

***OTC Tier Size Analysis***  
***(FINRA Rule 6433)***

**Cornerstone Research**

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## **I. Executive Summary**

1. This report is submitted by Cornerstone Research (“Cornerstone”) to the staff of the Financial Industry Regulatory Authority (“FINRA”). The report summarizes the results of research conducted by Cornerstone pursuant to a contract with FINRA. Cornerstone was selected to perform this research based on Cornerstone’s response to a Request for Proposal (RFP) entitled “OTC Tier Size – SEC Analysis,” issued by FINRA in October 2012.

2. This report was prepared by the staff of Cornerstone under the direction of Dr. Stewart Mayhew of Cornerstone, Dr. D. Timothy McCormick, and Dr. Jeffrey H. Harris of Syracuse University.

3. The research summarized in this report relates to FINRA Rule 6433, which designates a minimum quote size for firm quotes entered by members acting as OTC Market Makers. The minimum quote size in Rule 6433 also determines the minimum size at which price-improving customer limit orders must be reflected in the quote.<sup>1</sup> This minimum quote size varies as a function of the price level, according to a schedule specified in the rule, with higher minimum quote sizes corresponding to lower prices.

4. In particular, the research in this report evaluates the impact of recent amendments to Rule 6433 that modified the minimum quote size schedule.<sup>2</sup> The proposed rule change was first published for comment in the Federal Register on October 20, 2011,<sup>3</sup> and amended proposals were published on April 20, 2012 (“Amendment No. 1”)<sup>4</sup> and June 5, 2012 (“Amendment No. 2”).<sup>5</sup> On June 15, 2012, the Securities and Exchange Commission (“SEC” or “Commission”) approved the proposed rule change, as modified by Amendment No. 1 and No. 2, for a pilot period of one year.<sup>6</sup> The new rule became effective on a pilot basis on November 12, 2012.

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<sup>1</sup> Rule 6460 generally requires that OTC Market Makers fully display better-priced customer limit orders or same-priced customer limit orders that are at the best bid or offer and that increase the OTC Market Maker’s size by more than a *de minimus* amount.

<sup>2</sup> The new amendments also expanded the scope of Rule 6433 to apply to all quotations or orders displayed by alternative trading systems or by non-market makers representing customer trading interest.

<sup>3</sup> See Securities Act Release No. 65568 (October 14, 2011), 76 FR 65307.

<sup>4</sup> See Securities Act Release No. 66819 (April 17, 2012), 77 FR 23770. This amendment No. 1 revised the minimum quote size requirements and proposed the amended Rule operate as a pilot.

<sup>5</sup> See public file SR-FINRA-2011-058.

<sup>6</sup> See SEC Release No. 34-67208; File No. SR-FINRA-2011-058.

5. Prior to the amendment, Rule 6433 specified nine price tiers, with minimum quote sizes ranging from 1 share for the highest price tier to 5,000 shares for the lowest price tier. As amended, the rule specifies six price tiers, with minimum quote sizes ranging from 1 share for the highest price tier to 10,000 shares for the lowest price tier.

6. Table 1 summarizes the definition of the price tiers under the old rule and the amended rule, and how the minimum quote size requirement changed for each price range. The minimum quote size increased for prices below \$0.10, remained unchanged for prices between \$0.10 and \$0.20, decreased for prices between \$0.20 and \$100.00, remained unchanged for prices between \$100.00 and \$175.00, decreased for prices between \$175.00 and \$2,500.00, and remained unchanged for prices higher than \$2,500.00.

7. During the two comment periods, certain market participants expressed a view that the rule would harm market quality in the OTC markets.<sup>7</sup> Among the views expressed by these commenters were the following:

- a. Commenters suggested that FINRA had not shown sufficient economic evidence to support the minimum quotation size requirements and had not demonstrated that the proposed revisions would improve liquidity or lower transaction costs to investors;
- b. Commenters stated that the proposed rule could lead to a reduction in liquidity if it caused market makers to display less depth or stop quoting altogether;
- c. Commenters argued that the immediate effect of the proposal would be less displayed liquidity overall, because the additional liquidity from additional customer orders being displayed would be more than offset by reduced displayed liquidity from market makers—the commenters argued this reduced displayed liquidity would potentially lead to more volatility and increased trading costs.

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<sup>7</sup> See Letter from Daniel Zinn, General Counsel, OTC Markets Group Inc. (OTC Markets) to Elizabeth M. Murphy, Secretary, Commission, dated November 10, 2011 (OTC Markets Letter I); Letter from Michael T. Corrao, Managing Director, Knight Capital Group, Inc. (Knight) to Elizabeth M. Murphy, Secretary, Commission, dated November 16, 2011 (Knight Letter I); Letter from R. Cromwell Coulson, President & CEO, OTC Markets to Craig Lewis and Kathleen Hanley, Commission, dated November 18, 2011 (OTC Markets Letter II); Letter from Daniel Zinn, General Counsel, OTC Markets Group Inc. to Elizabeth M. Murphy, Secretary, Commission, dated December 29, 2011 (OTC Markets Letter III); Letter from Michael T. Corrao, Managing Director, Knight Capital Group, Inc. to Elizabeth M. Murphy, Secretary, Commission, dated January 13, 2012 (Knight Letter II); Letter from Daniel Zinn, General Counsel, OTC Markets Group Inc. to Elizabeth M. Murphy, Secretary, Commission, dated February 14, 2012 (OTC Markets Letter IV); Letter from Daniel Zinn, General Counsel, OTC Markets Group Inc. to Elizabeth M. Murphy, Secretary, Commission, dated May 7, 2012 (OTC Markets Letter V); Letter from Michael T. Corrao, Managing Director, Knight Capital Group, Inc. to Elizabeth M. Murphy, Secretary, Commission, dated May 7, 2012 (Knight Letter III).

8. In Amendment No. 2, FINRA proposed to provide the Commission with data necessary to assess the impact of the revised tier sizes on the OTC equity market, and to provide the Commission with its own assessment of the impact of the pilot.<sup>8</sup> In the approval order, the Commission summarized its expectations<sup>9</sup> regarding FINRA's responsibility to assess the impact of the rule change as follows:

Because of the uncertainty of the actual impact of FINRA's proposal on market maker behavior, however, the Commission believes that it is necessary to conduct a meaningful review of data collected during the pilot period to credibly assess this aspect of the proposed rule change.<sup>10</sup> The Commission notes that, in Amendment No. 2, FINRA committed to provide the Commission with specified data to assist the Commission in its assessment of the impact of the pilot on the OTC market.<sup>11</sup> Further, FINRA committed to provide, at least 60 days before the conclusion of the pilot, its own assessment of the impact of the pilot, addressing the concerns raised by commenters regarding the efficacy of the pilot in achieving its intended effects. Moreover, FINRA committed to revisit the pilot program during its pendency should an analysis of the data show degradation in liquidity and other factors indicating that the revisions to the Rule are having an adverse effect on OTC equity securities. *(Footnotes from original)*

9. This report summarizes the findings of research assessing the impact of Amended Rule 6433 on liquidity in the OTC markets. In particular, this research investigated whether Amended Rule 6433 had a statistically significant impact on various measures of liquidity in OTC traded equities.

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<sup>8</sup> See Federal Register, Vol. 77, No. 120, June 21, 2012, p. 37459.

<sup>9</sup> See Federal Register, Vol. 77, No. 120, June 21, 2012, p. 37468.

<sup>10</sup> With respect to the comment from Knight that the proposed rule change would have an adverse impact on both dealers and investors, the Commission preliminarily believes that the revised proposal, as described in Amendment No. 1, would facilitate the display of additional customer orders while still requiring a reasonable commitment of liquidity from market makers. See Knight Letter I at pp. 1–2.

<sup>11</sup> In Amendment No. 2, FINRA committed to provide the following data to the Commission, on a monthly basis, to allow its staff to evaluate the impact of the pilot: the price of the first trade of each trading day executed at or after 9:30:00 a.m., based on execution time; the price of the last trade of each trading day executed at or before 4:00:00 p.m., based on execution time; daily share volume; daily dollar volume; number of limit orders from customers and in total; percentage of day the size of the BBO (i.e., best bid and offer on FINRA's OTCBB facility and OTC Link) equals minimum quote size; number of market makers actively quoting; number of executions from a limit order and number of limit orders at the BBO or better by tier size from a customer and in total; time-weighted quoted spread; effective spread; time-weighted quoted depth (number of shares) at the inside; and time-weighted quoted depth (dollar value of shares) at the inside.

## **A. Methodology**

10. The question of whether Amended Rule 6433 had an impact on liquidity in the OTC markets was addressed by computing various liquidity metrics for OTC stocks before and after the effective date of the amendments, and examining whether these metrics exhibited a statistically significant change after the rule change went into effect. Further details regarding the data used to conduct this analysis are provided in Section II, below.

11. The liquidity metrics examined included quoted spreads, effective spreads, quoted depth at the best bid and offer (“BBO”), quoted depth within a range of prices surrounding the BBO midpoint, estimates of the price impact for hypothetical market orders of various sizes (assuming execution only against displayed depth), and the percentage of time hypothetical market orders of various sizes could be fully executed. Further details regarding the construction of these metrics are provided in Section III, below.

12. These metrics were computed for the universe of all OTC Link stocks each day, for samples of days before and after the effective date of the amendments.<sup>12</sup> The “Pre-Rule Sample period” included five randomly-selected<sup>13</sup> days each month from November 2011 to October 2012 and the “Post-Rule period” included all trading days from November 12, 2012 to June 30, 2013.

13. Price tiers as defined in the amended rule are referred to in this report as “Tier 1” through “Tier 6,” with Tier 1 corresponding to the lowest price range. For purposes of this study, Tier 5 was subdivided into three categories, designated 5a, 5b, and 5c, corresponding to three different tiers under the old rule. Tier 6, corresponding to prices greater than \$175.00, was not included in this study, due to concern that the number of securities quoted in that tier may not be sufficient to provide reliable statistical evidence.<sup>14</sup>

14. Metrics were averaged over time for each security, separately for the Pre-Rule Sample period and Post-Rule period. Statistical tests were then performed to evaluate whether there was a significant change in the metric between the two samples. These tests were performed separately for each price tier.

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<sup>12</sup> There were only a small number of securities that traded on the OTC Bulletin Board but not on OTC Link. These were excluded from the analysis.

<sup>13</sup> The days to be included in the Pre-Rule Sample period were randomly selected by FINRA.

<sup>14</sup> In particular, Tier 6 was subdivided into five categories, corresponding to the different tiers under the old rule. The number of securities with quote data in the various Tier 6 categories during either period ranged from nine to 52.

15. The metrics described above are based on data relating to displayed liquidity and executed trades. As such, these metrics might not fully capture the extent to which market makers are willing to provide liquidity beyond what is displayed, and might not adequately account for possible changes in order submission strategies under the pilot. To address this, the study examines whether the pilot changed the extent to which the market provides liquidity for larger trades. Data are presented summarizing the average number of trades executed at sizes larger than the minimum depth requirement<sup>15</sup>, separately for the Pre-Rule Sample period and Post-Rule period.

## **B. Results**

16. A decline in the average number of market makers providing quotes on OTC securities was observed on the day Amended Rule 6433 became effective. This appears to have been largely driven by a substantial decrease in the number of OTC securities quoted by certain large market makers. For example, Knight Securities reduced the number of securities covered from approximately 9,400 on November 9, 2012 to approximately 8,400 on November 12, 2012 (the day the rule became effective). Similarly, the number of stocks quoted by vFinance Investments, Inc. decreased from over 4,400 to roughly 1,700 when the rule became effective. As shown in Exhibit 1, these are two of several examples. This initial reduction in the number of market makers was not confined to securities in price ranges where the rule reduced the minimum quote size—there was a substantial reduction in the number of stocks quoted in Tier 1 (under \$0.10), where the rule increased the minimum quote size. The reduction in the number of stocks quoted at the time of the rule change appears to have been only a temporary response to the transition, as the initial reduction was reversed in the following months.

17. Results of the analysis of how the changes to Rule 6433 impacted market quality and liquidity are presented in Section IV, below. These results may be summarized as follows.

18. For stocks priced under \$0.10 where the rule change increased the minimum quote size requirement (Tier 1), some statistically significant changes were observed. In particular,

- a. Effective spreads increased, particularly for trades valued under \$10,000;

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<sup>15</sup> The minimum depth requirement is calculated as the larger of the Pre-Rule Sample period and the Post-Rule period minimum required depth.

- b. No significant reduction in quoted depth at the BBO was observed; however, there was a significant reduction in quoted depth within one percent of the quote midpoint and within two percent of the quote midpoint;
  - c. The price impact of hypothetical market orders declined for buy orders and sell orders of 5,000 and 10,000 shares, but increased for sell orders of 50,000 shares.
19. For stocks in those tiers where the minimum quote size requirement declined (Tiers 3, 4, 5a, 5b), the rule change consistently appears to be associated with narrower quoted spreads, and less displayed depth at the BBO. In particular:
- a. Quoted spreads narrowed significantly for all price tiers from \$0.20 to \$100.00 (Tiers 3, 4, 5a, and 5b);
  - b. Effective spreads for all trades and those trades valued under \$10,000 and trades valued between \$10,000 and \$200,000 decreased for the two price tiers from \$1.00 to \$100.00 (Tiers 5a and 5b);
  - c. Effective spreads for trades valued over \$200,000 increased for securities priced from \$0.20 to \$0.51 and from \$10.00 to \$100.00 (Tiers 3 and 5b);
  - d. Quoted depth at the BBO decreased for all price tiers from \$0.20 to \$100.00 (Tiers 3, 4, 5a, and 5b);
  - e. The reduction of depth at the BBO overstates the reduction of displayed liquidity because quoted spreads narrowed; for stocks priced between \$1.00 and \$100.00 (Tiers 5a and 5b), no significant change was observed in the total depth displayed within constant price bands of one percent, two percent, five percent, and ten percent surrounding the midpoint;
  - f. Liquidity as measured by the price impact of hypothetical market orders increased for all price tiers from \$0.20 to \$100.00 (Tiers 3, 4, 5a, and 5b).
20. For prices between \$0.10 and \$0.20 (Tier 2) and prices between \$100.00 and \$175.00 (Tier 5c), the minimum quote size requirement was not changed. While most of the market quality metrics exhibited no significant changes, some statistically significant changes were observed for these price tiers. In particular:
- a. Quoted spreads narrowed for Tier 2;



- b. Liquidity as measured by the price impact of hypothetical market orders increased for both buy and sell orders in Tier 2, and for sell orders in Tier 5c.

21. Since OTC market makers may be willing to provide liquidity beyond the amount displayed in their quotes (“hidden liquidity”), it is possible that the impact of the rule change on total liquidity may not be fully captured in the measures of displayed depth. Moreover, this study does not address whether order submission strategies might have changed from the Pre-Rule Sample period to the Post-Rule period, and the metrics described above do not account for the possibility that market participants may be submitting fewer large orders under the pilot rule.

22. For these two reasons, as an alternative way to measure the impact of the rule change on liquidity, this study examined whether there were substantive changes in the number of trades executed at sizes larger than the minimum quote requirement after the pilot went into effect. Exhibit 2 provides histograms summarizing the number of trades per stock per day for various ranges of dollar values, with one page for each tier. The exhibit shows that the number of trades executed at sizes exceeding the depth requirement<sup>16</sup> was noticeably larger for Tiers 1, 4, 5a, and 5c, stayed relatively constant for Tiers 2 and 5b, and declined for Tier 3. The preponderance of evidence for this measure suggests that liquidity continues to be provided at levels greater than the minimum required depth and the change in the minimum quote size requirements did not significantly alter the ability to execute larger trades in the OTC market.

23. In summary, the results of this study indicate that the Rule 6433 amendments were associated with declines in displayed depth at the BBO for those tiers where the minimum quote size requirement was reduced, but this decline in displayed liquidity was offset by a narrowing of the BBO spread across all tiers. For stocks priced between \$1.00 and \$100.00 (Tiers 5a and 5b), no evidence was found of a decrease in total displayed depth after controlling for the spread, but evidence was found of an improvement in execution quality (lower effective spreads) for trades valued up to \$200,000. Across tiers, the evidence indicates a decrease in the price impact of hypothetical large market orders executed against displayed depth, but also a decrease in the percentage of the time such orders could be fully executed. On balance, the evidence suggests that the changes in Rule 6433 were beneficial to market quality and liquidity in the OTC equity market, at least with respect to trades sized under \$200,000. This study was not designed to

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<sup>16</sup> Dollar value of depth requirement is calculated as the highest price in a given tier multiplied by the larger of the Pre-Rule Sample period and the Post-Rule period minimum required depth.

measure important aspects of larger trades, such as hidden liquidity or large orders broken up and executed over time. As a result, there are important limitations to the conclusions that can be drawn from the evidence on trades above \$200,000 and more generally on the execution quality for institutional investors.

24. This study was based on quote and trade data; although FINRA does receive order-level data through its Order Audit Trail System (OATS), because not all orders are captured by OATS, such as market making orders and orders received or originated by smaller firms that are exempt from the OATS Rules, it was determined that order level data would not be used in the study. Accordingly, it was not within the scope of this study to assess how the rule might have affected execution quality for institutional-sized orders that were broken up or executed over the course of the day or several days.

