pattern of changes in spreads, market depth and effective spreads for transactions sorted by relative tick size, trading volume and trade size consistent with the existence of an optimal tick size schedule as

hypothesized by Seppi (1997). Our study using samples of NYSE stocks with extremely low/high price (large/small relative ticks) and low/high trading volume confirms results from the 1995 tick size reduction on the Australian Stock Exchange documented by Aitken and Comerton-Forde (2005) indicating that transaction costs for orders of small size increased for the group of stocks with both small relative tick size and small trading volume. The remainder of the paper is organized as follows: Section II provides a review of existing literature relevant to this study; section III describes the sample selection criteria and sample descriptive statistics; section IV the testing methodology; section V presents analysis of changes in effective spreads surrounding the 1997 and 2001 NYSE tick size reductions and Section VI presents conclusions.

Section II: Tick size reduction and market liquidity

From its beginning with the Buttonwood Agreement in 1792 until the first reduction in minimum tick size in 1997, minimum price variation for the majority of NYSE stocks has been \$1/8[1]. Liquidity, defined as the ability to transact at price near current value, is provided on the NYSE by three groups of market participants; limit order traders, floor brokers and the specialist. Traders who place orders in the limit order book provide liquidity by publicly stating the amount that they are willing to trade at a certain price, floor brokers provide liquidity by filling orders that may or may not be displayed to the general market. The specialist may supply additional liquidity by choosing to improve

[1] Rule 62 New York Stock Exchange requires minimum tick size of \$1/8 for shares with price greater \$1, \$1/16 for stocks with price less than \$1 but greater than \$0.25 and 1/32 for shares priced less than \$0.25.

upon the limit order book and/or floor broker interest either by improving the price or by displaying more depth. The specialist operating within rules established by the Exchange, matches buy and sell orders at the best available price. On the NYSE the specialist fills orders according to both time and price precedence.

Minimum allowable price variation or tick size is an important market feature having multifaceted impact on the transactions costs of market participants. Minimum tick size determines both the minimum price for acquiring order precedence through price priority when time precedence is enforced and also the minimum transaction cost for entering and exiting a position. Transactions costs for orders of large size are most greatly impacted by the minimum price to acquire order precedence, while orders of small size are most greatly impacted by the market's minimum possible price increment.

Limit orders and specialist's quotes offer market participants a free option to improve price by placing a limit order on the same side of the market thus creating a free option to reverse the position at the pre-existing limit price or quote should the share price move against the position. An economically significant minimum tick size is a deterrent to this practice of quote matching. Large minimum tick size forces quote matchers to improve price significantly if they wish to cut in front of pre-existing quotes, Harris (1994). Too small a minimum tick size encourages quote matching and discourages market participants from providing liquidity (quotes/limit orders for substantial size) throughout the breadth of the limit order book.

A market's bid ask spread represents a transaction cost for traders entering and exiting a position. The minimum tick size, thus defines the minimum transaction cost.

Models explaining the economic determinants of optimal bid ask spread generally build from costs incurred by liquidity providers. These cost components have been identified as order processing, inventory holding and adverse selection. Adverse selection refers to the cost component due to the possibility of transacting with a better informed counterparty. Most models of this type suggest that specialists and other liquidity providers implicitly maintain an upward sloping schedule of bid and ask quotations for which optimal spreads increase with order size. In this study we will refer to liquidity providers optimal spread for a given size transaction as latent spreads.

Trading volume is recognized as an important determinant of the adverse selection component of the bid ask spread. The divergence between the last transaction price and current value should be smaller in markets with more frequent trading; hence the greater the trading volume, the smaller the adverse selection cost component. For low priced frequently traded shares the observed bid ask spread may be constrained above latent spreads due to the minimum tick size rule. In this circumstance suppliers of liquidity receive artificially inflated profits; especially for trades of small size where adverse selection costs are less likely. In a market with binding minimum tick size profit maximizing liquidity providers will offer greater quoted depths than in the absence of such a rule. For high priced (small relative tick) infrequently traded stocks it is less likely that minimum tick size artificially constrains bid ask spreads above liquidity provider's latent spreads. For these markets latent spreads are larger due to the costs associated with greater likelihood of adverse selection. Relative to markets where minimum tick size is a binding constraint it is expected that liquidity providers will

supply smaller market depth where minimum tick size is not a binding constraint.

