5-2019

Minimum Quotation Size and Market Quality: Evidence from the Modern OTC Markets

Kemerey Thompson
Utah State University

Minimum Quotation Size and Market Quality: Evidence from the Modern OTC Markets

Kemerey Thompson

Abstract

I examine the effects of a change in the minimum quotation size on liquidity and volatility in the modern over-the-counter (OTC) markets. On November 12, 2012, the Financial Industry Regulatory Agency (FINRA) introduced a pilot program to adjust the minimum quote sizes for securities transactions in the OTC markets. I find that an increase in the minimum quote size decreases OTC market quality as spreads widen and volatility increases. In contrast, I find that a decrease in the minimum quote size improves OTC market quality, but the results are sensitive to the price of the security. These results offer important insights to regulators, exchange officials, and market participants in the OTC marketplace.

1. Introduction

Financial market quality is critical to a well-functioning economy (Levine and Zervos, 1998). Liquid markets enable investor to trade quickly, at a low cost, and without substantially moving prices (Pastor and Stambaugh, 2003). Studies find that liquid markets assist in allocating capital efficiently and even reduce income inequality and poverty rates (Blau, 2018). Previous research also indicates that liquidity encourages arbitrage, which increases market efficiency (Chordia, Roll, and Subrahmanyam, 2007). Another important aspect of market quality is volatility, which is crucial to risk management and an important consideration in asset allocation. It is also used to forecast future equity spot prices (Alizadeh, Brandt, and Diebold, 2002).

Compared to exchange listed stocks, over-the-counter (OTC) securities are less liquid, disclose less information, and are primarily held by retail investors (Ang, Shtauber, and Tetlock, 2013). Exchange officials and regulators are constantly searching for ways to improve the liquidity of OTC securities. On November 12, 2012, a pilot program was initiated which simplified the minimum quotation requirements for different price levels of OTC securities. It decreased the number of price level tiers from nine to six and altered their minimum quote sizes (see Table 1). In this paper, I examine how changes in minimum quote sizes impact liquidity and volatility in OTC stocks. I use percent closing spreads as a measure of market breadth and daily price range as a measure of volatility. I use difference-in-differences to compare liquidity and volatility for securities that increased/decreased in minimum quote size to the securities that experienced no change in minimum quote size.

[Insert Table 1 Here]

According to the SEC (see Release No. 34-83753), the minimum quote size changed to: (1) simplify the structure of the minimum quotation sizes for OTC equity securities; (2) facilitate the display of customer limit orders, which might affect both price efficiency and bid-ask spreads;

and (3) to provide a uniform treatment of the types and sources of quotations. Decreasing the minimum quote size might increase the number of eligible quotes, allowing for greater market participation and liquidity. Consistent with Hayek (1945), greater market participation will result in more efficiently priced securities. I note that the SEC found that a lower minimum quote size lowered spreads, and an increase in the minimum quote size widened spreads.[1] However, the SEC argued that there was insufficient evidence that increasing the minimum quote size caused a decrease in liquidity. I examine the validity of these claims and the impact of a change in the minimum quote size on both spreads and volatility in OTC markets.

If decreasing the minimum quote size increases liquidity, it would make the OTC market more efficient (Chordia, Roll, and Subrahmanyam, 2007). However, since tighter spreads encourage more trading (Barclay, Kandel, and Marx, 1998), a decrease in the minimum quote size may also increase trade volume, and consequently, market volatility.[2] There is extensive evidence on a positive relation between price volatility and trading volume in financial markets (see Karpoff, 1987). Chen, Firth, and Rui (2001) argue that trading volume provides important information about the future returns of stocks. Therefore, a decrease in minimum quote size may lead to an increase in volatility.

First, I conduct an event study on each individual change of minimum quote size: increase, decrease, or no change. I find that an increase in the minimum quote size leads to an increase in the average percentage spread by 122 basis points and an increase in range volatility by 202 basis points. In contrast, I find that a decrease in the minimum quote size is associated with a decrease in the average percentage spread by 125 basis points and a decrease in range volatility by 111 basis

[1] See SEC Memorandum "FINRA's Pilot Program Amending Minimum Quotation Size Requirements for OTC Equity Securities" available at: https://www.sec.gov/files/otc_tiersizepilot_memo.pdf.
[2] FINRA reported that trading volume increased after the minimum quote size change was implemented.

points. These findings indicate that a change in the minimum quote size materially affects market quality, both in terms of liquidity and volatility.