## **II. Data Sources**

### **A. OTC Link Quotes and BBO data**

25. OTC Equity Securities may be quoted on the OTC Pink Link and the OTC Bulletin Board. OTC Markets Group Inc., formerly known as Pink OTC Markets Inc., operates OTC Link, an electronic quotation system that displays quotes from broker dealers for many OTC securities. FINRA operates the OTC Bulletin Board, an electronic quotation system that displays real-time quotes, last-sale prices, and volume information for a number of OTC securities. For the analysis in this study, FINRA provided on a monthly basis all published OTC Link quotes and the best bid and best offer (BBO) as calculated by OTC Link.<sup>17</sup> Data were received for five randomly chosen days, as selected by FINRA, for each month November 2011 through October 2012 (prior to the pilot), as reported in Table 2, and for all trading days from November 2012 through June 2013 (during the pilot study).

### **B. ORF Trade Reports**

26. The OTC Reporting Facility (“ORF”) is a service provided by FINRA for the reporting of trades in OTC Equity Securities executed other than on or through an exchange and for

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<sup>17</sup> In order for an OTC equity trading on the Bulletin Board to have a BBO value it must have two market makers quoting the stock. There only needs to be a single market maker for an equity quoted on OTC Pink Link.

dissemination of last sale information. Data were provided for the same set of dates as were provided in the OTC Link quotes and BBO data.

### **C. FINRA Calculated Data**

27. FINRA staff calculated data items #3-8 as outlined in Amendment No. 2. In particular, FINRA provided the following for each stock/date:

- a. Daily share volume;
- b. Daily dollar volume;
- c. Number of limit orders from customers and in total;
- d. Percentage of day the depth at the BBO equals the minimum quote size;
- e. Number of market makers actively quoting; and
- f. Number of executions from a limit order and number of limit orders at the BBO or better by tier size from a customer and in total.

## **III. Study Design and Methodology**

28. This section provides an overview of the empirical design of the study, including the market quality metrics and the empirical specifications used to assess the impact of Amended Rule 6433. Section A describes the metrics used for measuring market quality in the OTC markets, and Section B describes the statistical test methodology.

### **A. Market Quality Metrics**

29. Measures of market quality were calculated using intraday quote data from OTC Link, which contained time series of BBO prices by stock and also individual market maker quotes, and using intraday trade executions reported to the ORF. Metrics were computed for each stock/day.

30. In computing metrics that rely on quotes, quotes were removed prior to the calculation if the market was crossed, if the quoted bid or offer was zero, or if the quoted spread was greater than 90 percent of the offer price.<sup>18</sup>

31. In addition, stock/days were removed from the sample in cases where the bid and/or offer prices used to compute the metric of interest crossed the border between multiple tiers within the day. For example, if bid prices of \$0.19 (Tier 2) and \$0.21 (Tier 3) were observed on the same stock on the same day, any metric relying on the bid price would not be computed for that stock/day.<sup>19</sup>

32. For metrics relying on execution prices, trades were removed if they were executed at a price greater than 150 percent of the prevailing best offer or less than 50 percent of the prevailing best bid.<sup>20</sup> Trades were included if they were within market hours, disseminated to the public, and classified within the ORF database as having a trade status code of (A)-Accepted; locked in; (F)-forced match; (L)-Automatic; (M)-Matched; (R)-Received via an execution system interface; (S)-Automatic locked-in split trade; (T)-Trade reporting only/not for clearing submission; or (G)-One-sided submissions. Cancelled trades, trades without a non-zero price, reversal trades, and “as-of” trades were excluded.

## 1. Time-Weighted Quoted Spread

33. The time-weighted quoted spread refers to the intraday average difference between the best bid and offer prices for a security, as reported by OTC Link. Specifically, each stock’s daily time-weighted quoted spread ( $S$ ) was calculated according to the following formula:

$$S = \frac{1}{\sum_{j \in BBO} T_j} \sum_{j \in BBO} T_j (Offer_j - Bid_j)$$

where  $j$  traces the set of BBO quotes observed during trading hours,  $T_j$  is the amount of time  $BBO_j$  is active, and  $Offer_j$  and  $Bid_j$  are the best offer and bid prices from  $BBO_j$ .

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<sup>18</sup> This requirement was intended to eliminate situations where the best bid or offer was a stub quote. Overall less than 0.05 percent of BBOs were removed.

<sup>19</sup> This allows for cleaner interpretation of the within tier results since any transitions of stocks across tiers are eliminated.

<sup>20</sup> For example, in the exceptional case where the prevailing meaningful quote offer price is less than or equal to \$0.20, the trade is removed from calculation if the trade price is more than 10 cents over the offer or more than 10 cents below the bid.

34. The stock's daily time-weighted quoted spreads were then averaged by stock and price tier over the Pre-Rule Sample and the Post-Rule periods.

## 2. Volume-Weighted Effective Spread

35. The volume-weighted effective spread is a measure of the actual spreads at which transactions occur throughout the trading day for a stock. A stock's daily volume-weighted effective spread (Eff) was calculated according to the following formula:

$$Eff = \frac{1}{TV} \sum_{i \in Tr} V_i |P_i - Mid_t|$$

where TV is the total share volume,  $TV = \sum_{i \in Tr} V_i$ ,  $i$  traces Tr which is the set of trades throughout the day,  $V_i$  is the trade volume of trade  $i$ ,  $P_i$  is the price of trade  $i$ , and  $Mid_t$  is the midpoint of the BBO, as provided by OTC Link, at time  $t$ :

$$Mid_t = \frac{Offer_t + Bid_t}{2}$$

where  $Offer_t$  is the prevailing best offer at time  $t$ , and  $Bid_t$  is the prevailing best bid at time  $t$ , based on the most recent valid BBO at the time of the trade  $i$ .<sup>21</sup>

36. The stock's daily volume-weighted effective spreads were then averaged by stock and price tier over the Pre-Rule Sample and the Post-Rule periods.

## 3. Volume-Weighted Effective Spread by Dollar Trade Size

37. The effective spread measure described above is a value-weighted average of effective spreads across all trades regardless of size. Value-weighted effective spreads were also calculated separately for "Small" trades (defined as trades having a market value less than \$10,000), "Medium" trades (between \$10,000 and \$200,000), and "Large" trades (over \$200,000).<sup>22</sup>

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<sup>21</sup> Quotes are shown to the millisecond, whereas trades are not. For purposes of the calculation it is assumed that all trades took place at the beginning of the second reported as the execution time.

<sup>22</sup> These size categories follow Bessembinder H., and H. Kaufman, "A Comparison of Trade Execution Costs for NYSE and NASDAQ-Listed Stocks," *Journal of Financial and Quantitative Analysis*, 32 (1997), 287-310.

#### **4. Time-Weighted Quoted Depth**

38. The time-weighted quoted depth measures the average number of shares available for market purchase or sale at the quoted BBO for a given stock/day. For each quote throughout the trading day, the quoted depth at the bid and offer were obtained from the OTC Link data. For each stock/day, the sum of the bid plus offer quoted depth was then weighted by the period of time the corresponding quote was active, to compute the time weighted quoted depth metric. The stock/day metrics were then averaged by stock and price tier.

39. Specifically, a stock's daily time-weighted quoted depth sum (D) was calculated as follows:

$$D = \frac{1}{\sum_{j \in BBO} T_j} \sum_{j \in BBO} T_j (OD_j + BD_j)$$

where  $BD_j$  is the quoted depth of the best bid,  $OD_j$  is the quoted depth of the best offer, and all other variables are as defined previously.

40. The stock's daily time-weighted quoted depth sums were then averaged by stock and price tier over the Pre-Rule Sample and the Post-Rule periods.

#### **5. Time-Weighted Quoted Depth around the Midpoint**

41. The time-weighted quoted depth around the midpoint measures the number of shares displayed for market purchase or sale within a set range of prices around the BBO midpoint, aggregated across quotes posted by individual market makers. This metric differs from the depth at the BBO, in that it includes depth across all market makers quoting within a certain distance of the midpoint, not only those quoting at the BBO.

42. Because BBO spreads changed when the rule changed, comparing depth at the BBO before and after the rule change is confounded by the simultaneous change in spreads. The time-weighted quoted depth around the midpoint allows for a more proper comparison by defining a constant range of prices around the midpoint for the Pre-Rule and Post-Rule periods. This metric was calculated for four different ranges, including all quotes within one percent, two percent, five percent, and ten percent of the BBO midpoint.

43. In instances where different market makers were quoting within the specified range, this metric will include more depth than is displayed at the BBO. In cases where the BBO quotes are the only prices quoted within the specified range, this measure will be the same as the depth at the BBO. In cases where no market makers are quoting within the specified range, this measure will be zero.

44. These metrics were computed as follows. Each time a new quote was posted by any market maker, total bid depth within one percent of the midpoint was computed by summing the quote size across bids from all market makers that were bidding at most one percent below the BBO midpoint. Similarly, total offer depth within one percent of the midpoint was computed by summing across all offers at most one percent above the BBO midpoint. Bid depth and offer depth were then added together to compute total depth within one percent of the midpoint. A similar process was used to compute aggregate depth within two percent, five percent, and ten percent of the midpoint.

45. Each of the bid, offer, and aggregate quoted depth measures was then weighted by the period of time the current set of quotes was active—that is, by the amount of time between the quote update that triggered the calculation and the subsequent quote update.

46. Specifically, a stock's daily time-weighted quoted depth below the midpoint (WBM), time-weighted quoted depth above the midpoint (WAM), and time-weighted quoted depth around the midpoint (DM) were calculated using the following formulas:

$$WBM = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j (BD_j)$$

where  $BD_j$  is the sum of all market makers' quoted bid depths within a given level below the midpoint and  $MMquote$  is defined as each time a new quote was posted by any market maker;

$$WAM = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j (OD_j)$$

where  $OD_j$  is the sum of all market makers' quoted offer depths within a given level above the midpoint; and

$$DM = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j (OD_j + BD_j)$$

where all other variables are as defined previously.

47. The stock's daily WBM, WAM, and DM were then each averaged by stock and price tier. Holding all else constant, a smaller total quote depth around the midpoint is consistent with a lower level of liquidity or higher transaction costs.

## **6. Price Impact of Hypothetical Large Market Orders**

48. The price impact of hypothetical market orders is the effective half spread for a hypothetical market "sweep" order of a particular size. In other words, it is an estimate of what the volume-weighted average effective half spread would have been had a market order been broken up and routed to the market makers based on price priority. The price impact of the hypothetical trade was calculated using all market makers' displayed bids and offers.

49. For example, if the midpoint of the BBO is \$15.00, the best quoted offer price is 300 shares at \$15.10, and the next best quoted offer is 500 shares at \$15.20, a hypothetical buy order for 400 shares would be assumed to be executed 300 shares at \$15.10 and 100 shares at \$15.20. Three quarters of the order would have been filled \$0.10 above the midpoint, and one quarter of the order would have been filled \$0.20 above the midpoint. The weighted average price impact would have been \$0.125.<sup>23</sup>

50. This price impact metric was calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. Specifically, the metric was calculated for order sizes equal to one times, two times, five times, and ten times the minimum quote size under the pilot rule, for the corresponding tier.<sup>24</sup> If there was not enough depth in the market at that particular time to execute the entire order, the observation was classified as unexecutable.

51. To avoid the possibility that the hypothetical orders might be executed against quotes that were clearly stub quotes, hypothetical orders were assumed to be executed only against market maker quotes priced within 45 percent of the calculated BBO midpoint. Each of the bid (sell) and offer (buy) price impact measures was then weighted by the period of time the

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<sup>23</sup> When calculating the weighted average price impact for the bid side, the absolute value is taken.

<sup>24</sup> For example, the minimum quote size for Tier 1 under the old rule was 5,000 shares. For this tier, therefore, the price impact measure was computed for hypothetical market orders of 5,000 shares, 10,000 shares, 25,000 shares, and 50,000 shares.



corresponding market maker quotes were active to compute the time-weighted price impact metrics.

52. Specifically, a stock's daily time-weighted price impact at the bid (TWPIB) and time-weighted price impact at the offer (TWPIO) were calculated according to the following formula:

$$PIB = \sum_{j \in MMquote} \sum_{i \in MT} \frac{[Tr_i(PB_i - Mid_t)]}{MT}$$

where  $PB_i$  is the bid price of the shares executed,  $Tr_i$  is the quantity executed, and  $MT$  is the trade size.

$$TWPIB = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j (PIB_j)$$

where all variables are as defined previously.

$$PIO = \sum_{j \in MMquote} \sum_{i \in MT} \frac{[Tr_i(PO_i - Mid_t)]}{MT}$$

where  $PO_i$  is the offer price of the shares executed,  $Tr_i$  is the quantity executed, and  $MT$  is the trade size.

$$TWPIO = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j (PIO_j)$$

where all variables are as defined previously.

53. The stock's daily TWPIB and TWPIO were then each averaged by stock and price tier. Holding all else constant, a smaller hypothetical trade price impact is consistent with a higher level of liquidity or lower transaction costs.

## 7. Executability of Hypothetical Large Market Orders

54. The executability of hypothetical large market buy and sell orders is an estimate of what portion of the day a hypothetical market order of a given size could have been fully executed against displayed quotes.

55. Similar to the price impact metric described above in A.6, this hypothetical depth metric was calculated for various set sizes of hypothetical buy and sell orders, constituting fixed

multiples of the minimum required depth size for the corresponding tier. If there was not enough depth in the market at that particular time to execute the entire order, the observation was classified as unexecutable.

56. A stock's daily percentage of time executed for buy orders (PEB) and percentage of time executed for buy orders (PEO) were calculated according to the following formula:

$$PEB = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j(MDO_j)$$

where  $MDO_j$  sum of all market makers' quoted offer depths. If  $MDO_j$  is greater than or equal to order size then  $MDO_j = 1$ ; otherwise  $MDO_j = 0$ . All variables are as defined previously.

$$PEO = \frac{1}{\sum_{j \in MMquote} T_j} \sum_{j \in MMquote} T_j(MDB_j)$$

where  $MDB_j$  sum of all market makers' quoted offer depths. If  $MDB_j$  is greater than or equal to order size then  $MDB_j = 1$ ; otherwise  $MDB_j = 0$ . All variables are as defined previously.

57. The stock's daily PEB and PEO were then each averaged by stock and price tier. Holding all else constant, a smaller percentage of time executable is consistent with a lower level of liquidity.

## B. Statistical Test Methodology

58. This study utilized t-tests to address whether there were significant changes in the market quality metrics when the rule went into effect. The t-test is a commonly used methodology for determining whether there was a statistically significant difference in the average level of a variable between two samples. In this report, a t-test was used to test whether any observed changes in the average market quality metrics described in the previous section changed significantly after the rule was changed.

59. A t-statistic takes into account the variance in the sample that occurs within each period and is calculated separately for each metric as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Where,

$\bar{x}_1$  = the average metric across securities for the Post-Rule period;

$\bar{x}_2$  = the average metric across securities for the Pre-Rule Sample period;

$s_1^2$  = the variance of the average metrics across securities for the Post-Rule period;

$s_2^2$  = the variance of the average metrics across securities for the Pre-Rule Sample period;

$n_1$  = the number of securities in the Post-Rule period; and

$n_2$  = the number of securities in the Pre-Rule Sample period.

60. The tables in this report provide the “p-values” corresponding to the t-tests. The p-value represents the likelihood of observing a difference at least as large as that observed in the test, under the null hypothesis that the true difference is zero and the standard assumptions of the t-test hold. For example, if a particular difference has a p-value of 0.07, this indicates that there would be only a seven percent chance of observing such a difference if the true difference were zero.

61. Under the commonly applied 95 percent confidence level for statistical significance, a p-value lower than 0.05 is grounds for rejecting the null hypothesis that the true difference is zero. Under the more stringent 99 percent confidence level, a p-value lower than 0.01 is grounds for rejecting the null hypothesis. In this study, both the 95 percent and 99 percent confidence levels are applied for testing statistical significance.

## **IV. Analysis and Results**

### **A. Characteristics of Sample Period**

62. The research described in this study is based on data from November 2011 through June 2013. For the most part, this has been a relatively calm period for equity markets, during which

prices have generally increased and volatility decreased for U.S. equities in general and for small stocks specifically.

63. Exhibit 3 shows the evolution of the Wilshire 5000, Russell 2000, Russell Microcap, MSCI US Microcap, and Dow Jones Select Microcap indices over this period. Exhibit 4 shows the evolution of the CBOE SPX Volatility Index (VIX) and the Russell Small Cap Volatility Index (RVX) over the period.

## **B. Summary Statistics**

64. During the study period, approximately 10,000 OTC stocks were quoted on the OTC Pink Link. As shown in Exhibit 5, the number of stocks on OTC Pink Link remained relatively constant from November 2011 through June 2013. The number of securities quoted on the OTC Bulletin Board represented only a small percentage of all OTC stocks, and this percentage declined significantly during the Pre-Rule Sample period. As shown in Exhibit 6, the number of stocks quoted on OTC Pink Link within each price tier was relatively constant over time.

65. The number of trades per day during the study period typically ranged from about 60,000 to 100,000. As shown in Exhibit 7, the number of trades in the Pre-Rule Sample period was roughly 80,000 per day over the first half of the Pre-Rule Sample period and roughly 60,000 per day over the second half; however, during the Post-Rule period the number of trades per day trended back toward the levels of the first half of the Pre-Rule Sample period.