Chordia and Subrahmanyam (1995), Bernhardt and Hughson (1996), Kandel and Marx (1997), and Anshuman and Kalay (1998) argue that decreasing tick size reduces the wedge that exists between the minimum possible spread greater than or equal liquidity supplier's latent spreads and thus reduces transaction cost. Harris' (1994) argues that although transaction costs of small size trades decrease due to tick size reduction, the impact on transaction costs of large size trades is ambiguous. Liquidity suppliers may increase quoted spreads for large size orders to recapture the lost profit due to reducing spreads for small size orders, reduce their quoted depth at a given price, move quoted depth to limit prices further from the best available quotes or leave the market entirely.

Cordella and Foucault (1999) also conclude that reduction in tick size may not improve market liquidity. Harris (1997, 1999) argues that small tick size would reduce the revenues of liquidity providers, may weaken the incentive to provide liquidity, and potentially damage market quality. Glosten (1995) predicts that reducing tick size will decrease the transaction costs of small size trades, but forecasts that reduction in tick size will have no effect on large size trades. Angel (1997) proposes that there is an optimal relative tick size, which represents a trade-off between the profits of market makers and transaction costs of common traders.

Seppi (1997) develops a microstructure model of market liquidity in a setting where market liquidity is the outcome of trading decisions taken by liquidity suppliers identified as participants who sell at prices above or buy at prices below their individual pre-trade valuations, and liquidity demanders, i.e. participants who trade at a premium or discount

for the right to trade quickly. In Seppi's model, which incorporates institutional features like those of the NYSE, it is not optimal to mandate a single minimum tick size for all transactions. Instead optimal tick size is a function of trade size with institutional orders for large blocks having larger optimal tick size and small retail transactions having smaller optimal tick size.

Prior empirical research has reached general agreement that tick size reduction uniformly reduces bid ask spreads and quoted depth. Beyond these descriptive empirical findings there is little agreement across studies concerning the impact of tick size reduction for aggregate transaction costs. On September 3rd, 1992 the American Stock Exchange reduced tick size from 1/8 to 1/16th for shares with price between $1-$5. Using this sample, Ahn, Cao, and Choe (1996) test Harris' (1994) model for tick size reduction and confirm that bid-ask spreads decline after tick size reduction. In contrast to the findings of our study the authors find the AMEX tick size reduction does not have much impact on infrequently traded stocks. For these stocks, the effective spread, quoted depth and trading volume are almost unchanged.

Empirical studies of tick size reduction have consistently documented that a tick size reduction both reduces posted bid ask spreads but also reduces quoted market depth. Not surprisingly conclusions reached concerning the net impact on liquidity are mixed. Van Ness et al. (2000) survey 12 studies and illustrate the disparate conclusions presented in the literature. Their empirical results indicate a significant reduction in spreads at NYSE, AMEX, and NASDAQ following tick size reduction. Chakravarty et al. (2004) find that decimalization leads to significantly lower quoted and effective bid-ask spreads.

Bessembinder (2003) examines trade execution costs and market quality after decimalization and finds that quoted bid-ask spreads decline, percentage of shares receiving price improvements increase.

In studies considering the impact of tick size reduction on transactions costs for large size orders, Goldstein and Kavajecz (2000) use limit order data provided by the NYSE to analyze the impact of the 1997 tick size reduction on quoted depth and the dispersion of depth in the limit order book. They find narrower spreads but less cumulative depth in the limit order book after the change. They conclude that traders submitting small orders are made better off while traders transacting in large size suffer higher transactions costs due to the reduction in tick size. Jones and Lipson (2001) investigate institutional trade records and find that after NYSE and NASDAQ reduced tick size from $1/8 to $1/16, institutional transaction costs increased especially for sizes of at least 10, 000 shares.

These studies illustrates that the effect of tick size reduction is sensitive to both trade size and trading volume with reductions in quoted spread and depth being the greatest for the most frequently traded stocks. For stocks that are infrequently traded, Goldstein and Kavajecz (2000) find that average quoted spread actually increased. The adverse consequence of tick size reduction for infrequently traded stocks is also documented in a study examining tick size reduction on the Australian Stock Exchange by Aitken and Comerton-Forde (2005) who find that stocks with small relative tick size and low trading volume experience reduced liquidity after the tick size reduction.