Second, to draw more causal inferences, I conduct difference-in-difference analyses on stocks which experience an increase/decrease in minimum quotation size, relative to stocks that experience no change. Similar to the event study, I find increasing the minimum quote size decreases market quality, visible through increased spreads and increased volatility. The results hold when controlling for day and firm fixed effects. I find no significant relation between minimum quote size and spreads for stocks that experience a decrease in the minimum quote size, relative to the control group. However, my findings suggest that the stocks which decreased in minimum quote size experience an increase in range volatility between 85 and 123 basis points, relative to the control group.

Third, I separate stocks which experienced a decrease in minimum quote size by price tiers. My findings suggest price tiers below $10.00, which decreased in minimum quote size, experienced a decrease in percent closing spreads, relative to the control stocks. However, stocks which decreased in minimum quote size but are priced above $10.00 did not experience a decrease in percent spreads, relative to the control stocks. Separated into individual price tiers, my findings suggest that all stocks which experience a decrease in minimum quote size experience a decrease in range volatility, other factors held constant.

The main goal of this study is to compare the percent spread and range volatility of OTC market stocks surrounding changes in minimum quotation sizes. These results offer important insights to regulators, exchange officials, and market participants in the OTC marketplace. Regulators have potential to impact the liquidity and volatility of OTC markets. My findings indicate that the change in the minimum quote size impacts market quality, if regulators were to change the minimum quote requirements again it could further impact market quality. Due to looser disclosure requirements, OTC securities tend to exhibit wider spreads than exchange traded securities (Welker, 1995). The cost of trading is an important consideration for investors, thus evaluating how the change in the minimum quote size impacts spreads is valuable.

2. OTC Market Summary

Over-the-counter markets have less regulatory and listing requirements than exchanges. Firms are not required to register with the SEC prior to trading. Little information is required to be provided to investors from OTC firms. The OTC market has no requirements for size or price for firms. The OTC market is a decentralized dealer market where securities, if quoted, are quoted by a SEC-registered and FINRA-approved broker-dealer. Regulated by FINRA, broker-dealers are required to follow certain trading rules. These rules such as best execution, customer priority, and quote integrity increase investor confidence and encourage trading in OTC markets. Once a quote is posted, broker-dealers are obligated to honor the price and lot size.

OTC market data is aggregated by the Trade Data Dissemination Service (TDDS). TDDS receives all quote data as broker-dealers are required to report trades to FINRA who delivers the data to TDDS (see Davis, Griffith, Roseman and Yildiz, 2019).

3. Data Description

Stock and trading information are obtained from Center for Research in Security Prices (CRSP). I obtain prices of these securities and find an approximation of the effective spread and range volatility. I use average percent closing spread as an approximation for the effective spread. Chung and Zhang (2014) show that closing spreads in the equity markets are highly correlated with trade and quote intraday effective spreads. The percent closing spread is equal to the difference between the closing ask the closing bid prices, divided by the midpoint. I measure range volatility as the difference in the natural log of the high ask price minus the natural log of the low bid price. Alizadeh, Brandt, and Diebold (2002) show that this measure of range volatility is a robust approximation of stochastic volatility. The variable price is the daily closing price for each security. Stocks are only included if they remained in the same tier throughout the trading day. Share volume is the number of shares traded in that day. The number of trades shows how many trades were executed that day, regardless of each individual trade size. Trade size is an average daily measure for every stock within the category.

[Insert Table 2 Here]

To test the effect of the change in quote size on spread and volatility, I use a sample of 1,872 firms which trade in the OTC markets. The sample includes all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot program on November 12, 2012 and 40-days after. The price of the sample is right skewed: the mean price is $10.78 and the median is $0.54. The average number of trades for a security in a day is 27. Trade size is also right skewed: with a median of 2,000 and a mean of 40,055. It is reasonable to infer that there are one or more substantially bigger than average trades. The average closing percentage spread is 9.85% and the average range-based volatility is 9.22%.

[Insert Table 3 Here]

Next, I report pooled Pearson correlation coefficients for the variables used throughout the empirical analysis. I find a correlation coefficient between share price and average percent closing spread of -7.11%, significant at the 0.01 level. Share price and range volatility have a correlation coefficient of -6.56%, significant at the 0.01 level. This suggests higher priced securities are less risky and cheaper to trade.

Similar to McInish and Wood (1992), I find that the number of trades is negatively correlated with the spread, with a correlation coefficient of 11.82% that is significant at the 0.01 level. This is because a dealer must compensate for the risk of holding an illiquid security with higher spreads. The number of trades is positively correlated with range volatility, with a correlation coefficient of 7.57% that is significant at the 0.01 level. This positive relationship between the number of trades and volatility is consistent with several theoretical models (Karpoff, 1987). I also find that range volatility, a measure of risk, is directly correlated with spreads with a correlation coefficient of 42.91%, significant at the 0.01 level. Orders and prices aggregate market information and dealers will increase spreads if there is a perceived informational change in markets (Schwartz, 1988).