66. The number of BBOs per day during the Pre-Rule Sample period and Post-Rule period differed. As shown in Exhibit 8, the BBO quotes entered generally ranged between 2 and 3 million per day during the Pre-Rule Sample period, and steadily increased to 6 million per day towards the end of the Post-Rule period.<sup>25</sup>

67. Exhibits 9A through 9E show graphs summarizing the time series of some of the data items requested by the Commission in connection with the pilot. Exhibit 9A shows the percentage of the day that the total size at the best offer is equal to the minimum quote size, averaged across all securities with prices under \$175.00 (Tiers 1-5c). Exhibit 9B shows the same

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<sup>25</sup> This chart includes potential stub and flickering quotes. Flickering quotes occur when a given market maker places several differing BBO values or depths within seconds. Stub quotes occur when a market maker enters a quote a price that is far away from the market and designed to not be executed, such as a bid quote of one penny on a stock that otherwise trades near ten dollars.

metric for the best bid. Charts breaking down these metrics by price tier are provided in the supplemental appendix (Exhibit 10).

68. Exhibit 9C shows the time series of the total number of limit orders at the BBO or better. Exhibit 9D shows the time series of the total number of limit orders, and Exhibit 9E shows the total number of limit orders executed. Charts breaking down these metrics by price tier are provided in the supplemental appendix (Exhibit 10).

## **C. Main Results**

### **1. Overview**

69. Table 3 summarizes the main results of the market quality analysis. In this table, each column corresponds to a different price tier in Rule 6433, and each row corresponds to a different market quality metric. The entries in the table indicate the outcome of the t-test. A single “up” arrow indicates that the Rule 6433 pilot was associated with an increase in the metric that was statistically significant at the 95 percent confidence level. Two “up” arrows indicates a statistically significant increase at the 99 percent confidence level. Likewise, one or two “down” arrows indicates statistically significant declines at the 95 percent and 99 percent level, respectively. A blank indicates that the test showed no statistically significant change.

70. For example, in the row labeled “time-weighted quoted spread,” the second column, corresponding to Tier 2, contains one “down” arrow. This means that the t-test indicated a decrease in quoted spreads for Tier 2 stocks after the pilot rule became effective, and this result is significant at the 95 percent confidence level. For each metric summarized in Table 3, further details of the underlying statistical test are provided in separate tables, described below.

### **2. Time-Weighted Quoted Spreads**

71. Table 4 provides summary statistics for an analysis of time-weighted quoted spreads before and after the implementation of the Rule 6433 pilot. Each row in Table 4 corresponds to a different range of prices, corresponding to the different tiers as defined by the rule. The first

two columns in this table indicate the tier and whether Amended Rule 6433 increased, maintained, or decreased the minimum quote size requirement.

72. Columns three through five of Table 4 report the number of unique stocks included in the Pre-Rule Sample period, and the mean and median time-weighted quoted spread across stocks in the Pre-Rule Sample period. Columns six through eight report the same statistics for the Post-Rule period.

73. Columns nine and ten report the results of the statistical test evaluating whether the amended rule impacted the time-weighted quoted spread. The table reports the t-statistic and the corresponding p-value for the t-test of whether there was a change in the average spread when the rule went into effect. Negative t-statistics (in parentheses) correspond to decreases in the spread.

74. To illustrate, the fourth row of Table 4 corresponds to Tier 4 for which Rule 6433 decreased the minimum quote size from 2,500 shares to 1,000 shares. As the table indicates, there were 953 unique stocks during the Pre-Rule Sample period. The mean time-weighted quoted spread across these stock dates in the Pre-Rule Sample period was 0.0961, and the median was 0.0659. Over the Post-Rule period, there were 918 unique stocks, the mean time-weighted quoted spread was 0.0847 and the median was 0.0540. The t-test indicated a statistically significant decrease in quoted spreads for Tier 4 stocks when the rule went into effect, at the 99 percent confidence level.

75. As indicated by the other rows in Table 4, the t-test results showed statistically significant decreases in time-weighted quoted spreads for Tier 2 through Tier 5b (that is, for all price levels from \$0.10 to \$100.00). This result was statistically significant at the 99 percent confidence level for all tiers except Tier 2, which was significant at only the 95 percent confidence level. These results are summarized by the first row of “up” and “down” arrows in Table 3.

76. While the tables described above provide information about the *statistical* significance of the changes in quoted spreads when the rule went into effect, they do not contain provide much intuition about the *economic* significance of these changes, or the precise timing of when the changes occurred. A more complete picture of the evolution of time-weighted quoted spread measures is provided in a series of graphs in the supplemental appendix (see Exhibit 11). Each of these graphs corresponds to a particular tier, and shows how the average quoted spread

evolved from November 2011 through June 2013. On each graph, the horizontal axis represents time and the vertical axis represents the average time-weighted quoted spread across all stocks that were in that tier on that day. The time series represented by lines on the bottom of the graph indicate the number of stock observations per day.

### **3. Volume-Weighted Effective Spreads**

77. Table 5, page 1 summarizes the results of tests based on volume-weighted effective spreads. The format of the table is identical to that of Table 4. As the table indicates, the t-test provides evidence that the rule was associated with statistically significant declines in effective spreads for Tier 5a and Tier 5b (that is, prices from \$1.00 to \$100.00) and a statistically significant increase in effective spreads for Tier 1.

78. Table 5, pages 2 – 4 report the results of tests of how the rule impacted effective spreads on small trades (under \$10,000), medium trades (\$10,000 to \$200,000) and large trades (over \$200,000). The evidence in these tables indicates the same statistically significant reduction in effective spreads for small trades as were in all trades (namely Tier 5a and Tier 5b). For medium trades the t-test provides evidence that the rule was associated with statistically significant declines in effective spreads for Tier 5a and Tier 5b (prices from \$1.00 to \$100.00). For large trades there is evidence that the effective spreads significantly increased for Tiers 3 and 5b. In summary, the evidence suggests that the rule change was associated with either no change or a decrease in effective spreads for trades valued up to \$200,000 for those categories of stocks where the minimum required depth declined.

79. Exhibit 11 in the supplemental appendix provides additional detail on the time series of effective spreads for each tier, in general and separately for small, medium, and large trades.

### **4. Time-Weighted Quoted Depth at the BBO**

80. Table 6 reports the results of t-tests for changes in quoted depth. As the table indicates quoted depth at the BBO declined significantly for every price range from Tier 3 through Tier 5b (all prices from \$0.20 to \$100.00).

81. Exhibit 11 in the supplemental appendix provides additional detail on the time series of quoted depth, showing how quoted depth evolved for each tier over time. As expected (given the

fact that quoted spreads narrowed significantly), these graphs demonstrate that many of the tiers experienced immediate, dramatic decreases in quoted depth at the BBO when the rule went into effect.

## **5. Time-Weighted Depth around the Midpoint**

82. Table 7 reports the results of t-tests examining changes in aggregate quoted depth within set ranges of prices surrounding the BBO midpoint. The first panel shows the impact of the rule on total quoted depth within one percent on either side of the midpoint, and the second, third, and fourth panels shows the impact on quoted depth within two percent, five percent, and ten percent of the midpoint, respectively.

83. The results in Table 7 indicate that the evidence of a decline in depth associated with the rule change is weaker than suggested by Table 6. Where the tests based on quoted depth at the BBO reported in Table 6 indicated economically large and statistically significant declines in depth for all price ranges from Tier 3 through Tier 5b, Table 7 shows that after controlling for the spread, the declines in displayed depth were smaller and generally not statistically significant for Tiers 5a or 5b.

84. For Tiers 3 and 4 (prices between \$0.20 and \$1.00), the tests reported in Table 7 indicate a statistically significant decrease in quoted depth within the majority of the bands around the quote midpoint. While the declines are not as large in percentage terms as indicated in Table 6, the evidence is consistent with significant reductions in total displayed depth for stocks in this price range.

85. Exhibit 11 in the supplemental appendix provides additional detail on the time series of quoted depth within set ranges of prices surrounding the BBO midpoint.

## **6. Price Impact for Hypothetical Large Market Orders**

86. Table 8 reports the results of t-tests based on price impact measures. As described above, these price impact measures are alternative metrics of total liquidity that measure what the effective spread would have been for hypothetical market orders of various sizes. Unlike the depth around the midpoint metrics, which give equal importance to all quotes that fall within the



stated price range, the price impact metrics produce a more favorable number in instances where more of the quoted depth is at a better price.

87. The first four panels of the table report estimates of the price impact for sell orders with sizes of one times, two times, five times, and ten times the minimum quote size. These tests indicate that there was a statistically significant reduction in price impact (improvement in liquidity) at the bid for most trade sizes across all tiers. The only exceptions were for the largest (10X) trades in Tier 1, where there was a statistically significant increase in the price impact measure, and for 5X trades in Tier 1 and 10X trades in Tier 2, where there no statistically significant change at the 95 percent confidence level.

88. The second four panels in Table 8 report the corresponding statistics for the price impact of buy orders, a measure of liquidity on the offer side. Similar to the evidence on the bid side, these tests consistently indicate decreases in price impact (increases in liquidity) at the offer for those tiers where the minimum quote size declined. Estimates of price impact declined for all trade sizes in Tiers 2 through 5a (prices between \$0.10 and \$10.00), and for the smaller trade sizes in Tier 5b (prices between \$10.00 and \$100.00). No significant change in price impact was observed for the larger trades sizes (5X or 10X trades) in Tier 5b. In addition, statistically significant declines were observed for smaller trades in Tier 1 (prices below \$0.10).

89. Exhibit 11 in the supplemental appendix provides additional detail on the time series of price impact for hypothetical large market orders at both the bid and the offer.

## **7. Executability of Hypothetical Large Market Orders**

90. Table 9 reports the results of t-tests based on the executability of hypothetical large market orders. As described above, these percentages measure the percentage of time when the total displayed depth was sufficient to execute hypothetical market “sweep” orders of various sizes.

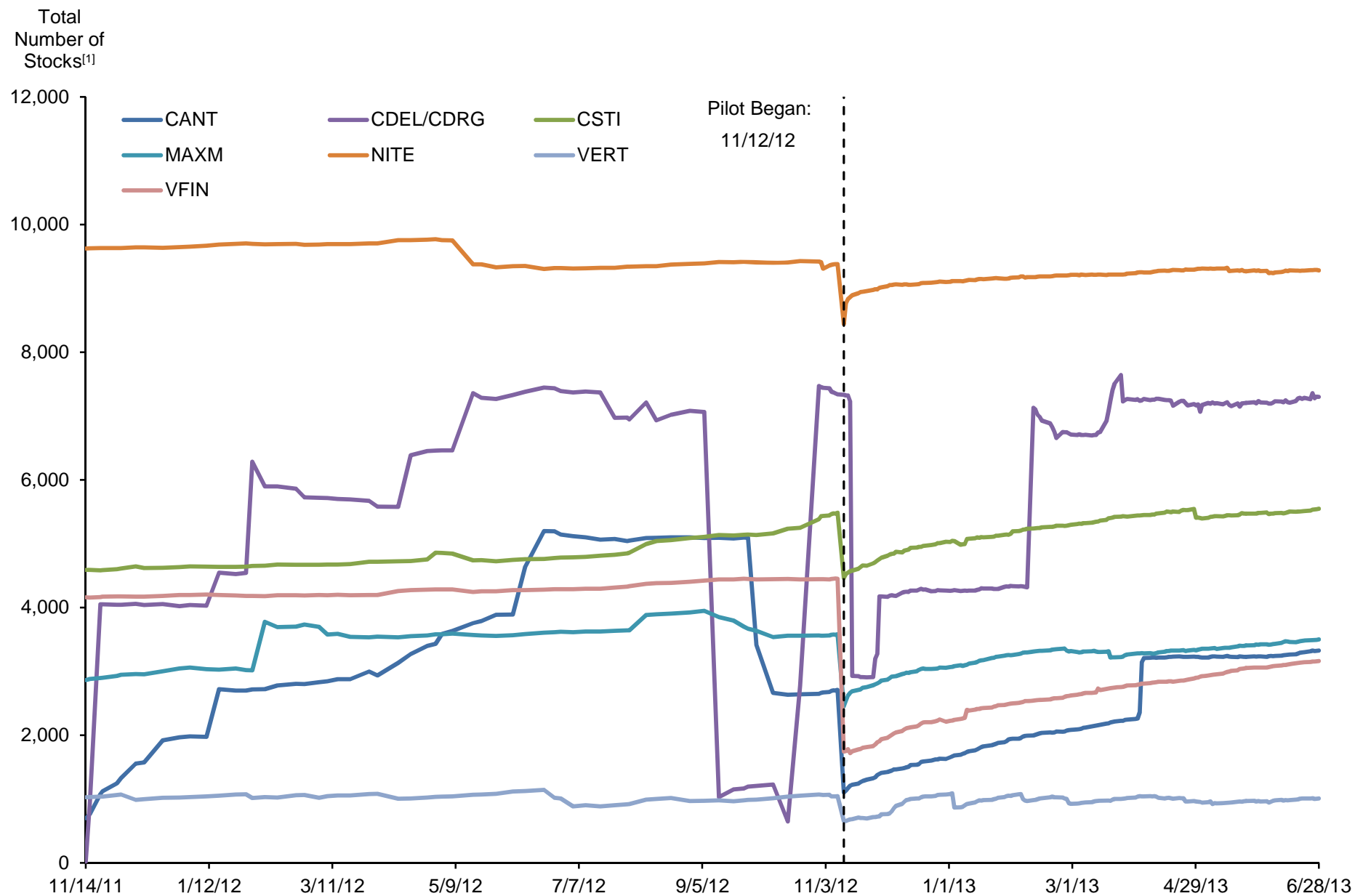
91. The first four panels of the table report estimates of the percentage of time hypothetical market sell orders of various sizes would have been fully executable against displayed depth. These tests indicate that there was a statistically significant reduction in the executability of hypothetical large market orders on the bid side for most trade sizes in Tiers 4 through 5b (prices between \$0.51 and \$100.00). The only exceptions were for the smallest trades in Tiers 4 and 5a,

where there was a statistically significant increase the executability of hypothetical large market orders on the bid side. For these tiers there was also a statistically significant decrease in the price impact measure described above. For Tiers 1 and 2, there were statistically significant increases in the executability of hypothetical large market sell orders in all but the smallest trade size.

92. The second four panels in Table 9 report the corresponding statistics for the percentages of time hypothetical buy orders would be able to be executed using displayed depth, a measure of liquidity on the offer side. These tests indicate a statistically significant reduction in the executability of hypothetical large market orders at the offer for Tiers 3 through 5b (prices between \$0.20 and \$100.00). The only exceptions were for the smallest trades in Tiers 3, 4, and 5a, where there was a statistically significant increase the executability of hypothetical large market orders on the offer side. For these tiers there was also a statistically significant decrease in the price impact measure described above. For Tiers 1 and 2, there were statistically significant increases in the executability of hypothetical large market buy orders in at least half of the trade sizes.

93. Exhibit 11 in the supplemental appendix provides additional detail on the time series of the executability of hypothetical large market orders at both the bid and the offer.