III. Data and Methodology

The studies by Harris (1994), Goldstein and Kavajecz (2000), and Aitken and

Comerton-Forde (2005), imply that changes in transaction costs induced by tick size reduction are a function of price level, trading volume and transaction size. To examine the influence of price and volume on the change in transaction costs induced by tick size reduction, we collect extreme price and volume samples for the NYSE's 1997 and 2001 tick size reductions. Within price/volume groups transactions are parsed into 10 trade size groupings.

Van Ness, Van Ness, Pruitt (2000) evaluate the 1997 tick size reduction utilizing samples from NYSE, AMEX and NASDAQ traded shares using the following selection criteria.

1. AMEX stocks with at least 10 trades per day and NASDAQ and NYSE stocks with at least 40 trades per day.
2. Stocks with an average price of at least $10.

Relative to previous studies, as exemplified by Van Ness, Van Ness, Pruitt (2000), our selection criteria produce subsamples from the extremes of the price and volume distributions of NYSE listed equities. It is our contention that the tick size reduction will have the greatest impact on stocks with extremely low/high price and low/high volume.

Extreme low/high price and low/high trading volume shares were identified using the Center for Research in Security Prices (CRSP) data set. High-price samples; HPLV and HPHV consist of all NYSE listed firms with three month minimum share price greater than $60 (1997) or $80 (2001) for the three months preceding the tick size reduction and average monthly trading volume less than 1,000,000 shares (HPLV); or average monthly

trading volume greater than 10,000,000 shares (HPHV). Low price samples consist of all NYSE listed firms with three month maximum share price less than $10 but greater than $1 for the three months preceding the tick size reduction and average monthly trading volume less than 200,000 shares (LPLV); or average monthly trading volume greater than 4,500,000 shares (LPHV). The pre-event period for the 1997 tick size reduction spans March 23, 1997 - June 23, 1997, the post-event period June 24, 1997 - October 6, 1997. The pre-event period for the 2001 tick size reduction spans October 26, 2000 - January 26, 2001, the post-event period January 29, 2001 - April 30, 2001. Because the 2001 tick size reduction was implemented in stages, firms previously converted to decimal trading prior to January 29 were eliminated from extreme price and volume samples[2].

For these firms the NYSE's Trade and Quote's (TAQ) trade records were used to collect intraday bid and ask quotes, transaction prices and trade sizes. We separate all the transactions into 10 size groups based on the number of shares traded.

Chakravarty, Wood, and Van Ness (2004) in an examination of the impact of the NYSE's 2001 move to decimal pricing merge data from the Consolidated Tape Association and Consolidated Quotation System to evaluate market measures associated with liquidity for five trade size categories. To construct matched samples during the phase in period, their sample consists of 79 firms affected by the phased pilot program. Given our focus contrasting high and low trade volume samples, we use a finer size grid

[2] The 2001 tick size reduction for $1/16 to $0.01 was accomplished in stages. The NYSE reduced tick size to $0.01 for seven securities on August 28, 200, 57 additional securities on September 25, 2000 and an additional 94 securities on December 5, 2000. All remaining stocks began trading in decimals on January 29, 2001.

for larger trades and separate transactions by size into 10 groups[3].

[Table 1 here]

For our subsamples pre-event average quoted spread, spread as a percentage of the bid ask midpoint and quoted depths are provided in Table 2.

[Table 2 here]

It is informative to contrast these descriptive statistics for our subsamples with those found in previous studies. Sorting NYSE firms by pre-event dollar spread, Jones and Lipson (2001) who examine the 1997 event, report an average dollar spread for the quartile of firms with the largest spread of $0.238. It is clear that in most cases our sample selection criteria result in shares that trade in markets with significantly larger bid ask spreads. Relative to Van Ness, VanNess, Pruit (2000), the extreme low price samples of our study also exhibit significantly larger percentage spreads.

Harris (1994, 1997, and 1999) argues that the net impact of tick size reduction may diminish market quality because liquidity suppliers have less incentive to supply liquidity to the market. The ambiguous impact of tick size reduction on market quality is clearly illustrated from examination of the ratio of post- to pre-change quoted spreads and depth. For extreme low-price stocks the 1997 reduction from 1/8 to 1/16 significantly reduces dollar bid ask spread by a minimum of 10%, however quoted depth also suffers a reduction of a minimum of 44%. As noted by Lipson and Jones (2001) and others, by itself the reduction in quoted depth at best available bid and ask prices (inside quotes) is