I find a positive correlation coefficient of 24.22% between trade size and the average percent closing spreads, significant at the 0.01 level. Hasbrouck (1988) states that "large trades convey more information than small trades" and, therefore, the direct relationship between trade size and spread supports this finding. I also find a positive correlation of 29.20% between trade size and the average range-based volatility, significant at the 0.01 level. This suggests that as larger trades are executed there is a correlated increase in risk of trading that specific security. Last, the correlation coefficient between the average percent closing spread and the average range-based volatility is 42.91% and is significant at the 0.01 level. The cost of trading a security and the risk of that specific security are positively correlated.

4. Empirical Results

4.1. Change in minimum quote size: event study

In my first set of tests, I examine the effects of a change in the minimum quote size on stock liquidity and volatility. I expect the market to react favorably to a decrease in the minimum quote size and, therefore, spreads will narrow and volatility will decrease. I expect no significant change in market quality for stocks that maintain the same minimum quote size throughout the sample period. I anticipate an increase in both spreads and volatility for stocks that experience an increase in the minimum quote size. To examine my research question, I estimate specifications of the following fixed-effects regression equation on daily OTC stock observations in the 80-day window surrounding the change in minimum quote size:

$$\begin{aligned} \%\, Spread_{i,t} \; or \; Range\; Volatility_{i,t} \\ = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Ln(\#\, of\; Trades)_{i,t} \\ + \beta_3 Ln(Price)_{i,t} + \beta_4 Ln(Trade\; Size)_{i,t} + \varepsilon\,, \end{aligned} \quad (1)$$

where the dependent variable is either the relative closing spread or the range-based volatility. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. This is the difference estimator and the variable of interest. I include as control variables: *trades*, *price*, and *trade size*. To normalize the data and remove potential outliers, I take the natural log of the control variables. The regression coefficients on the control variables are consistent with my expectations (see McInish and Wood, 1992), so I will focus my discussion on the variable of interest, *Post*. I note that the relation between bid-ask spreads and tradesize is negative once I control for other variables that affect liquidity. While this disagrees with our correlation matrix, it is consistent with the findings of McInish and Wood (1992). I report the estimated coefficient in equation (1) in Table 4 with *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level.

[Insert Table 4 Here]

The results in Table 4 provide evidence that the change in minimum quote size effects the spreads and volatility of OTC equities. For stocks that experience an increase in the minimum quote size, I find an increase in the round-trip cost to trade. Specifically, in column [1], I find that the average percent closing spread increases by 122 basis points for stocks that experience an increase in the minimum quotation size. This increase in the cost of trading suggests the change in minimum quote size negatively affects market liquidity. In column [2], I find that an increase in the minimum quote size also increases the average daily range volatility, holding constant other factors. For instance, range volatility increases by an average of 202 basis points after the minimum quote size increases. The r-squared value on the regression in column [2] suggests that the independent variables explain 28.33% of the variation in the average percent closing spread. Overall, the results seem to suggest that an increase in the minimum quote size increases both the cost and risk of trading in the OTC markets. This is significant as the price tier which experienced an increase in minimum quotation size encompassed 24.48% of all OTC trades pre-pilot period (see Table 1).

Next, I examine the effects of a decrease in the minimum quote size on liquidity and volatility. In column [3] of Table 4, I find that the average percentage closing spread decreases by 125 basis points after the minimum quote size is reduced, holding constant trading activity, security price, and trade size. This decrease in the average closing spread is significant at the .01 level. When controlling for the same explanatory variables as above, in column [4] of Table 4, I find that a decrease in minimum quote size is associated with a decrease in average daily range volatility by 111 basis points. It appears that the increase in market quality associated with a decrease in the minimum quote size is not as large as the decrease in market quality associated with an increase in the minimum quote size.[3]

In my final set of tests in this subsection, I examine the liquidity and volatility in securities that did not experience a change in the minimum quote size. The results in columns [5] and [6] of

[3] I use simple z-statistics to test for differences across the regression coefficients.

Table 4 show that liquidity and volatility remain the same surrounding the introduction of the pilot program for stocks that experience no change in the minimum quote size. I use this set of stock/day observations as a control group in the following analysis, which allows me to better control for time-series variation in market quality and unobservable macroeconomic trends.