# Selected OTC Market Makers Quoting More than 1000 Stocks 11/14/11 – 6/28/13



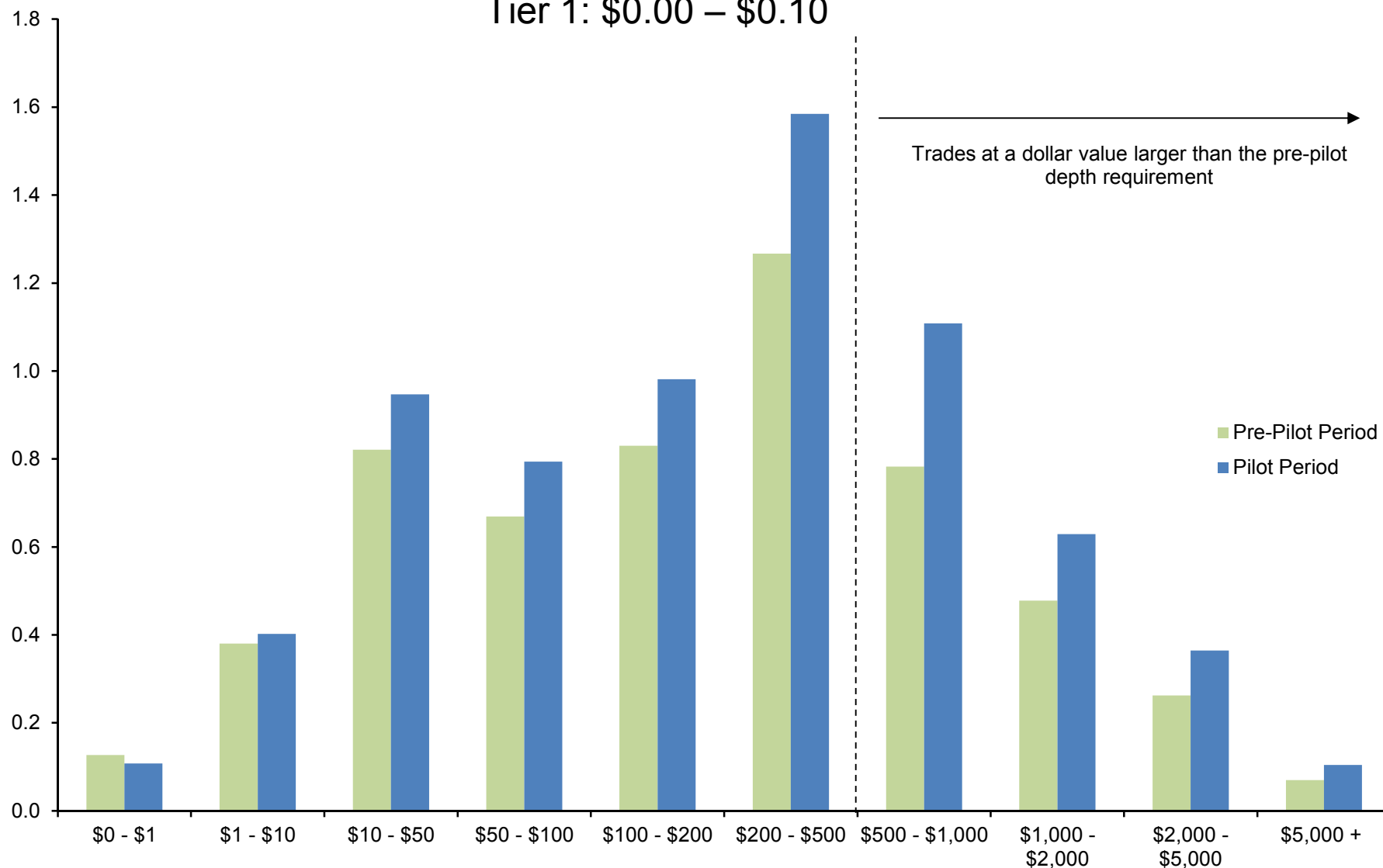
Note:

[1] Total number of stocks is calculated daily by summing the number of stocks each market maker provides a one-sided or two-sided quote.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13  
Tier 1: \$0.00 – \$0.10

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

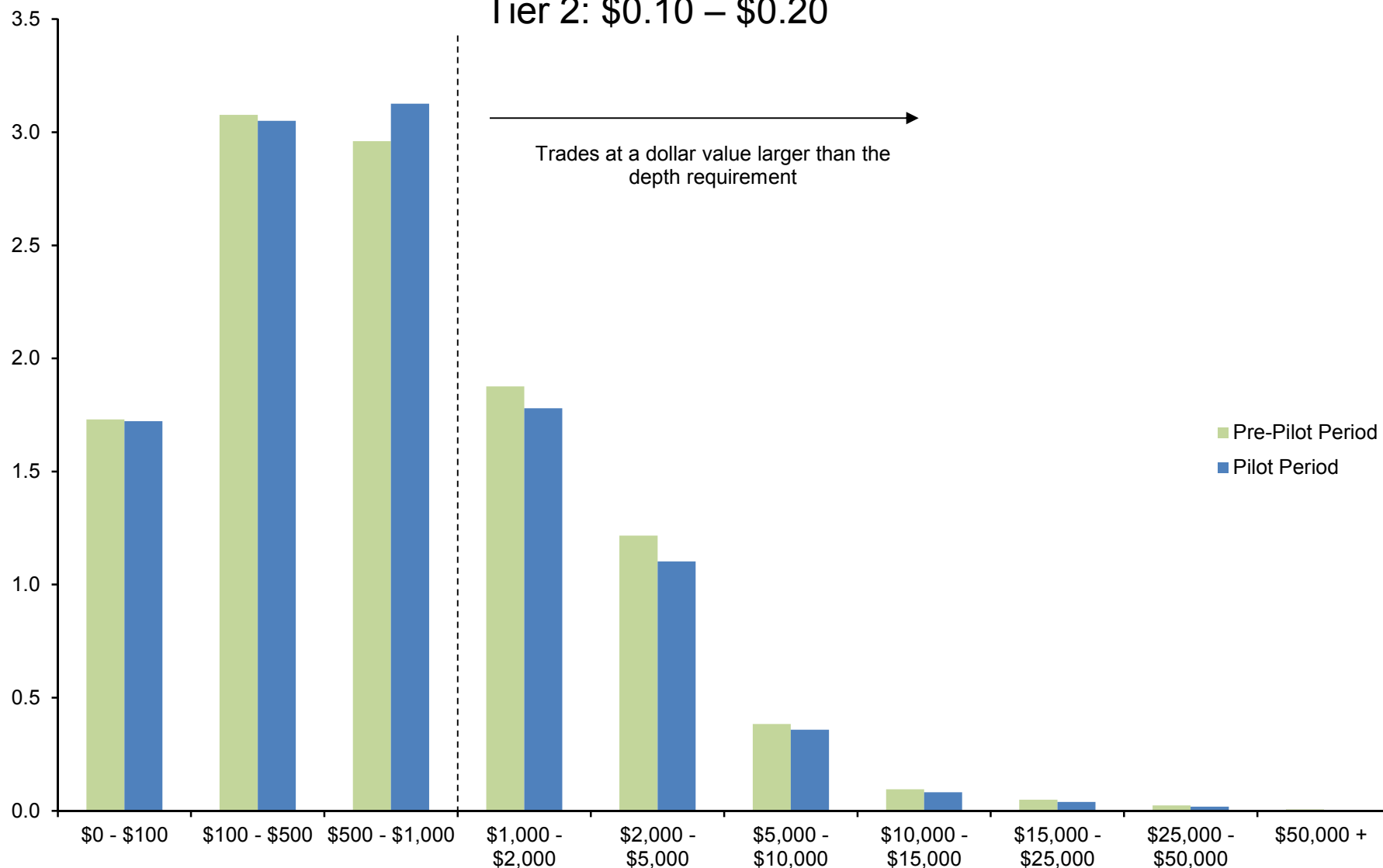
[2] For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13  
Tier 2: \$0.10 – \$0.20

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

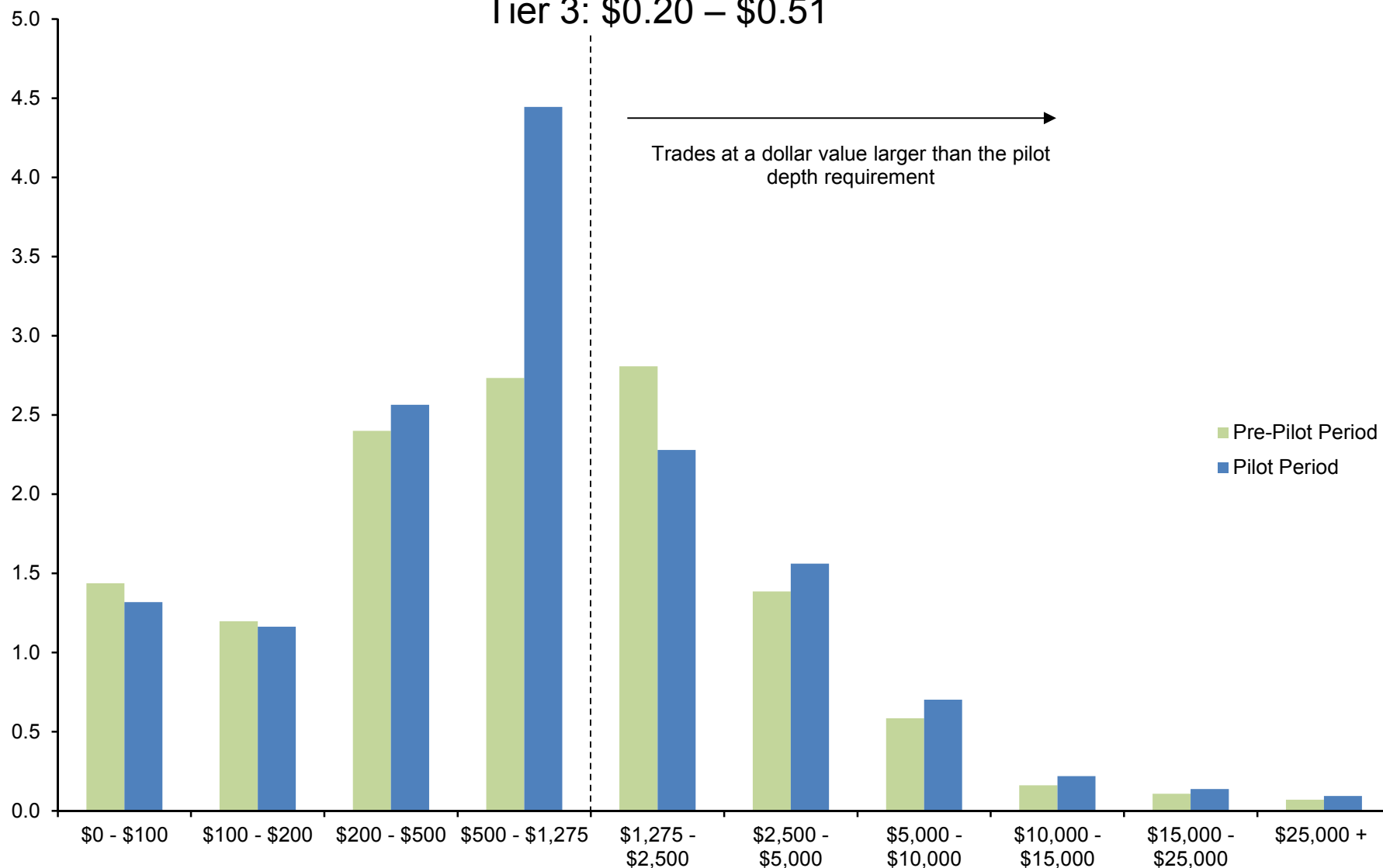
[2] For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirement of 5,000 shares.

[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13  
Tier 3: \$0.20 – \$0.51

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

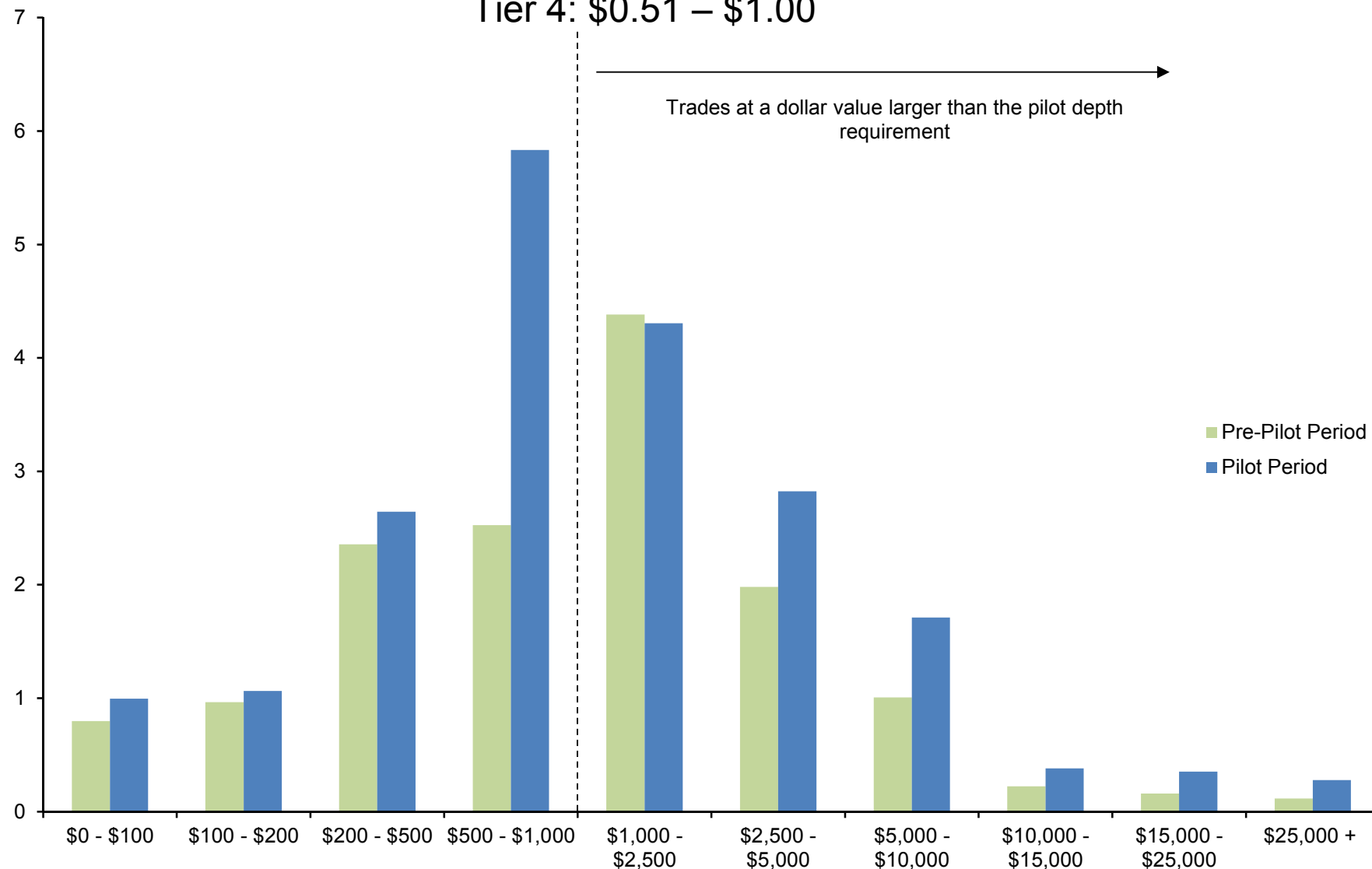
[2] For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13  
Tier 4: \$0.51 – \$1.00

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

[2] For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

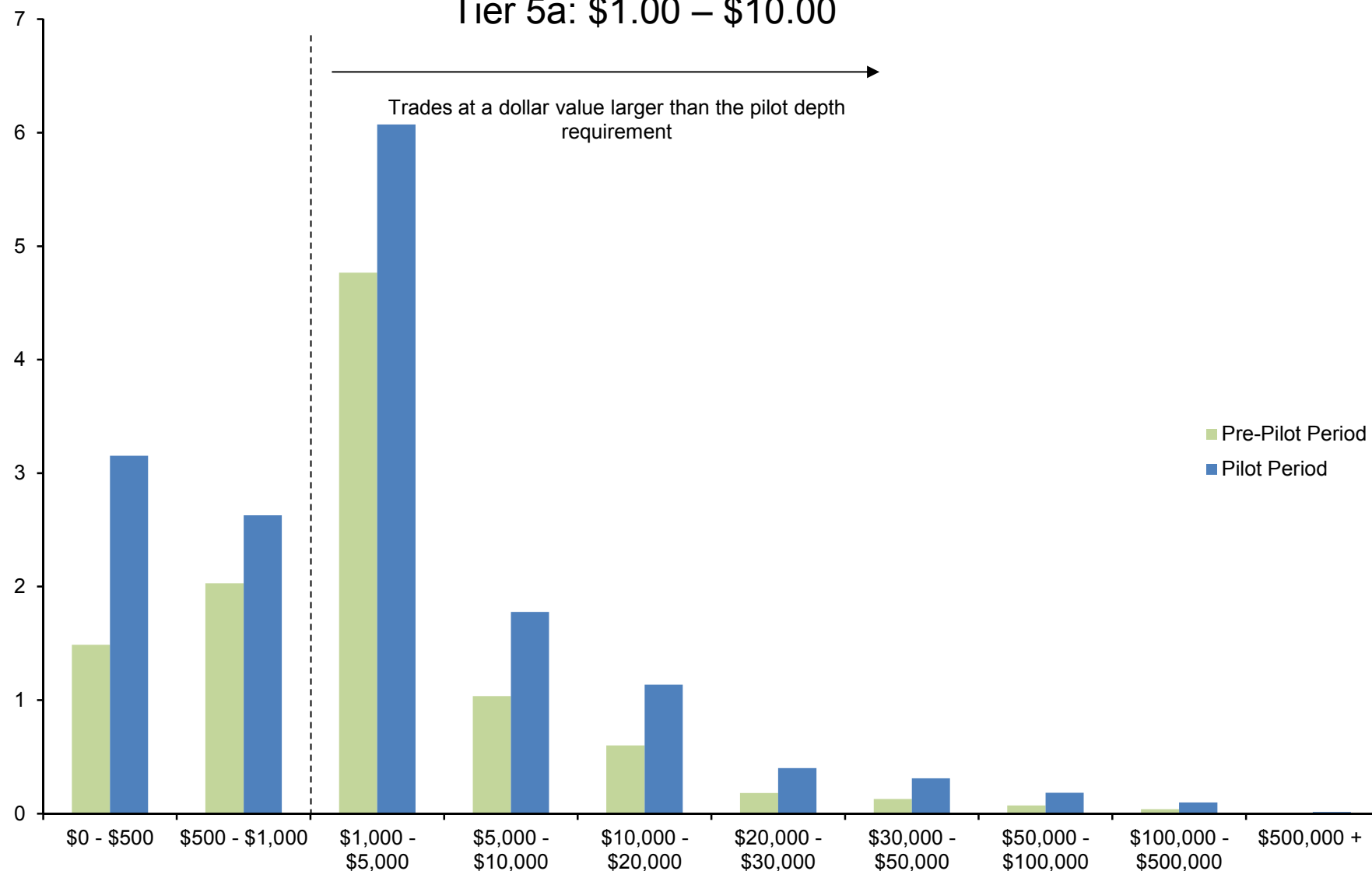
[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13

Tier 5a: \$1.00 – \$10.00

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

[2] For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.