[3] The ten transaction size groups: 100 to 400 shares, 500 to 900 shares, 1,000 to 4,900 shares, 5,000 to 9,900 shares, 10,000 to 49,900 shares, 50,000 to 74,900 shares, 75,000 to 99,900 shares, 100,000 to 249,900 shares, 250,000 to 499,900 shares, and greater than 499,900 shares.

not surprising. Post-event redistribution of market depth across a finer price grid is likely to reduce quoted depth at any single price. For our study's high volume stocks quoted depth is reduced significantly by both the 1997 and 2001 tick size reductions. However, only for low price stocks for which relative tick size is assumed large relative to latent spreads do quoted spreads decrease significantly. The impact on quoted spreads of high-price and high-volume stocks is mixed for the 1997 and 2001 events.

Notice that for the 1997 change, the indicated change in market liquidity for the high-price low-volume sample is unambiguous. Dollar bid ask spreads are 8% greater after tick size reduction and quoted depth is also significantly smaller in the post-event period. The market liquidity of HPLV stocks is adversely impacted by the NYSE's 1997 tick size reduction.

[Table 3 here]

For small orders, the quoted bid ask spread is a good indication of the execution cost for a trade. For large orders, bid ask spread may not fully represent the cost. The effective spread better captures the cost of a round-trip order by including both price improvement, liquidity supplier's offers to execute an order at a price better than quoted, and market impact, i.e. realized spread greater than quoted spread due to the order size. Effective spread is defined as twice the difference between the trade execution price and the mid-point of the bid ask quote at the time of the transaction.

Section IV: Methodology

We use a paired differences test to determine if average effective spread for transactions of a given size is significantly different in the pre- and post-event periods.

For the j^{th} stock in the k^{th} transaction size group, the i^{th} transaction's dollar effective spread is

$$DES_{k,j,i} = 2\left|P_{k,j,i} - M_{k,j,i}\right|.$$

$P_{k,j,i}$ is the price of the i^{th} transaction for the j^{th} stock in the k^{th} size group, and $M_{k,j,i}$ is the midpoint of quoted spread prevailing at time of the i^{th} transaction. The corresponding percentage effective spread is:

$$PES_{k,j,i} = 2\left|P_{k,j,i} - M_{k,j,i}\right| / M_{k,j,i}.$$

The average dollar effective spread for the j^{th} stock, in the k^{th} group, in the pre-event period is

$$ADES_{k,j}^{pre} = \frac{1}{n_{k,j}^{pre}} \sum_{i=1}^{n} DES_{k,j,i}^{pre}.$$

where $n_{k,j}^{pre}$ is the total number of transactions for the j^{th} stock, in the k^{th} size group, in pre-event period. The corresponding average percentage effective spread is defined similarly. Following the same process, we obtain the average dollar and percentage effective spread in the k^{th} size group, for the j^{th} stock, in post-event period.

We use paired differences tests to test the null hypothesis that average effective spreads for each group are the same in pre- and post-event periods. The differences are between the average post-event effective spread and the average pre-event effective spread for each stock in each size group, $D_{k,j} = ADES_{k,j}^{post} - ADES_{k,j}^{pre}$. TAQ data for the firms of the extreme price and volume samples does not contain transactions for all stocks for all ten trade size categories in both pre-event and post-event periods. Stocks in the k^{th} group that do not have transactions in both pre- and post- event periods are deleted.

IV: Change in average transaction cost due to reduction in tick size

Examination of the changes in average effective spreads for markets of low trading volume will be presented first. For HPLV stocks (Panel A of Table 4), tick size reduction produces a pattern of increased transaction costs as measured by effective spreads for all size transactions. The 1997 tick size reduction significantly increased transaction costs by a minimum of $0.05 for transactions of 4,900 shares or less. For transactions of size 4,900 shares or less of HPLV stocks the statistically significant increase in transaction costs due to tick size reduction is consistent with tick size reduction from $1/8 to $1/16 reducing relative minimum tick size below the optimal level. Given the small relative tick size in these markets, it is unlikely that the minimum tick size was a binding constraint prior to the event. The reduction in tick size reduced relative tick size in relation to liquidity provider's latent spreads. Thus tick size reduction for HPLV stocks induced liquidity providers to increase effective spreads. Once the optimal tick size was breached by the tick size reduction in 1997 the 2001 decimalization had no further adverse effects on HPLV stock's transactions costs.