4.2. Increase in minimum quote size: difference-in-difference

In this subsection, I use difference-in-difference analysis to further test the impact of an increase in the minimum quote size on liquidity and volatility. To do so, I estimate specifications of the following regression equation:

$$\begin{aligned} \%\,Spread_{i,t}\ or\ Range\ Volatility_{i,t} & \\ = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Increase_{i,t} & \\ + \beta_3 Post_t \times Increase_{i,t} + \beta_3 Ln(\#\ of\ Trades)_{i,t} & \qquad (2) \\ + \beta_4 Ln(Price)_{i,t} + \beta_5 Ln(Trade\ Size)_{i,t} + \varepsilon\,, & \end{aligned}$$

where the dependent variable is either the percent closing spread or range-based volatility. *Increase* is a binary variable equal to one if the stock experienced an increase in minimum quote size and zero otherwise. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. The interaction term of the two binary variables, *post* and *increase*, is the difference-in-difference estimator and the variable of interest. It is equal to one if the stock experienced an increase in minimum quote size and during the pilot period. The control variables include, number of trades, price, and trade size. In the full model specifications, I also include day fixed effects and stock fixed effects. I report the estimated coefficients from equation (2) in Table 5 with *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level.

[Insert Table 5 Here]

In column [1] of Table 5 I find that, relative to stocks for which the minimum quote size remains constant, stocks that experience an increase in the minimum quote size exhibit an increase in quoted spreads by 215 basis points. The beta coefficient on the interaction term is significant at the .01 level and suggests that increasing the minimum quote size decreases market liquidity. I note that 32.23% of the variation in the average percentage closing spread is explained by the regression model. Controlling for both day and firm fixed effects, in column [2] of Table 5, I find that the average percent closing spread is 230 basis points higher for stocks that experience an increase in the minimum quote size, relative to those the experience no change. Therefore, relative to the control group, and relative to the time period before the minimum quote change, treatment stocks or stocks with an increase in minimum quote size experienced an increase in trading costs.

In column [3] of Table 5, I find that the average daily return volatility for stocks which experience an increase in the minimum quote size, relative to stocks that experience no change in the minimum quote size, increases by 35 basis points after the change. This increase is not significant at the 0.10 level. In column [4] of Table 5, the results hold after controlling for day fixed effects and stock fixed effects. In fact, in the full model specification, the average daily volatility increases by 146 basis points for stocks that experience an increase in the minimum quote size, relative to those that experience no change. Thus, I find that an increase in minimum quote size significantly increases volatility in OTC stocks.

In summary, an increase in the minimum quotation size is associated with both an increase in bid-ask spreads and an increase in volatility. Although only one tier experienced an increase in minimum quotation size, this tier represented almost one-fourth of all OTC equities pre-pilot period (see Table 1).

4.3. Decrease in minimum quote size: difference-in-difference

Similar to the previous subsection, I use a difference-in-difference analysis to further examine the impact of a decrease in the minimum quote size on liquidity and volatility. To do so, I estimate the following fixed effects regression equation on daily OTC stock observations:

$$\begin{aligned}
\%\,Spread_{i,t}\ or\ Range\ Volatility_{i,t} \\
&= \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Decrease_{i,t} \\
&+ \beta_3 Post_t \times Decrease_{i,t} + \beta_3 Ln(\#\ of\ Trades)_{i,t} \qquad (3) \\
&+ \beta_4 Ln(Price)_{i,t} + \beta_5 Ln(Trade\ Size)_{i,t} + \varepsilon\,,
\end{aligned}$$

where the dependent variable is either percent closing spread or range volatility. *Decrease* is an indicator variable equal to one if the stock experienced a decrease in the minimum quote size and zero otherwise. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. Again, the interaction term of the two binary variables is the difference-in-difference estimator and the variable of interest, which is equal to one if the stock experienced a decrease in minimum quote size during the pilot period. The control variables still include the number of trades, closing price, and trade size. In the full model, I also include both day and stock fixed effects. I report the estimated coefficients from equation (3) in Table 6, with *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level.

[Insert Table 6 Here]

For the sample of stocks that experienced a decrease in minimum quote size, relative to those that experienced no change, I do not find a significant decrease in average closing spreads. For instance, in columns [1] and [2] of Table 6, the beta coefficients on the interaction term are not significantly different from zero. However, in columns [3] and [4] of Table 6, I find that for stocks that experienced a decrease in the minimum quote size, relative to the control stocks, average volatility decreases between 85 and 123 basis points, depending on the model specification. This suggests that a decrease in the minimum quote size is associated with a decrease in firm-specific risk.

In my final set of tests, I separate stocks that experienced a decrease in the minimum quote size into their respective price level tiers. I then re-estimate equation (3) separately for these individual tiers. Panel A reports the regression of percent closing spread on my control variables. Panel B reports the regression of range volatility on my control variables. The estimated coefficients are reported in Table 7 with *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level.

[Insert Table 7 Here]

In Panel A of Table 7, I examine the effect of a decrease in the minimum quote size across various price tiers on liquidity. For securities priced between $0.20 and $0.51, I find a decrease in the minimum quote size is associated with a decrease in the average percent closing spread by 151 basis points, relative to the control group. For securities priced between $0.51 and $1.00, a decrease in the minimum quote size is associated with a decrease in the average percent closing spread by 112 basis points, relative to the control group. However, this are the only two groups, that experienced a decrease in the minimum quote size, for which I find a significant improvement in liquidity.