[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

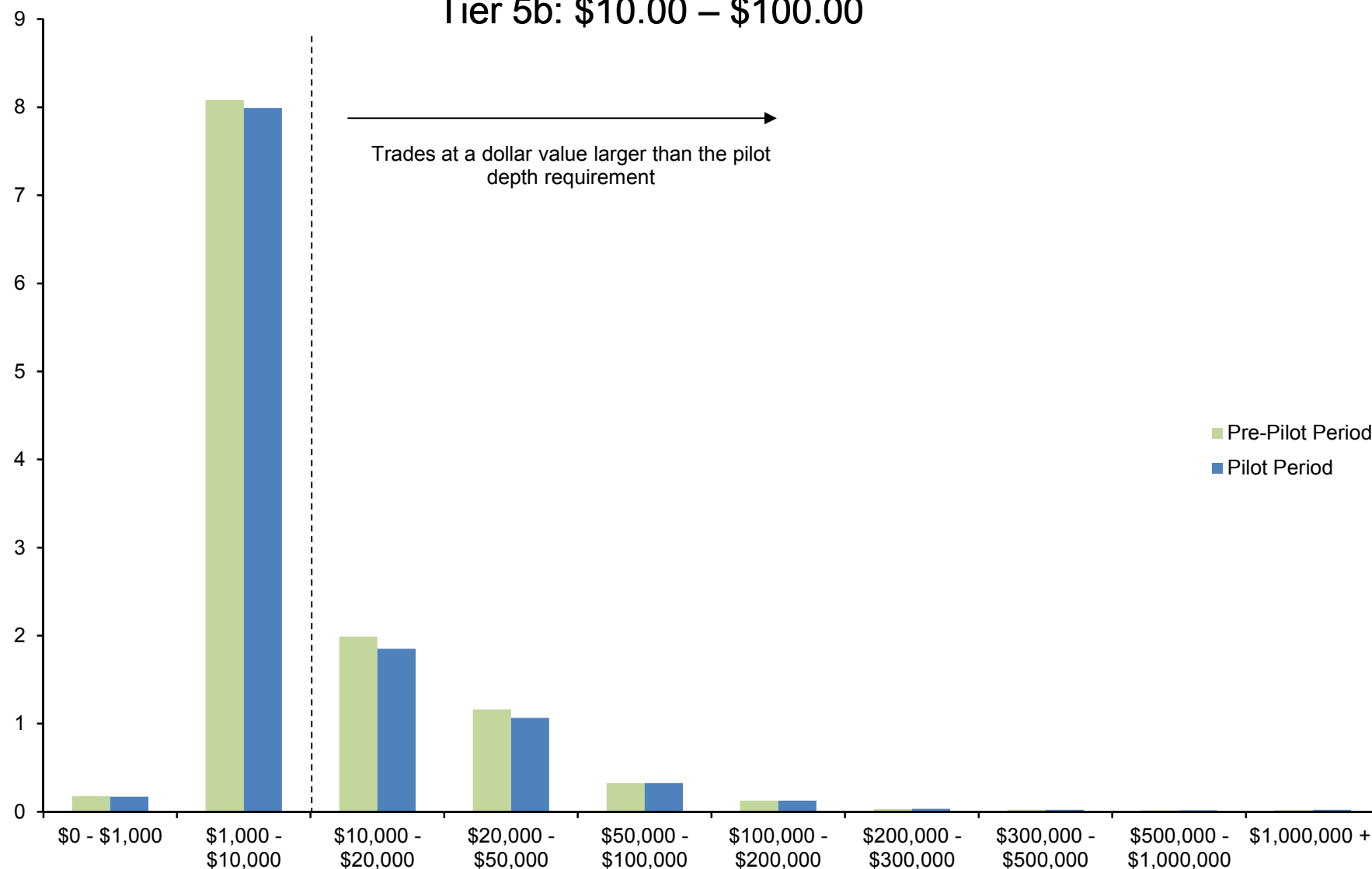


# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13

Tier 5b: \$10.00 – \$100.00

Average Number of  
Trades per Stock/Day



Source: OTC Link

Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

[2] For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.

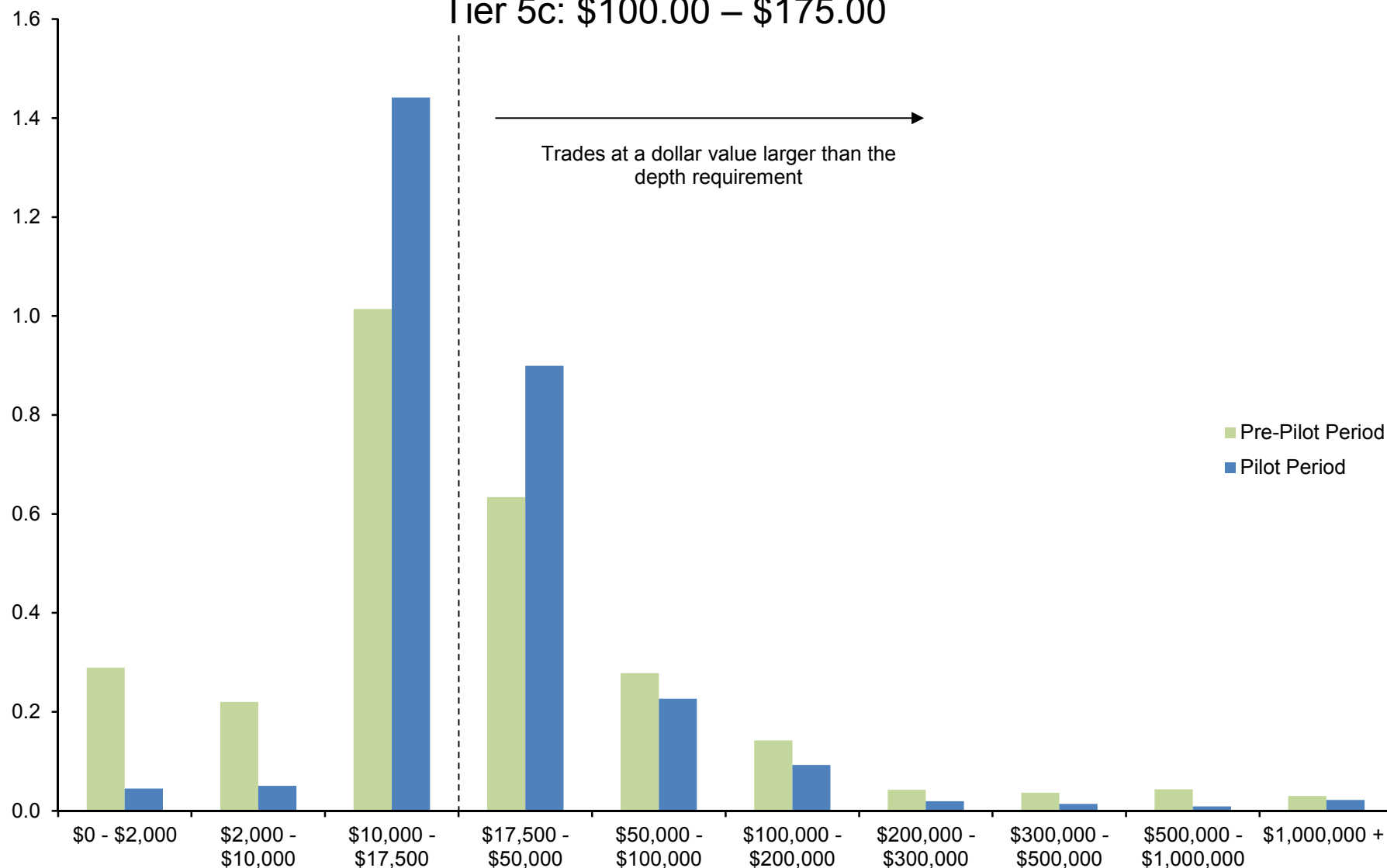
[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# Average Trades per Stock/Day by Dollar Volume

11/14/11 – 6/28/13

Tier 5c: \$100.00 – \$175.00

Average Number of  
Trades per Stock/Day



Source: OTC Link

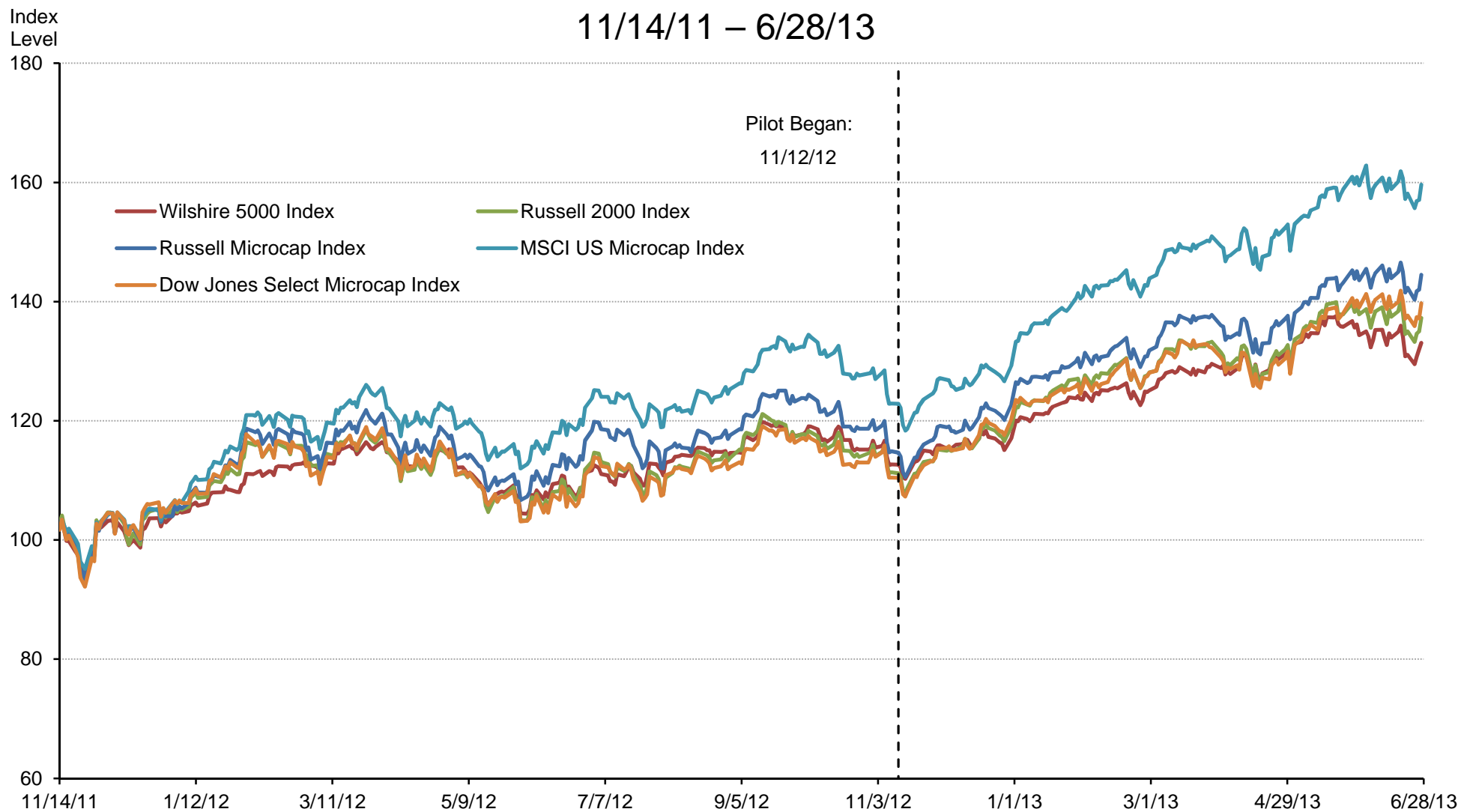
Note:

[1] A stock/day is day for a given stock where the quote data does not span a tier.

[2] For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirement of 100 shares.

[3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

## Selected Index Movements 11/14/11 – 6/28/13

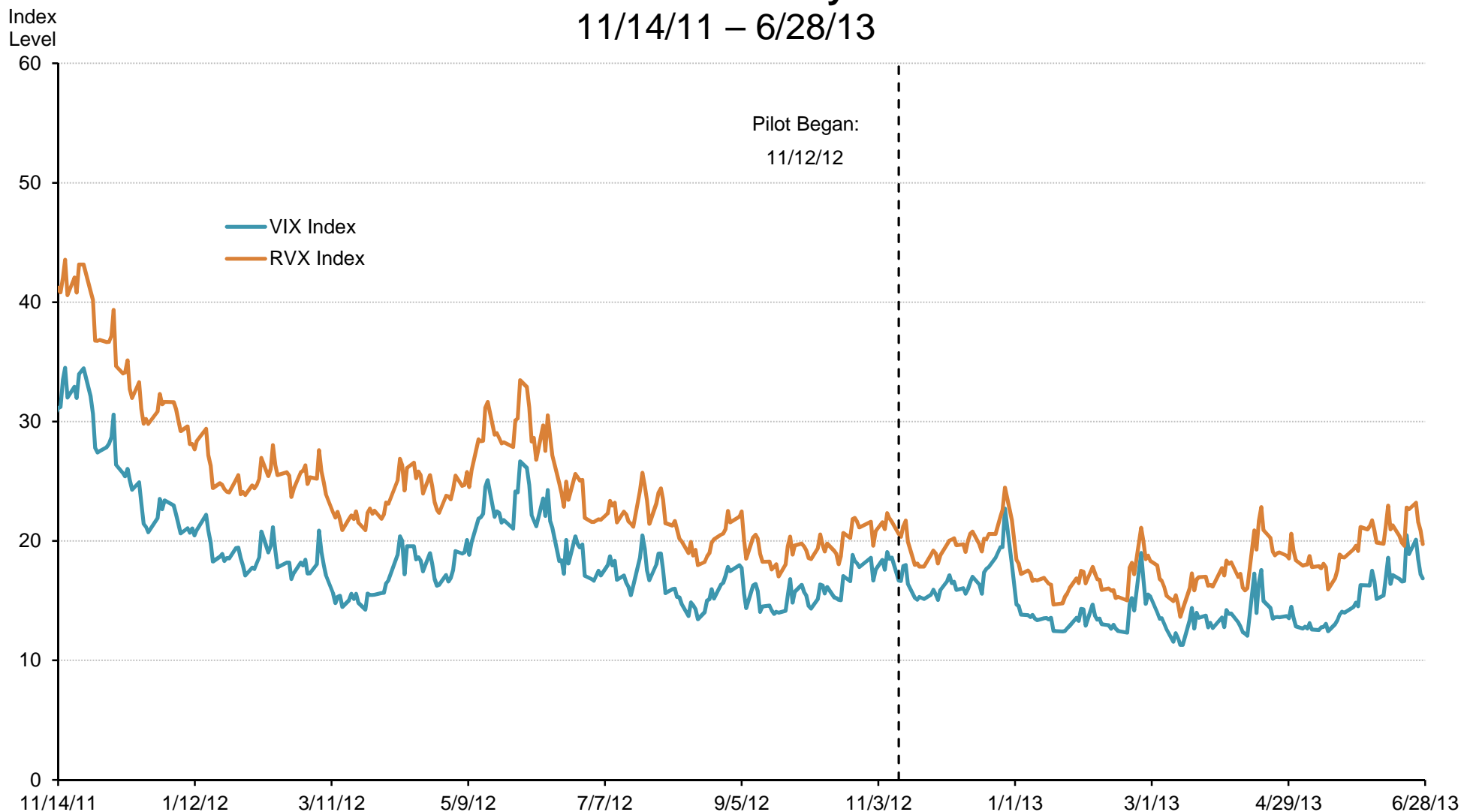


Source: Bloomberg

Note: The indices are scaled down by a constant deflator. The deflator is chosen for each index such that the index price on 11/1/11 is 100.