In general for LPLV (Panel B of Table 4) markets the NYSE's tick size reductions produce smaller transactions costs as measured by effective spread. Relative to markets for high priced stocks, minimum tick size is more likely a binding constraint for stocks in low-price low-volume markets. For LPLV stocks, tick size reductions in 1997 and 2001 reduce the wedge between market quotes and liquidity provider's latent quotes, thereby reducing transactions costs for stocks with low-price and low trading volume.

[Table 4 here]

As discussed previously, liquidity provider's latent spreads in markets for frequently traded stocks will be smaller than for markets with low trading volume. Examination of changes in effective spread for HPHV stocks, presented in Table 5, produces comparatively little evidence of significant effects on trading costs. In contrast tick size reductions produce significant reductions in transactions costs for LPHV stocks, Table 6. For LPHV stocks, each tick size reduction reduced average transaction costs by approximately $0.04 for all transaction size groups considered. The difference in these results is potentially explained by the fact that the relative minimum tick in the low priced stock groups was very large relative to the liquidity provider's latent spreads prior to tick size reduction and the change allowed liquidity providers to narrow effective spreads post event.

[Table 5 here]

[Table 6 here]

Conclusions

Similar to Goldstein and Kavajecz (2000), we find that trading volume is a critical factor that influences the impact of tick size reduction on transaction costs. Infrequently traded stocks have higher incidence of increased transactions costs due to market wide tick size reductions. Trading volume provides an indicator of the magnitude of latent spreads for trades of given size on liquidity providers schedules. For high volume markets with correspondingly small latent spreads, reduced transactions costs due to tick size reduction are expected. For example if liquidity suppliers' latent spread for a given size transaction is smaller than half one pre-event tick, mapping the latent spread to the

market price grid produces an empirical spread of one pre-event tick. After tick size reduction from $1/8 to $1/16, the empirical spread for a transaction of this size will be one post-event tick, since the new tick size is still greater than liquidity suppliers' latent spread. However, when volume is low and liquidity suppliers' latent spread for a given size order is greater than half but smaller than one pre-event tick, post-event the empirical spread cannot be one post-event tick; the post-event tick is smaller than the liquidity suppliers' latent spread. If, in this circumstance, the midpoint of bid-ask spread is at an integral multiple of $1/16, then post-event spread will be two post-event ticks which equal one pre-event tick. If the midpoint of bid-ask spread is not at an integral multiple of $1/16, then post-event empirical spread will be three post-event ticks. The change in average effective spread for high-price low-volume stocks empirically validate that tick size reduction can increase transactions costs not only for large transactions but also for small.

Moreover, we find that price level is also a critical factor that influences the impact of tick size reduction on transaction costs. In our study, we find that high-price (low relative tick) stocks have a higher incidence of increased average transaction costs after tick size reduction. When stock price is high and liquidity suppliers' latent spread for a given size transaction is greater than half but less than one pre-event tick, post-event the empirical spread for transactions of this size will be either two or three-post event ticks. Therefore, when stock price is high enough, we may observe an increase in average transaction costs due to tick size reduction.

Chordia and Subrahmanyam (1995), Bernhardt and Hughson (1996), Kandel and

Marx (1997), and Anshuman and Kalay (1998) argue that decreasing tick size reduces the wedge between posted prices and liquidity providers' reservation prices. Decimalization allows a very small wedge. After decimalization the difference between empirical spreads and liquidity providers' reservation spreads will be less than one cent. Before decimalization, empirical spreads would be greater than liquidity providers' reservation spreads by at most $0.0625. On average, decimalization should reduce percentage transactions costs by more than the tick size reduction from $1/8 to $1/16. This implication is supported by the reduction in average percentage effective spread for low price stocks examined in this study. Average percentage effective spread decreases by a greater absolute amount for the 2001 decimalization than for the 1997 tick size reduction.

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Table 1

Sub samples for investigation of the 1997 and 2001 NYSE tick size reductions.

High-price samples; HPLV, HPHV contain all NYSE listed firms with three month minimum share price greater than $60 (1997) or $80 (2001) for the three months preceding the tick size reduction and average monthly trading volume less than 1,000,000 shares (HPLV); or average monthly trading volume greater than 10,000,000 shares (HPHV). Low-price samples contain all NYSE listed firms with three month maximum share price less than $10 but greater than $1 for the three months preceding the tick size reduction and average monthly trading volume less than 200,000 shares (LPLV); average monthly trading volume greater than 4,500,000 shares (LPHV).