In Panel B of Table 7, I examine the effect of a decrease in the minimum quote size across various price tiers on volatility. I find that for all stocks, a decrease in the minimum quote size leads to lower volatility, other factors held constant. Specifically, I find that, relative to the control stocks, the average volatility for the treatment stocks decreases between 76 and 244 basis points.

It appears that a decrease in the minimum quote size has the greatest effect on higher priced OTC securities, at least in terms of firm-specific risk.

5. Concluding Remarks

In this paper, I analyze the effects of changes in the minimum quotation sizes in the OTC markets on liquidity and volatility. FINRA Rule 6433 changed the minimum quote size requirements for securities traded in the OTC market, which was first applied on a pilot basis on November 12, 2012 and later permanently implemented. I find that this rule affects securities that increased in minimum quote size and securities that decreased in minimum quote size. There is no significant effect on securities that experienced no change in minimum quote size and I use these securities as my control group.

To minimize the noise in the error term of my regressions, I control for variables that are known to impact stock liquidity and stock volatility. Through robust difference-in-difference models, I find that changing the minimum quote size in OTC markets affects market quality, in terms of both liquidity and volatility. Stocks which increased in minimum quote size experience an increase in percent spreads and range volatility. This makes trading and investing in these stocks more expensive and riskier. These stocks which experienced an increase in minimum quote size represent almost a quarter of all OTC sample trades in the pre-pilot period. All tiers of stocks which experience a decrease in minimum quote size, relative to the control group, experienced a decrease in range volatility. Only stocks priced below $10,00 that experience a decrease in the minimum quote size exhibit a decrease in spreads, relative to the control group.

Overall, an increase in the minimum quote size is associated with a decrease in market quality, and a decrease in the minimum quote size is associated with an increase in market quality. However, the effects of a decrease in the minimum quotation size on liquidity depends on the price of the security. The results from this analysis hold after controlling for day fixed effects, stock fixed effects, trading activity, price, and trade size. Thus, my analysis predicts that an increase in the minimum quote size for OTC stocks will increase both spreads and volatility. This would increase the cost of trading and the risks associated with trading. In contrast, a decrease in the minimum quote size for OTC stocks does not necessarily improve market quality, as spreads remain the same but volatility decreases.

References

Alizadeh, S., M. Brandt, and F. Diebold. 2002. Range-based Estimation of Stochastic Volatility Models. *Journal of Finance* 57 (3), 1047-1091.

Ang, A., A. Shtauber, and P. Tetlock. 2013. Asset Pricing in the Dark: The Cross Section of OTC Stocks. *Review of Financial Studies* 26 (12), 2985-3028.

Barclay, M. J., Kandel, E., & Marx, L. M. (1998). The effects of transaction costs on stock prices and trading volume. *Journal of Financial Intermediation*, *7*(2), 130-150.

Blau, B. M. (2018). Income inequality, poverty, and the liquidity of stock markets. *Journal of Development Economics*, *130*, 113-126.

Chen, G. M., Firth, M., & Rui, O. M. (2001). The dynamic relation between stock returns, trading volume, and volatility. *Financial Review*, *36*(3), 153-174.

Chordia, T., Roll, R., & Subrahmanyam, A. (2008). Liquidity and market efficiency. *Journal of Financial Economics*, *87*(2), 249-268.

Davis, R., Griffith, T., Roseman, B., Yildiz, S. (2010). "Uplisting from the Modern OTC Markets: The Effects on Liquidity, Volatility, and Capital Structure. *Working Paper*. Working Paper TBD, 1–38.

Hasbrouck, J., & Schwartz, R. A. (1988). Liquidity and execution costs in equity markets. *Journal of Portfolio Management*, *14*(3), 10.

Hayek, F. A. (1945). The use of knowledge in society. *The American Economic Review*, *35*(4), 519-530.

Karpoff, J. M. (1987). The relation between price changes and trading volume: A survey. *Journal of Financial and Quantitative Analysis*, *22*(1), 109-126.

McInish, T. H., & Wood, R. A. (1992). An analysis of intraday patterns in bid/ask spreads for NYSE stocks. *the Journal of Finance*, *47*(2), 753-764.

McQueen, G., & Thorley, S. (1991). Are stock returns predictable? A test using Markov chains. *The Journal of Finance*, *46*(1), 239-263.

Schwartz, R. A. (1988). Equity markets. *New York*.