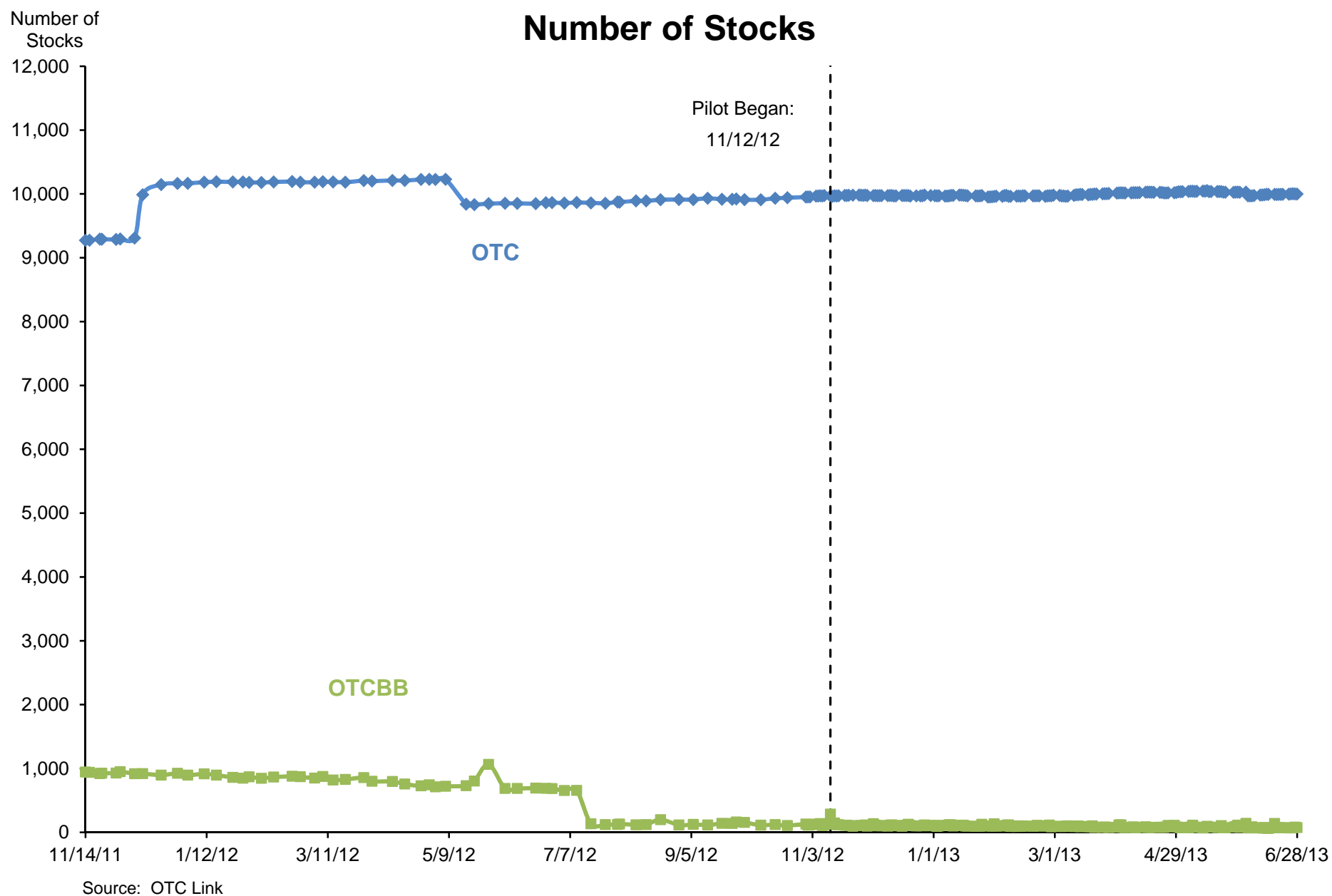
## VIX and RVX Volatility Indices

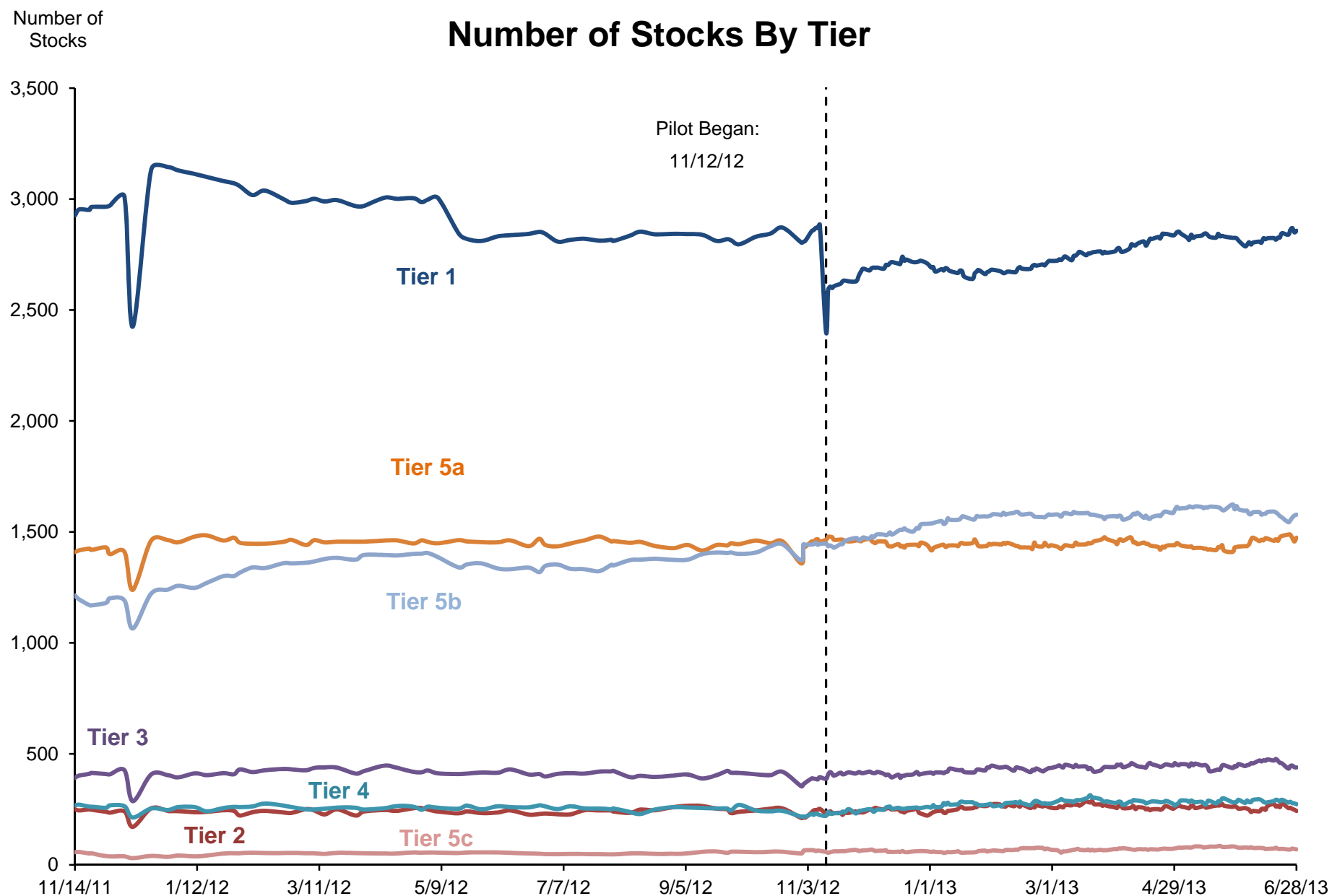
11/14/11 – 6/28/13



Source: Bloomberg

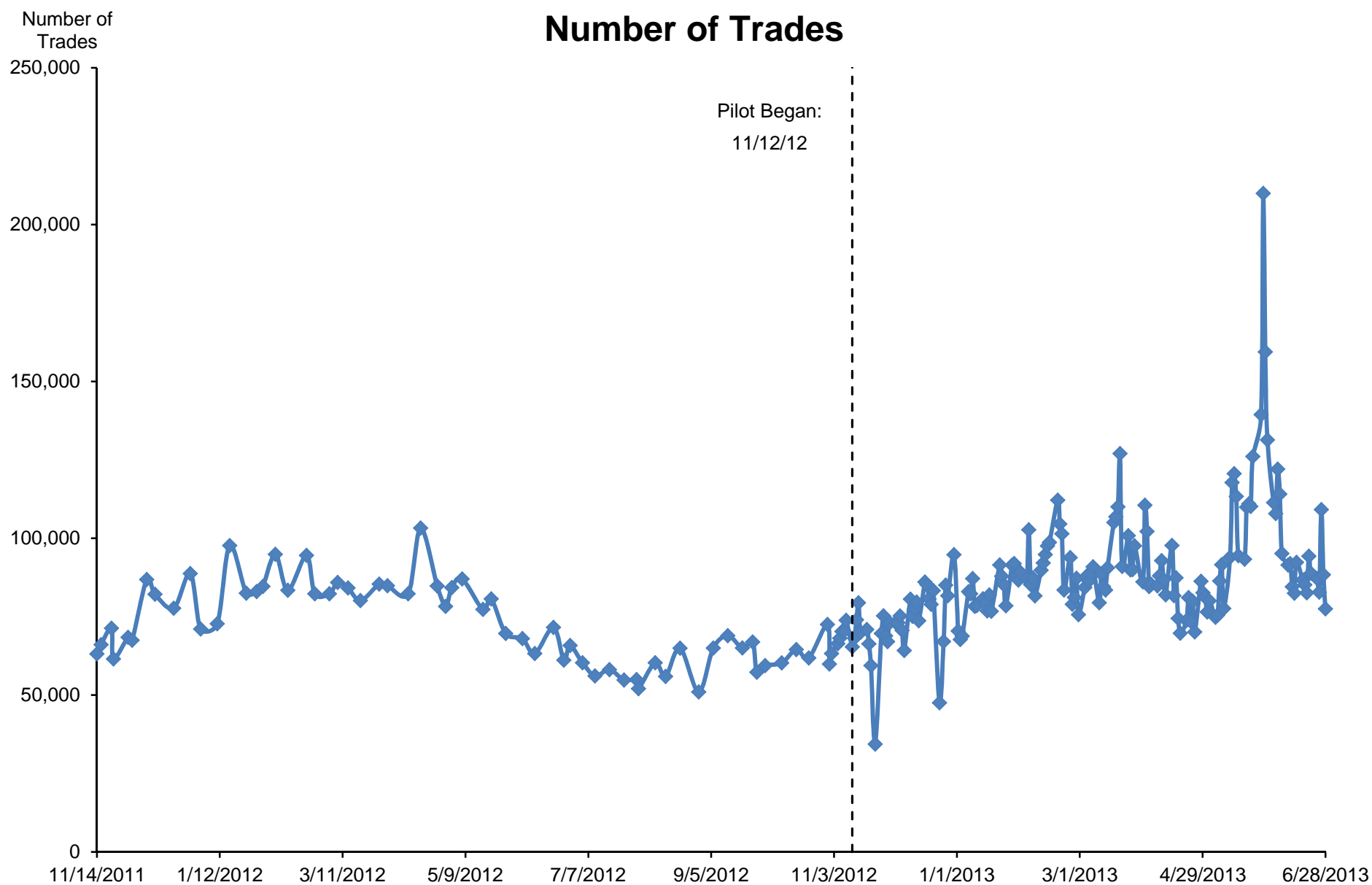
Note: VIX is the CBOE SPX Volatility Index and reflects implied volatilities for first-and-second-month options on the S&P 500 Index. RVX is the Russell Small Cap Volatility Index and reflects implied 30-day volatilities on Russell 2000 index options.





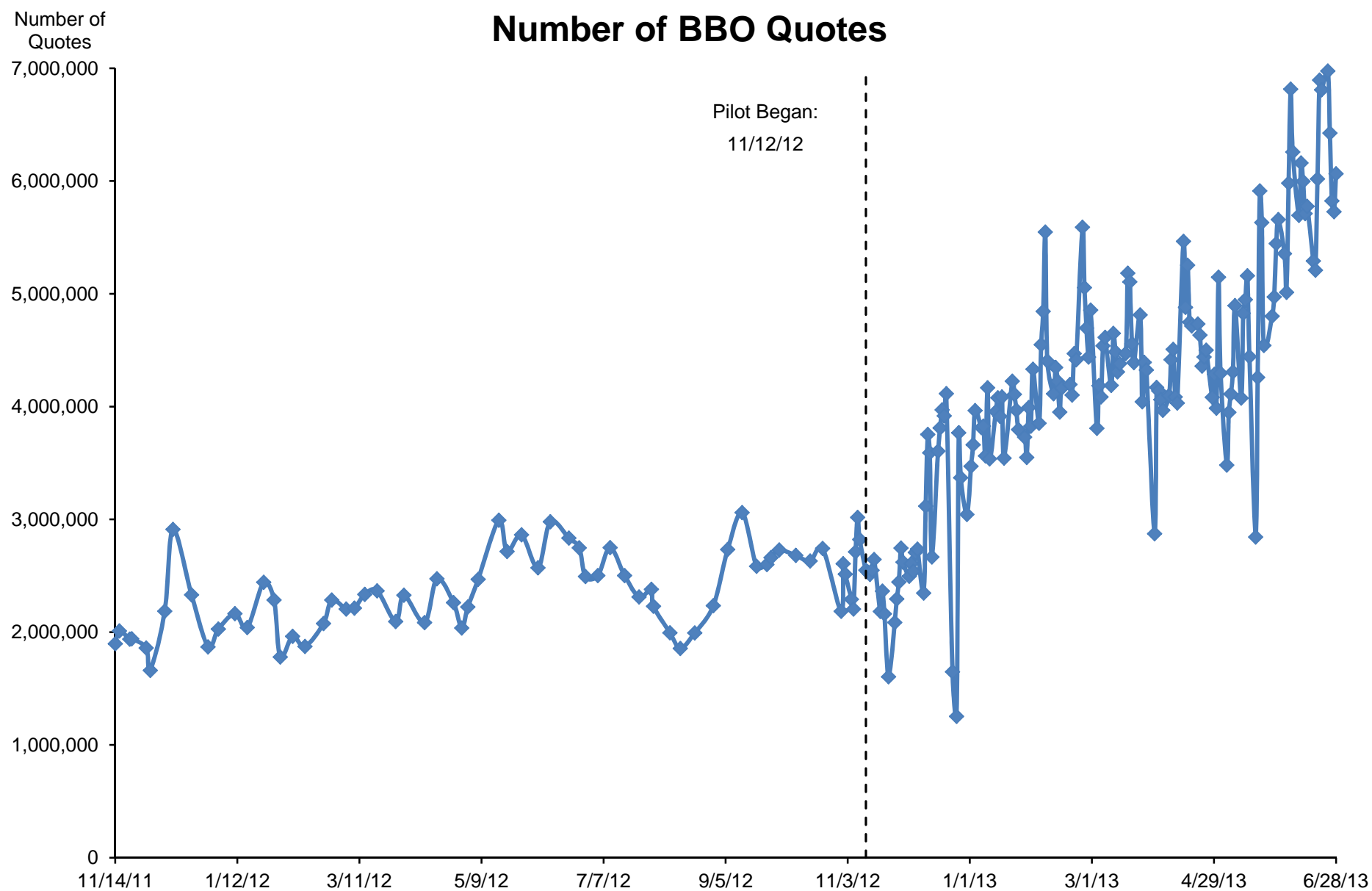
Source: OTC Link

Note: Does not include stocks traded on the OTC Bulletin Board. The maximum number of stocks in any of the Tier 6 subtiers is 41.



Source: OTC Link

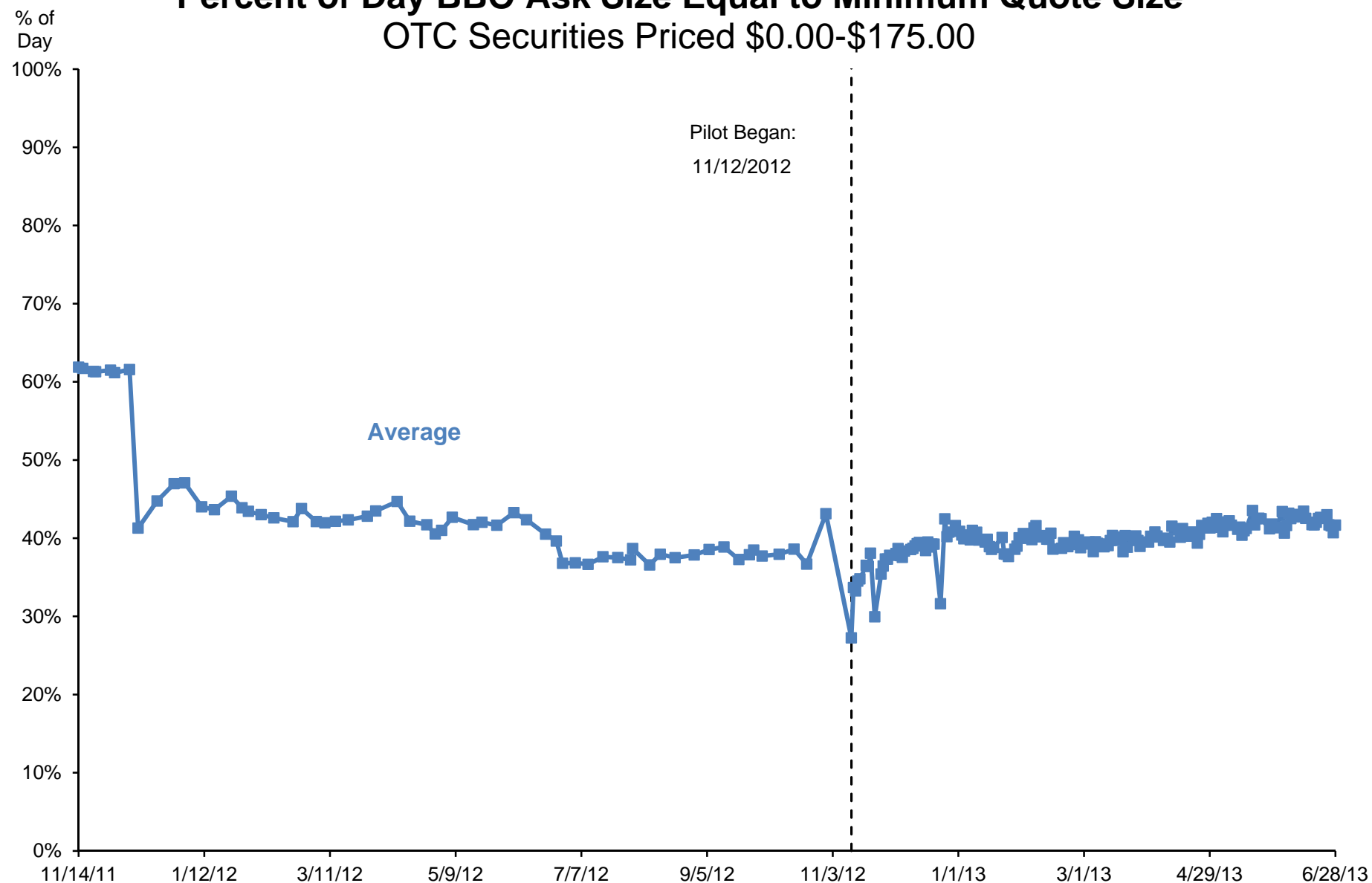
Note: The drop in trades occurred on early market close days, due to Thanksgiving and Christmas.