	1997	2001
HPLV: S>$60,V<1MM	27	20
HPHV: S>$80,V>10MM	25	23
LPLV: S<$10,V<200M	33	50
LPHV: S<$10,V>4.5MM	34	42

Table 2

Pre-event period average dollar spread, percentage spread and depths 3/23/1997 - 6/23/1997 and 10/26/2000 - 1/26/2001.

1997				
	$-Spread	%-Spread	Bid	Ask
HPLV	0.976	0.74%	412	518
HPHV	0.390	0.40%	1762	2018
LPLV	0.356	5.51%	2751	2434
LPHV	0.212	3.68%	23778	23946
2001				
	$-Spread	%-Spread	Bid	Ask
HPLV	1.358	1.03%	260	281
HPHV	0.576	0.61%	846	1121
LPLV	0.434	6.37%	948	792
LPHV	0.204	4.31%	17736	16683

Table 3

Percentage change in quoted bid ask spreads, percentage spreads and depth at the inside quotes NYSE 1997 tick size reduction from 1/8 to 1/16 and 2001 NYSE tick size reduction from 1/16 to 0.01

	1997			
	$-Spread	%-Spread	Bid	Ask
HPLV	8.15%[a]	1.34%	-12.14%[a]	-14.67%[b]
HPHV	3.54%	-7.32%[b]	-42.57%[a]	-42.42%[a]
LPLV	-10.52%[a]	-21.89%[a]	-44.75%	-46.75%[b]
LPHV	-15.21%[a]	-23.64%[a]	-48.96%[a]	-45.57%[a]
	2001			
	$-Spread	%-Spread	Bid	Ask
HPLV	-14.41%	2.53%	-5.77%	-6.05%
HPHV	9.62%	22.31%[b]	-33.57%[a]	-32.29%[b]
LPLV	-37.10%[a]	-42.89%[a]	-4.54%	4.92%
LPHV	-15.89%[a]	-24.47%[a]	-81.76%[b]	-77.11%[a]

a – statistically different from zero at the 1% confidence level

b – statistically different from zero at the 5% confidence level

Table 4

Change in dollar and percentage effective spread Panel A: High-price & Low-volume stocks 1997 and 2001 NYSE tick size reductions; Panel B: Low-price and Low-volume stocks 1997 and 2001 NYSE tick size reductions

Panel A:	Dollar effective spread High-price and Low-volume							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	27	0.310	0.359	0.049[a]	20	0.550	0.625	0.076
2	27	0.289	0.355	0.066[a]	20	0.527	0.711	0.184
3	27	0.291	0.346	0.055[a]	20	0.581	0.642	0.061
4	19	0.277	0.343	0.067	17	0.768	0.693	-0.076
5	16	0.258	0.331	0.073	13	0.627	0.726	0.099
	Percentage effective spread High-price and Low-volume							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	27	0.28%	0.30%	0.02%[b]	20	0.42%	0.53%	0.11%
2	27	0.32%	0.35%	0.03%[b]	20	0.50%	0.73%	0.23%
3	27	0.32%	0.36%	0.03%[b]	20	0.57%	0.68%	0.11%
4	19	0.35%	0.38%	0.028	17	0.73%	0.78%	0.05%
5	16	0.34%	0.39%	0.051	13	0.69%	0.75%	0.07%
Panel B:	Dollar effective spread Low-price and Low-volume							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	33	0.131	0.107	-0.024[a]	50	0.291	0.095	-0.196[a]
2	33	0.131	0.126	-0.005	49	0.243	0.114	-0.129[a]
3	33	0.138	0.126	-0.012	50	0.252	0.118	-0.134[a]
4	30	0.154	0.130	-0.024[b]	40	0.290	0.147	-0.143[a]
5	20	0.144	0.141	-0.002	24	0.260	0.115	-0.145[a]
	Percentage effective spread Low-price and Low-volume							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	33	2.05%	1.51%	-0.55%[a]	50	4.40%	1.50%	-2.90%[a]
2	33	2.06%	1.68%	-0.37%[b]	49	4.16%	1.91%	-2.26%[a]
3	33	2.49%	1.93%	-0.56%[a]	50	4.62%	2.14%	-2.48%[a]
4	30	2.99%	2.32%	-0.67%[b]	40	5.24%	2.36%	-2.88%[a]
5	20	2.82%	2.52%	-0.29%	24	4.52%	2.13%	-2.38%[a]

a – statistically different from zero at the 1% confidence level

b – statistically different from zero at the 5% confidence level

Table 5

Change in dollar and percentage effective spread High-price & High-volume stocks 1997 and 2001 NYSE tick size reductions.