Stoll, H. R., & Schenzler, C. (2006). Trades outside the quotes: Reporting delay, trading option, or trade size? *Journal of Financial Economics*, *79*(3), 615-653.

Welker, M. (1995). Disclosure policy, information asymmetry, and liquidity in equity markets. *Contemporary accounting research*, *11*(2), 801-827.

Table 1. Minimum quotation size tiers

The table reports the structural change in the minimum quote sizes across various price tiers in the OTC markets. The sample size and the percent of trades are measured in the pre-pilot period.

Tier	Price Range	Minimum Quote Size (# of shares) Pre-Pilot	Pilot	Quote Size Change	N	% of Trades
1	$0 < price < $0.10	5,000	10,000	Increase	22,185	24.48%
2	$0.10 <= price < $0.20	5,000	5,000	Same	4,771	6.78%
3	$0.20 <= price < $0.51	5,000	2,500	Decrease	6,593	10.14%
4	$0.51 <= price < $1.00	2,500	1,000	Decrease	4,585	6.21%
5a	$1.00 <= price <= $10.00	500	100	Decrease	13,581	21.51%
5b	$10.00 < price <= $100.00	200	100	Decrease	15,293	30.30%
5c	$100.00 < price < $175.00	100	100	Same	242	0.16%
6a	$175.00 <= price <= $200.00	100	1	Decrease	30	0.01%
6b	$200.00 < price <= $500.00	25	1	Decrease	83	0.37%
6c	$500.00 < price <= $1,000.00	10	1	Decrease	80	0.06%
6d	$1,000.00 < price <= $2,500.00	5	1	Decrease	0	0.00%
6e	$2,500.00 < price	1	1	Same	28	0.01%

Table 2. Summary statistics

This table reports period summary statistics for the various measures used in the empirical analysis. The sample includes all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot on November 12, 2012 and the 40-days after. The price is the closing price for each security. The number of trades describes how many trades were executed on a given day. Trade size is a daily measure for each stock, reflecting the magnitude of stocks traded. The spread is a percent closing spread. Range volatility is the difference between the natural log of the high ask price minus the natural log of the low bid price.

	N	Mean	Median	Std. Dev.	Minimum	Maximum
Price	67,471	10.7810	0.5400	96.0687	0.0001	4500.0000
# of Trades	67,471	27	10	94	1	11753
Tradesize	67,471	40,055	2,000	195,936	1	10,445,081
Spread	67,471	0.0985	0.0417	0.1382	0.0009	0.7368
Range Volatility	67,471	0.0922	0.0315	0.1354	0.0000	0.6931

Table 3. Correlation matrix

This table reports Pearson correlation coefficients between the variables used in the empirical analysis. The sample includes all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot on November 12, 2012 and the 40-days after. All variables have previously been defined, p-values are reported in brackets.

	Price	# of Trades	Tradesize	%Spread	Range Volatility
Price	1.0000				
	-				
# of Trades	-0.0003	1.0000			
	[0.9413]	-			
Tradesize	-0.0226	-0.0051	1.0000		
	[<.0001]	[0.1878]	-		
%Spread	-0.0711	-0.1182	0.2422	1.0000	
	[<.0001]	[<.0001]	[<.0001]	-	
Range Volatility	-0.0656	0.0757	0.2920	0.4291	1.0000
	[<.0001]	[<.0001]	[<.0001]	[<.0001]	-

Table 4. Change in minimum quote size: event study

This table reports the results from an event study on all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot on November 12, 2012 and the 40-days after.

$$\% Spread_{i,t} \text{ or } Range\ Volatility_{i,t} = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Ln(\#\ of\ Trades)_{i,t} + \beta_3 Ln(Price)_{i,t} + \beta_4 Ln(Trade\ Size)_{i,t} + \varepsilon\ ,$$

The dependent variable is either the relative *closing percent spread* or *range-based volatility*. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. This is the difference estimator and the variable of interest. I include as control variables: *trades*, *price*, and *trade size*. *Ln(# of Trades)* is the natural log of the average number of trades that occurred in a day. *Ln(Price)* is the natural log of the closing price. *Ln(Trade Size)* is the natural log of the average trade size. I report *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