Source: OTC Link



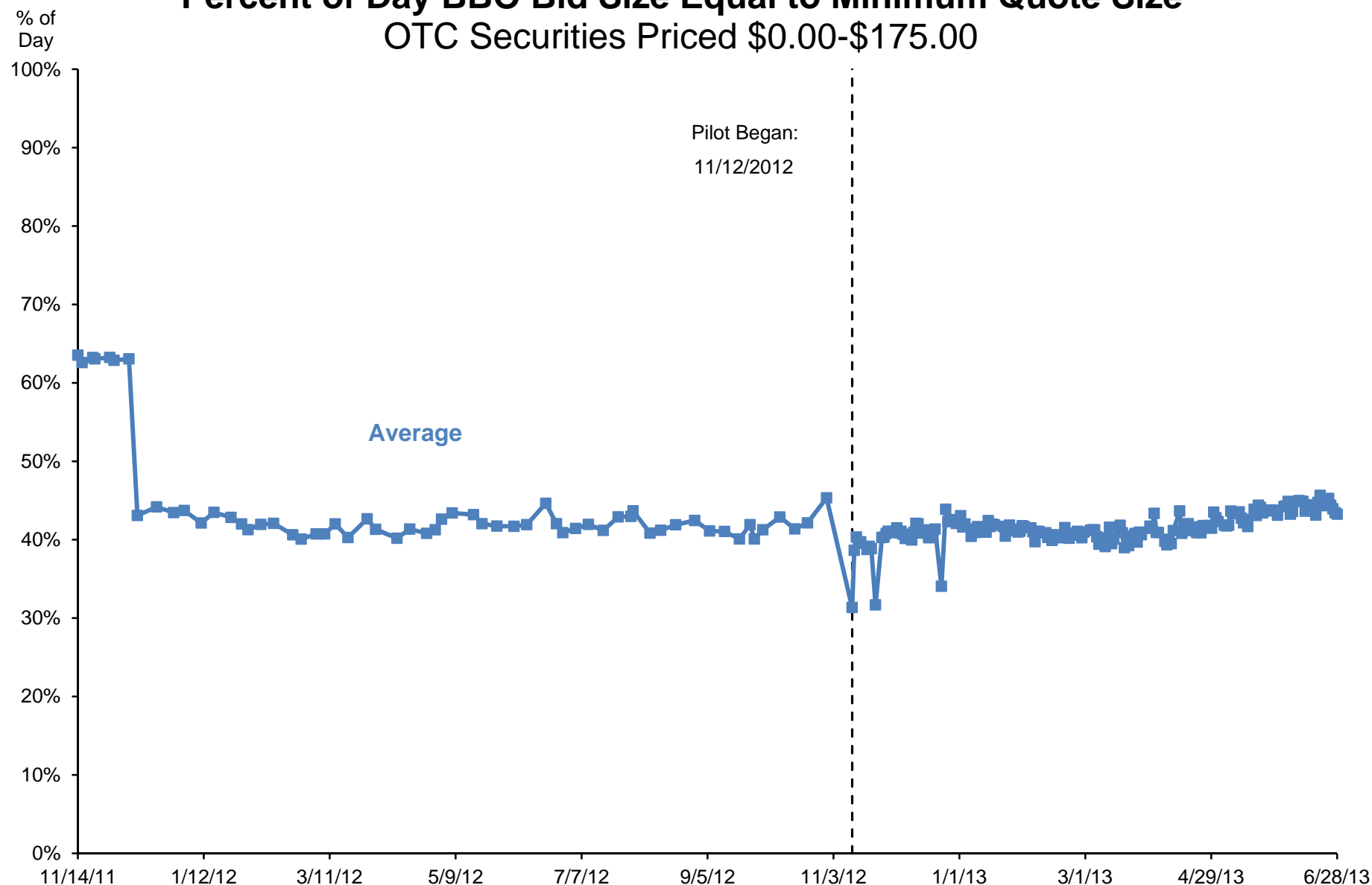
# Percent of Day BBO Ask Size Equal to Minimum Quote Size OTC Securities Priced \$0.00-\$175.00



Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier.

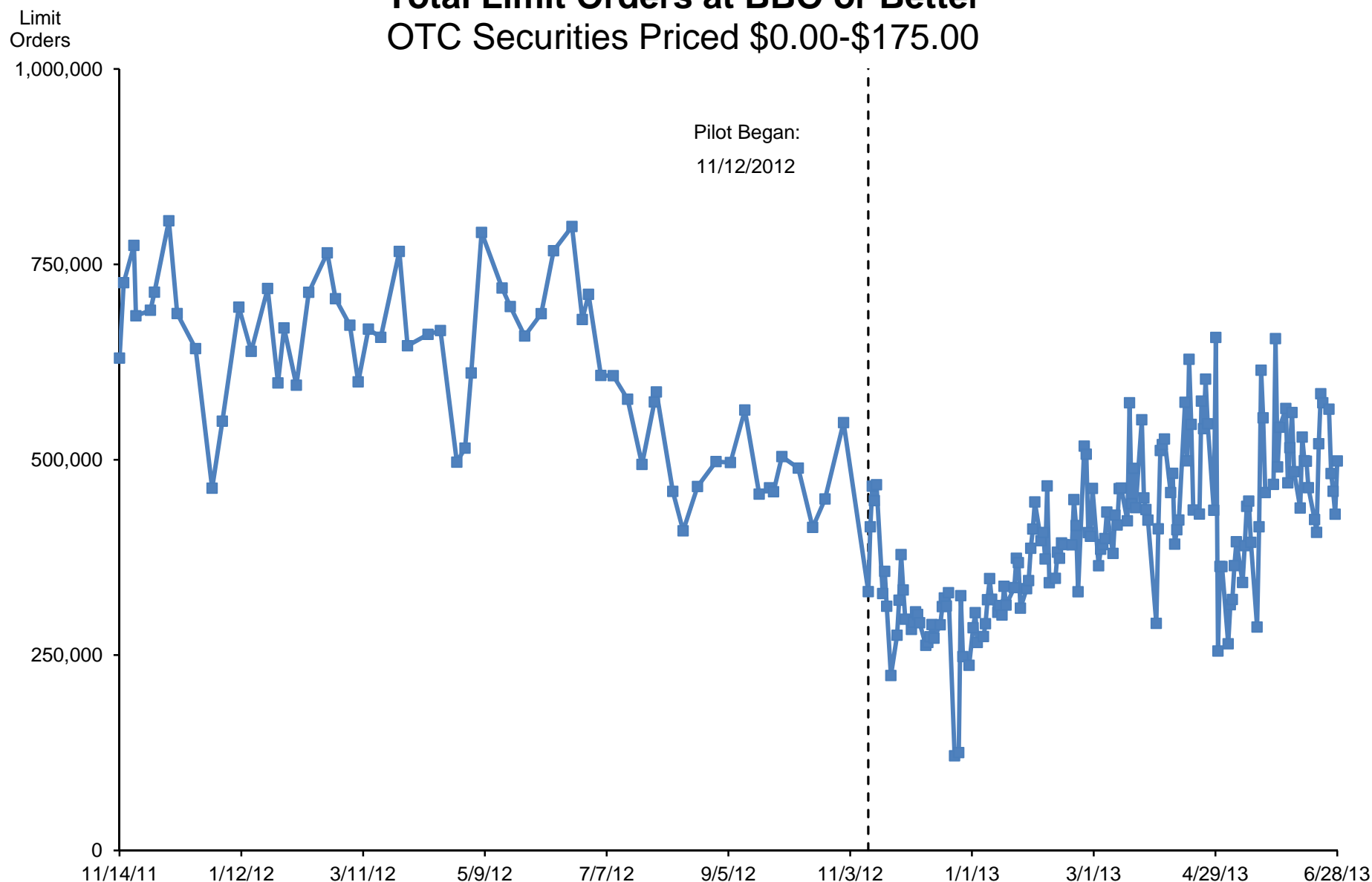
# Percent of Day BBO Bid Size Equal to Minimum Quote Size OTC Securities Priced \$0.00-\$175.00



Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier.

# **Total Limit Orders at BBO or Better** **OTC Securities Priced \$0.00-\$175.00**

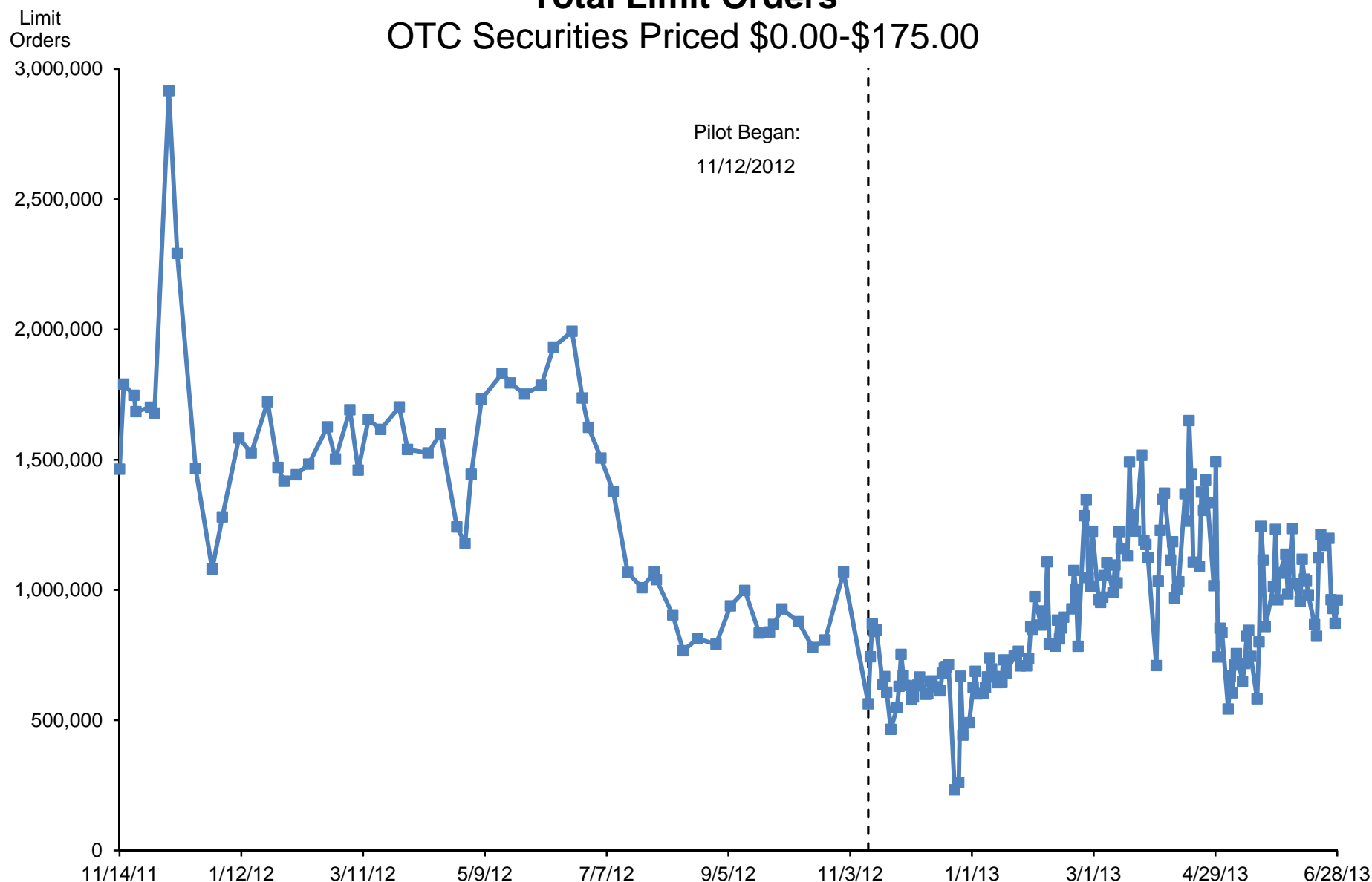


Source: OTC Link

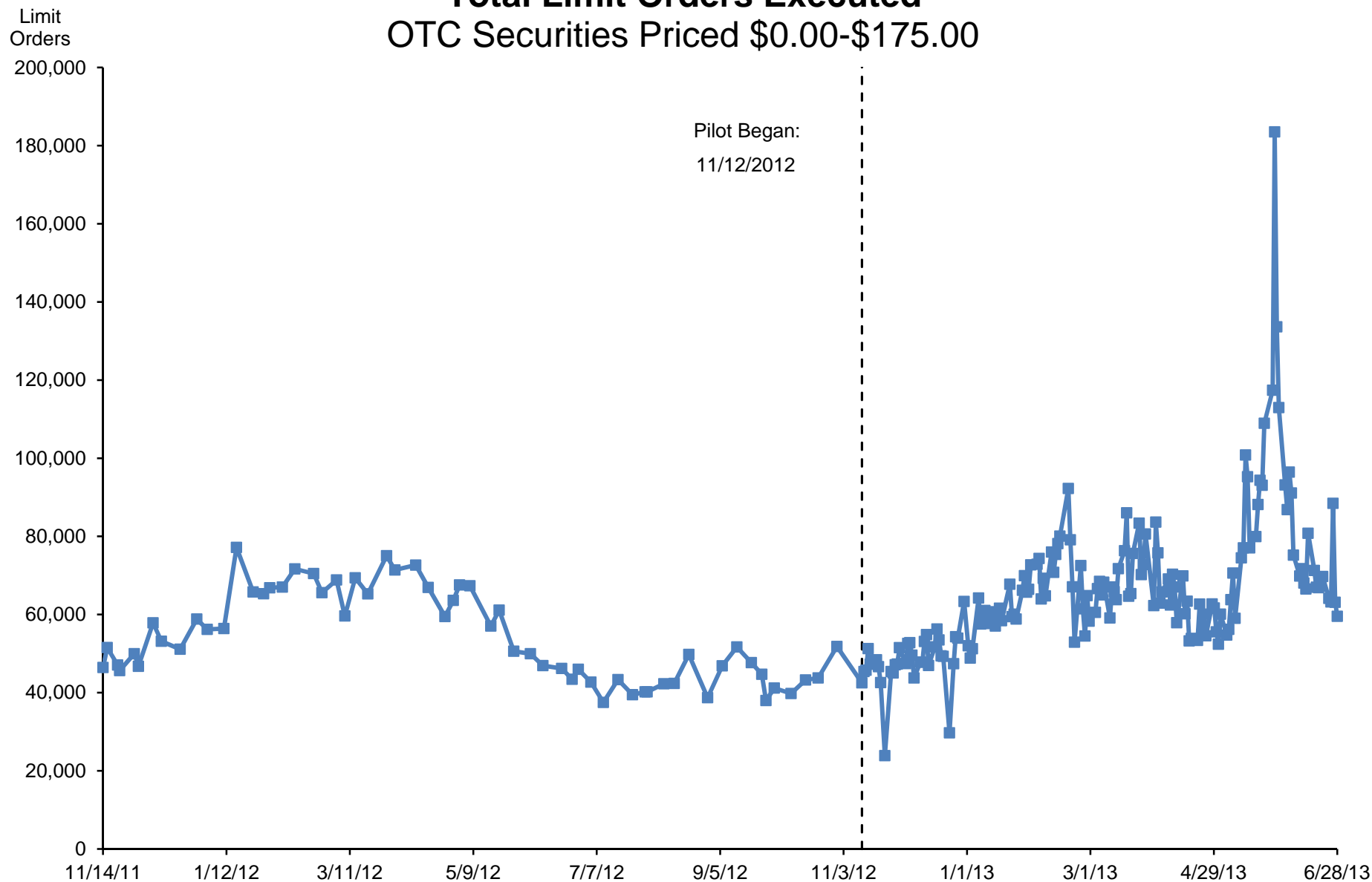
Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO for stocks priced according to amended tier definitions.

## Total Limit Orders

### OTC Securities Priced \$0.00-\$175.00



# Total Limit Orders Executed OTC Securities Priced \$0.00-\$175.00



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier.