	Dollar effective spread							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	25	0.143	0.137	-0.005	23	0.192	0.189	-0.002
2	25	0.135	0.131	-0.004	23	0.197	0.193	-0.004
3	25	0.147	0.140	-0.007	23	0.214	0.196	-0.017
4	25	0.156	0.160	0.004	23	0.243	0.216	-0.027
5	25	0.179	0.182	0.003	23	0.267	0.256	-0.011
6	25	0.193	0.229	0.036	23	0.328	0.290	-0.038
7	19	0.198	0.338	0.140	20	0.376	0.342	-0.034
8	23	0.262	0.489	0.227	22	0.425	0.446	0.021
9	4	0.156	0.296	0.141	13	0.730	0.950	0.221
10	NA	NA	NA	NA	5	0.364	0.320	-0.044
	Percentage effective spread							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	25	0.15%	0.13%	-0.02%[a]	23	0.21%	0.22%	0.02%
2	25	0.14%	0.12%	-0.02%[a]	23	0.21%	0.23%	0.01%
3	25	0.15%	0.13%	-0.02%[a]	23	0.23%	0.23%	0.00%
4	25	0.16%	0.15%	-0.01%	23	0.26%	0.26%	-0.01%
5	25	0.18%	0.17%	-0.01%[b]	23	0.29%	0.31%	0.01%
6	25	0.21%	0.22%	0.01%	23	0.36%	0.36%	-0.01%
7	19	0.22%	0.32%	0.10%	20	0.42%	0.42%	0.00%
8	23	0.28%	0.43%	0.15%	22	0.46%	0.53%	0.07%
9	4	0.17%	0.30%	0.13%	13	0.80%	1.01%	0.21%
10	NA	NA	NA	NA	5	0.36%	0.37%	0.01%

Table 6

Change in dollar and percentage effective spread Low-price & High-volume stocks 1997 and 2001 NYSE tick size reductions.

	Dollar effective spread							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	34	0.117	0.072	-0.045[a]	42	0.096	0.052	-0.044[a]
2	34	0.114	0.071	-0.043[a]	42	0.099	0.056	-0.043[a]
3	34	0.111	0.070	-0.040[a]	42	0.099	0.058	-0.04 [a]
4	34	0.108	0.070	-0.038[a]	42	0.102	0.060	-0.042[a]
5	34	0.111	0.073	-0.038[a]	42	0.110	0.068	-0.042[a]
6	31	0.115	0.077	-0.038[a]	40	0.114	0.073	-0.042[a]
7	22	0.130	0.093	-0.037[a]	39	0.119	0.071	-0.048[a]
8	28	0.121	0.074	-0.047[a]	38	0.125	0.072	-0.053[a]
9	10	0.083	0.074	-0.010	22	0.142	0.081	-0.061[b]
10	4	0.101	0.068	-0.033	15	0.137	0.108	-0.030
	Percentage effective spread							
	1997				2001			
size	sample	pre	post	change	sample	pre	post	change
1	34	2.00%	1.12%	-0.88%[a]	42	2.18%	1.02%	-1.17%[a]
2	34	2.11%	1.21%	-0.91%[a]	42	2.35%	1.15%	-1.20%[a]
3	34	2.38%	1.43%	-0.95%[a]	42	2.51%	1.30%	-1.21%[a]
4	34	2.48%	1.55%	-0.93%[a]	42	2.72%	1.47%	-1.26%[a]
5	34	2.43%	1.49%	-0.94%[a]	42	2.83%	1.58%	-1.25%[a]
6	31	2.58%	1.61%	-0.97%[a]	40	3.10%	1.81%	-1.30%[a]
7	22	2.69%	1.87%	-0.82%[a]	39	3.26%	1.72%	-1.54%[a]
8	28	3.21%	2.01%	-1.20%[a]	38	3.25%	1.90%	-1.35%[a]
9	10	2.77%	2.46%	-0.31%	22	3.88%	2.40%	-1.49%[b]
10	4	11.03%	2.36%	-8.67%	15	4.71%	3.10%	-1.61%