	Increase in Quote Size		Decrease in Quote Size		No Change in Quote Size	
	%Spread	Range Volatility	%Spread	Range Volatility	%Spread	Range Volatility
	[1]	[2]	[3]	[4]	[5]	[6]
Post	0.0122*	0.0202**	-0.0125***	-0.0111***	-0.0127	-0.0039
	(1.71)	(2.27)	(-6.88)	(-5.66)	(-1.17)	(-0.38)
Ln(# of Trades)	-0.0088***	0.1048***	-0.0038***	0.0237***	-0.0072***	0.0543***
	(-7.49)	(62.03)	(-9.12)	(30.84)	(-5.19)	(26.26)
Ln(Price)	-0.0632***	-0.0275***	-0.0329***	-0.0185***	-0.0183	0.0320***
	(-11.50)	(-4.88)	(-7.76)	(-4.50)	(-1.38)	(2.71)
Ln(Tradesize)	-0.0086***	0.0038***	-0.0022***	-0.0010***	-0.0051***	-0.0019
	(-10.14)	(2.61)	(-7.01)	(-3.60)	(-3.97)	(-1.23)
Constant	0.0023	-0.2094***	0.1148***	0.0187***	0.1561***	0.0418*
	(0.08)	(-8.01)	(16.02)	(2.94)	(6.51)	(1.89)
Day FE	Yes	Yes	Yes	Yes	Yes	Yes
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0775	0.2833	0.0388	0.1622	0.0233	0.2476
N	46,105	46,105	79,479	79,479	9,931	9,931

Table 5. Increase in minimum quote size: difference-in-difference

This table reports the results from an event study on all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot on November 12, 2012 and the 40-days after.

$$\% Spread_{i,t} \text{ or } Range\ Volatility_{i,t} = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Increase_{i,t} + \beta_3 Post_t \times Increase_{i,t} + \beta_3 Ln(\#\ of\ Trades)_{i,t} + \beta_4 Ln(Price)_{i,t} + \beta_5 Ln(Trade\ Size)_{i,t} + \varepsilon\ ,$$

The dependent variable is either the relative *closing percent spread* or *range-based volatility*. *Increase* is a binary variable that is equal to one if the stock experienced an increase in minimum quote size. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. The interaction term of the two binary variables, *post* and *increase*, is the difference-in-difference estimator and the variable of interest. I include as control variables: *trades*, *price*, and *trade size*. *Ln(# of Trades)* is the natural log of the average number of trades that occurred in a day. *Ln(Price)* is the natural log of the closing price. *Ln(Trade Size)* is the natural log of the average trade size. I report *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

	%Spread		Range Volatility	
	[1]	[2]	[3]	[4]
Post	0.0030	-0.0127*	0.0073*	0.0048
	(0.64)	(-1.78)	(1.72)	(0.62)
Increase	-0.0228***	-0.0072	0.0263***	0.0194***
	(-2.85)	(-1.04)	(3.64)	(3.39)
Post x Increase	0.0215***	0.0230***	0.0034	0.0146***
	(3.83)	(4.57)	(0.64)	(3.12)
Ln(# of Trades)	-0.0314***	-0.0087***	0.0565***	0.0968***
	(-19.17)	(-8.47)	(21.26)	(60.57)
Ln(Price)	-0.0517***	-0.0622***	-0.0193***	-0.0241***
	(-17.95)	(-11.74)	(-9.40)	(-4.54)
Ln(Tradesize)	-0.0297***	-0.0085***	0.0038**	0.0035***
	(-12.06)	(-11.11)	(2.11)	(2.76)
Constant	0.3372***	0.0327	-0.0845***	-0.1900***
	(18.54)	(1.43)	(-6.58)	(-9.10)
Day FE	No	Yes	No	Yes
Stock FE	No	Yes	No	Yes
R^2	0.3223	0.0750	0.2434	0.2716
N	56,036	56,036	56,036	56,036

Table 6. Decrease in minimum quote size: difference-in-difference

This table reports the results from an event study on all OTC securities that trade in a minimum of 80% of sample days, which includes the 40-days before the introduction of the pilot on November 12, 2012 and the 40-days after.

$$\% \, Spread_{i,t} \text{ or } Range\ Volatility_{i,t} = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Decrease_{i,t} + \beta_3 Post_t \times Decrease_{i,t} + \beta_3 Ln(\#\ of\ Trades)_{i,t} + \beta_4 Ln(Price)_{i,t} + \beta_5 Ln(Trade\ Size)_{i,t} + \varepsilon\,,$$

The dependent variable is either the relative *closing percent spread* or *range-based volatility*. *Decrease* is a binary variable that is equal to one if the stock experienced a decrease in minimum quote size. *Post* is a dummy variable equal to one if the observation is after the change in minimum quote size and zero otherwise. The interaction term of the two binary variables, *post* and *decrease*, is the difference-in-difference estimator and the variable of interest. I include as control variables: *trades*, *price*, and *trade size*. *Ln(# of Trades)* is the natural log of the average number of trades that occurred in a day. *Ln(Price)* is the natural log of the closing price. *Ln(Trade Size)* is the natural log of the average trade size. I report *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

	%Spread		Range Volatility	
	[1]	[2]	[3]	[4]
Post	0.0017	-0.0119**	0.0082**	-0.0028
	(0.35)	(-2.56)	(2.45)	(-0.79)
Decrease	-0.0208***	-0.0025	-0.0073**	0.0024
	(-3.57)	(-0.42)	(-2.01)	(0.58)
Post x Decrease	-0.0082	-0.0012	-0.0123***	-0.0085***
	(-1.60)	(-0.30)	(-3.57)	(-2.83)
Ln(# of Trades)	-0.0109***	-0.0044***	0.0110***	0.0273***
	(-17.34)	(-10.54)	(20.05)	(35.44)
Ln(Price)	-0.0220***	-0.0336***	-0.0175***	-0.0147***
	(-17.51)	(-7.48)	(-29.11)	(-3.79)
Ln(Tradesize)	-0.0115***	-0.0029***	-0.0026***	-0.0006*
	(-6.97)	(-7.95)	(-4.08)	(-1.77)
Constant	0.1963***	0.1236***	0.0612***	0.0003
	(13.59)	(13.29)	(10.43)	(0.05)
Day FE	No	Yes	No	Yes
Stock FE	No	Yes	No	Yes
R^2	0.3616	0.0353	0.2847	0.1658
N	89,410	89,410	89,410	89,410

Table 7. Decrease in minimum quote size by price tiers: difference-in-difference

In my final set of tests, I separate stocks that experienced a decrease in the minimum quote size into their respective price level tiers.

$$\% \, Spread_{i,t} \text{ or } Range\ Volatility_{i,t} = \alpha + \gamma_i + \delta_t + \beta_1 Post_t + \beta_2 Decrease_{i,t} + \beta_3 Post_t \times Decrease_{i,t} + \beta_3 Ln(\#\ of\ Trades)_{i,t} + \beta_4 Ln(Price)_{i,t} + \beta_5 Ln(Trade\ Size)_{i,t} + \varepsilon\,,$$

Panel A presents the results where *percent closing spread* is the dependent variable, while Panel B reports the results when *range volatility* is the dependent variable. The control variables are *trades*, *price*, and *trade size*. *Ln(# of Trades)* is the natural log of the average number of trades that occurred in a day. *Ln(Price)* is the natural log of the closing price. *Ln(Trade Size)* is the natural log of the average trade size. I control for day fixed effects and firm fixed effects. I report *t*-statistics in parentheses obtained from robust standard errors clustered at the stock level. ***, **, * denote statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Panel A. Percent closing spreads

	$0.20 <= price < $0.51	$0.51 <= price < $1.00	$1.00 <= price <= $10.00	$10.00 < price <= $100.00	$175.00 <= price <= $2,500.00
	[1]	[2]	[3]	[4]	[5]
Post	-0.0100	-0.0193**	-0.0107**	-0.0065	-0.0123
	(-1.40)	(-2.31)	(-2.00)	(-1.32)	(-1.18)
Decrease	0.0011	-0.1319*	-0.1250***	0.0018	0.0017
	(0.17)	(-1.74)	(-4.76)	(0.48)	(0.64)
Post x Decrease	-0.0151***	-0.0112**	-0.0043	0.0009	0.0019
	(-2.91)	(-2.18)	(-1.02)	(0.22)	(0.42)
Constant	0.1538***	0.2050***	0.1884***	0.0817***	0.1529***
	(9.98)	(4.46)	(9.81)	(4.70)	(7.64)
Controls	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes
Stock FE	Yes	Yes	Yes	Yes	Yes
R^2	0.0334	0.0440	0.0278	0.0111	0.0223
N	22,571	18,973	36,668	40,561	10,361

Panel B. Range Volatility

	$0.20 <= price < $0.51	$0.51 <= price < $1.00	$1.00 <= price <= $10.00	$10.00 < price <= $100.00	$175.00 <= price <= $2,500.00
	[1]	[2]	[3]	[4]	[5]
Post	-0.0078	-0.0054	-0.0063	-0.0027	-0.0047
	(-1.09)	(-0.81)	(-1.42)	(-0.68)	(-0.48)
Decrease	-0.0142**	-0.0848***	-0.0879**	0.0085**	0.0092
	(-2.50)	(-4.54)	(-2.57)	(2.11)	(1.03)
Post x Decrease	-0.0111***	-0.0077**	-0.0076**	-0.0103***	-0.0244***
	(-2.74)	(-2.07)	(-2.37)	(-3.17)	(-5.28)
Constant	0.0351**	0.0574***	0.0513**	-0.0785***	0.0303
	(2.45)	(3.29)	(2.12)	(-4.53)	(1.63)
Controls	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes
Stock FE	Yes	Yes	Yes	Yes	Yes
R^2	0.2449	0.2329	0.1821	0.1167	0.2426
N	22,571	18,973	36,668	40,561	10,361