## Amended Rule 6433

### Minimum Quote Size Requirement Change

Tier	Price Range	Minimum Quote Size	
		Pre-Rule	Post-Rule
1	\$0.0001 – \$0.0999	5,000	10,000
2	\$0.1000 – \$0.1999	5,000	5,000
3	\$0.2000 – \$0.5099	5,000	2,500
4	\$0.51 – \$1.00	2,500	1,000
5a	\$1.00 – \$10.00	500	100
5b	\$10.00 – \$100.00	200	100
5c	\$100.00 – \$175.00	100	100
6a	\$175.00 – \$200.00	100	1
6b	\$200.00 – \$500.00	25	1
6c	\$500.00 – \$1,000.00	10	1
6d	\$1,000.00 – \$2,500.00	5	1
6e	Over \$2,500	1	1

Source: SEC Release No. 34-67208; SR-FINRA-2011-058

Table 2

## Pre-Rule Randomly Selected Dates

Month	Date 1	Date 2	Date 3	Date 4	Date 5
Nov-11	11/14/11	11/16/11	11/21/11	11/22/11	11/29/11
Dec-11	12/1/11	12/8/11	12/12/11	12/21/11	12/29/11
Jan-12	1/3/12	1/11/12	1/17/12	1/25/12	1/30/12
Feb-12	2/2/12	2/8/12	2/14/12	2/23/12	2/27/12
Mar-12	3/5/12	3/9/12	3/14/12	3/20/12	3/29/12
Apr-12	4/2/12	4/12/12	4/18/12	4/26/12	4/30/12
May-12	5/3/12	5/8/12	5/18/12	5/22/12	5/29/12
Jun-12	6/6/12	6/12/12	6/21/12	6/26/12	6/29/12
Jul-12	7/5/12	7/11/12	7/18/12	7/25/12	7/31/12
Aug-12	8/1/12	8/9/12	8/14/12	8/21/12	8/30/12
Sep-12	9/6/12	9/13/12	9/20/12	9/25/12	9/27/12
Oct-12	10/1/12	10/9/12	10/16/12	10/22/12	10/31/12

Table 3

### Summary of t-tests Pre-Rule Sample v. Post-Rule

Metric	Tier						
	1	2	3	4	5a	5b	5c
Minimum Quotation Size Change	Increased	Maintained	Decreased	Decreased	Decreased	Decreased	Maintained
<b>I. Time-weighted quoted spread</b>		↓	↓↓	↓↓	↓↓	↓↓	
<b>II. Volume-weighted effective spread</b>							
All Trades	↑				↓↓	↓↓	
Small	↑				↓↓	↓↓	
Medium					↓	↓	
Large			↑			↑	
<b>III. Time-weighted quoted depth (shares)</b>			↓↓	↓↓	↓↓	↓↓	
<b>IV. Time-weighted quoted depth at quotes around the BBO midpoint</b>							
1% Band	↓		↓	↓↓			↓↓
2% Band	↓			↓↓			
5% Band			↓	↓↓			
10% Band			↓↓	↓↓			
Hypothetical Trade Size	5,000	2,500	2,500	1,000	100	100	100
<b>V. Hypothetical trade price impact of sell orders</b>							
Set Trade Size	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Set Trade Size X2	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Set Trade Size X5		↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Set Trade Size X10	↑↑		↓↓	↓	↓↓	↓↓	↓↓
<b>VI. Hypothetical trade price impact of buy orders</b>							
Set Trade Size	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Set Trade Size X2	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓	
Set Trade Size X5		↓↓	↓↓	↓↓	↓↓		
Set Trade Size X10		↓↓	↓↓	↓↓	↓↓		
<b>VII. Hypothetical trade percentage of time executed for sell orders</b>							
Set Trade Size				↑↑	↑↑		
Set Trade Size X2	↑↑	↑↑	↓↓	↓	↓↓	↓↓	↓↓
Set Trade Size X5	↑↑	↑↑	↑↑	↓↓	↓↓	↓↓	↑↑
Set Trade Size X10	↑↑	↑↑	↑↑	↓↓	↓↓	↓↓	
<b>VIII. Hypothetical trade percentage of time executed for buy orders</b>							
Set Trade Size			↑	↑↑	↑		
Set Trade Size X2	↑↑	↑↑	↓↓	↓↓	↓↓	↓↓	↑
Set Trade Size X5	↑↑	↑	↓↓	↓↓	↓↓	↓↓	
Set Trade Size X10	↑↑		↓↓	↓↓	↓↓	↓↓	

Source: OTC Link

Note:

This analysis tests whether there was a statistically significant difference in the average metric. "↑↑" and "↑" denote a statistically significant increase at the 1% and 5% levels, respectively, based on a two-tailed t-test. "↓↓" and "↓" denote a statistically significant decrease at the 1% and 5% levels, respectively, based on a two-tailed t-test.



Table 4

## Time-Weighted Quoted Spread

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,537	0.0096	0.0055	3,968	0.0099	0.0056	1.24	0.217
2	Maintained	1,275	0.0264	0.0222	1,097	0.0250	0.0209	(2.04)	0.042
3	Decreased	1,476	0.0703	0.0500	1,338	0.0628	0.0440	(3.49)	<0.001
4	Decreased	953	0.0961	0.0659	918	0.0847	0.0540	(2.97)	0.003
5a	Decreased	2,488	0.6081	0.2581	2,315	0.4534	0.1841	(6.00)	<0.001
5b	Decreased	1,850	2.448	0.612	1,991	1.793	0.451	(4.17)	<0.001
5c	Maintained	128	8.214	3.039	150	6.705	3.224	(1.21)	0.227

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

Table 5

## Volume-Weighted Effective Spread

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,197	0.0078	0.0045	3,844	0.0083	0.0049	2.33	0.020
2	Maintained	1,106	0.0209	0.0169	1,025	0.0197	0.0158	(1.85)	0.065
3	Decreased	1,303	0.0512	0.0347	1,237	0.0499	0.0339	(0.71)	0.481
4	Decreased	828	0.0715	0.0450	846	0.0656	0.0418	(1.70)	0.090
5a	Decreased	2,132	0.3740	0.1590	2,082	0.2807	0.1239	(5.01)	<0.001
5b	Decreased	1,525	1.301	0.384	1,754	1.004	0.307	(2.62)	0.009
5c	Maintained	87	4.278	1.546	123	3.578	1.345	(0.86)	0.394

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers

Table 5

## Volume-Weighted Effective Spread - Small Trades

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,196	0.0078	0.0045	3,843	0.0083	0.0049	2.34	0.019
2	Maintained	1,104	0.0208	0.0169	1,024	0.0197	0.0157	(1.76)	0.079
3	Decreased	1,302	0.0512	0.0350	1,235	0.0497	0.0339	(0.77)	0.441
4	Decreased	825	0.0713	0.0456	846	0.0655	0.0424	(1.68)	0.094
5a	Decreased	2,125	0.3720	0.1598	2,074	0.2797	0.1253	(5.00)	<0.001
5b	Decreased	1,447	1.248	0.375	1,720	0.880	0.293	(3.25)	0.001
5c	Maintained	21	3.935	1.787	26	6.161	3.559	1.55	0.137

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

Table 5

## Volume-Weighted Effective Spread - Medium Trades

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	454	0.0035	0.0016	664	0.0036	0.0018	0.37	0.709
2	Maintained	241	0.0101	0.0066	325	0.0097	0.0075	(0.51)	0.609
3	Decreased	465	0.0211	0.0142	593	0.0236	0.0152	1.65	0.099
4	Decreased	413	0.0316	0.0210	485	0.0313	0.0217	(0.15)	0.882
5a	Decreased	1,405	0.1715	0.0783	1,531	0.1480	0.0800	(2.20)	0.028
5b	Decreased	1,309	1.054	0.303	1,564	0.832	0.263	(2.12)	0.034
5c	Maintained	81	4.271	1.524	119	3.653	1.345	(0.68)	0.501

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

Table 5

## Volume-Weighted Effective Spread - Large Trades

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	1	0.0040	0.0040	7	0.0064	0.0046	–	–
2	Maintained	3	0.0021	0.0018	6	0.0176	0.0155	3.24	0.083
3	Decreased	15	0.0076	0.0075	37	0.0288	0.0104	2.19	0.046
4	Decreased	21	0.0282	0.0135	44	0.0271	0.0149	(0.13)	0.900
5a	Decreased	264	0.1036	0.0500	411	0.1306	0.0613	1.59	0.114
5b	Decreased	517	0.412	0.151	775	0.615	0.170	2.06	0.040
5c	Maintained	29	2.543	0.954	49	1.216	0.760	(1.66)	0.107

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

Table 6

## Time-Weighted Quoted Depth (Shares)

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,537	5,330,741	60,919	3,968	6,488,478	79,264	1.34	0.179
2	Maintained	1,275	27,712	21,614	1,097	27,694	24,000	(0.02)	0.983
3	Decreased	1,476	21,176	18,180	1,338	15,470	12,734	(11.45)	<0.001
4	Decreased	953	11,727	9,469	918	7,675	5,923	(5.45)	<0.001
5a	Decreased	2,488	3,208	2,109	2,315	2,213	1,028	(6.19)	<0.001
5b	Decreased	1,850	980	741	1,991	633	431	(11.27)	<0.001
5c	Maintained	128	655	343	150	525	355	(1.23)	0.222

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers

Table 7

## Time-Weighted Quoted Depth around the BBO Midpoint - Share Volume

**One Percent Band**

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	2,955	369,748	28,266	2,575	232,410	20,450	(2.37)	0.018
2	Maintained	1,029	23,338	8,657	1,082	17,730	8,666	(0.96)	0.338
3	Decreased	1,248	14,924	6,863	1,315	9,440	4,757	(2.12)	0.034
4	Decreased	976	8,333	4,333	973	5,548	2,587	(3.61)	<0.001
5a	Decreased	2,249	3,018	1,043	2,296	2,313	429	(1.93)	0.054
5b	Decreased	1,741	995	347	2,034	517	173	(1.90)	0.057
5c	Maintained	250	530	179	233	341	173	(2.70)	0.007

**Two Percent Band**

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	2,955	381,163	35,825	2,575	238,557	24,448	(2.44)	0.015
2	Maintained	1,023	27,016	11,664	1,079	20,596	12,128	(1.09)	0.276
3	Decreased	1,248	16,464	8,660	1,313	11,620	7,332	(1.87)	0.062
4	Decreased	976	9,096	4,637	971	6,730	3,791	(3.08)	0.002
5a	Decreased	2,249	3,205	1,251	2,293	2,817	716	(1.02)	0.307
5b	Decreased	1,741	1,045	353	2,031	742	347	(1.21)	0.227
5c	Maintained	249	572	311	233	460	322	(1.57)	0.119

**Five Percent Band**

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	2,955	403,675	48,070	2,575	286,045	41,145	(1.96)	0.050
2	Maintained	1,021	35,118	17,787	1,062	29,703	19,947	(0.91)	0.363
3	Decreased	1,235	22,900	14,426	1,291	17,127	12,578	(2.23)	0.026
4	Decreased	969	11,817	8,656	957	9,645	6,802	(2.74)	0.006
5a	Decreased	2,248	3,465	1,448	2,293	3,399	1,141	(0.17)	0.864
5b	Decreased	1,740	1,612	1,039	2,030	1,128	866	(1.93)	0.054
5c	Maintained	247	728	432	230	616	433	(1.52)	0.130

**Ten Percent Band**

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	2,955	438,872	66,844	2,575	346,368	61,436	(1.52)	0.129
2	Maintained	1,010	44,230	22,872	1,052	40,233	28,793	(0.66)	0.508
3	Decreased	1,229	28,886	19,593	1,286	23,556	17,303	(2.65)	0.008
4	Decreased	958	16,092	11,918	953	12,642	8,764	(3.96)	<0.001
5a	Decreased	2,242	4,329	2,356	2,292	3,854	1,625	(1.24)	0.217
5b	Decreased	1,730	2,288	1,730	2,029	1,442	1,123	(1.69)	0.092
5c	Maintained	246	797	433	230	719	523	(1.08)	0.282

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

## Price Impact for Hypothetical Large Market Sell Orders

## Set Trade Size

		Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
Tier	Minimum Quotation Size Change	Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,334	0.0062	0.0026	3,960	0.0054	0.0025	(4.53)	<0.001
2	Maintained	2,036	0.0238	0.0152	1,997	0.0196	0.0145	(6.10)	<0.001
3	Decreased	2,275	0.0616	0.0347	2,235	0.0451	0.0274	(9.00)	<0.001
4	Decreased	1,716	0.1169	0.0690	1,645	0.0930	0.0509	(6.07)	<0.001
5a	Decreased	3,062	0.4172	0.1479	2,944	0.2817	0.1000	(7.02)	<0.001
5b	Decreased	2,220	2.7296	0.3754	2,338	1.3084	0.2250	(8.95)	<0.001
5c	Maintained	341	17.4830	7.3426	316	10.8237	3.0625	(3.29)	0.001

## Set Trade Size × 2

		Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
Tier	Minimum Quotation Size Change	Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,204	0.0064	0.0029	3,960	0.0054	0.0025	(5.31)	<0.001
2	Maintained	1,878	0.0234	0.0160	1,952	0.0206	0.0150	(4.49)	<0.001
3	Decreased	2,274	0.0617	0.0347	2,184	0.0472	0.0300	(8.11)	<0.001
4	Decreased	1,715	0.1170	0.0691	1,610	0.0972	0.0584	(4.99)	<0.001
5a	Decreased	3,059	0.4172	0.1475	2,917	0.2886	0.1103	(7.09)	<0.001
5b	Decreased	2,218	2.7309	0.3750	2,295	1.2874	0.2524	(8.57)	<0.001
5c	Maintained	340	17.8635	7.4977	308	10.6644	3.7725	(4.17)	<0.001

## Set Trade Size × 5

		Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
Tier	Minimum Quotation Size Change	Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	3,931	0.0062	0.0027	3,808	0.0059	0.0029	(1.67)	0.095
2	Maintained	1,483	0.0233	0.0177	1,696	0.0213	0.0168	(3.13)	0.002
3	Decreased	1,787	0.0540	0.0320	1,899	0.0468	0.0322	(4.06)	<0.001
4	Decreased	1,676	0.1214	0.0746	1,497	0.1050	0.0695	(3.94)	<0.001
5a	Decreased	3,059	0.4170	0.1475	2,838	0.3164	0.1458	(5.48)	<0.001
5b	Decreased	2,145	2.3563	0.4405	2,171	1.4510	0.3963	(6.52)	<0.001
5c	Maintained	288	14.8135	6.9622	262	9.2650	3.9937	(3.81)	<0.001

## Set Trade Size × 10

		Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
Tier	Minimum Quotation Size Change	Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	3,710	0.0058	0.0025	3,600	0.0062	0.0028	2.63	0.009
2	Maintained	1,133	0.0232	0.0179	1,419	0.0225	0.0187	(0.95)	0.344
3	Decreased	1,439	0.0534	0.0357	1,519	0.0459	0.0303	(4.08)	<0.001
4	Decreased	1,400	0.1134	0.0716	1,268	0.1043	0.0672	(2.23)	0.026
5a	Decreased	2,992	0.4181	0.1602	2,696	0.3447	0.1750	(4.00)	<0.001
5b	Decreased	1,940	2.0124	0.5774	1,886	1.5827	0.5702	(3.28)	0.001
5c	Maintained	208	12.9528	5.8717	182	8.2577	4.0231	(2.71)	0.007

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Trade size is defined by the lowest minimum share requirement over the two periods. Subsequent iterations of this analysis take various multiples of this amount. Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.



## Price Impact for Hypothetical Large Market Buy Orders

## Set Trade Size

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,321	0.0062	0.0026	3,952	0.0054	0.0025	(4.56)	<0.001
2	Maintained	2,027	0.0228	0.0151	1,990	0.0193	0.0142	(6.14)	<0.001
3	Decreased	2,251	0.0547	0.0344	2,215	0.0434	0.0270	(8.19)	<0.001
4	Decreased	1,683	0.1096	0.0685	1,633	0.0899	0.0512	(5.70)	<0.001
5a	Decreased	3,048	0.4191	0.1479	2,935	0.2827	0.1000	(7.09)	<0.001
5b	Decreased	2,215	2.4586	0.3758	2,332	1.2593	0.2268	(8.39)	<0.001
5c	Maintained	336	13.2019	6.5971	313	9.1706	3.0250	(3.89)	<0.001

## Set Trade Size × 2

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,065	0.0062	0.0025	3,949	0.0053	0.0025	(4.74)	<0.001
2	Maintained	1,771	0.0236	0.0160	1,883	0.0187	0.0139	(7.65)	<0.001
3	Decreased	2,233	0.0522	0.0339	2,089	0.0420	0.0272	(7.52)	<0.001
4	Decreased	1,676	0.1066	0.0679	1,537	0.0853	0.0500	(6.32)	<0.001
5a	Decreased	3,045	0.4191	0.1498	2,864	0.2741	0.1083	(7.66)	<0.001
5b	Decreased	2,208	1.9156	0.3750	2,250	1.2896	0.2500	(5.96)	<0.001
5c	Maintained	303	9.7865	4.1960	274	8.5459	3.0000	(1.28)	0.200

## Set Trade Size × 5

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	3,586	0.0055	0.0022	3,645	0.0051	0.0024	(1.80)	0.072
2	Maintained	1,254	0.0235	0.0162	1,403	0.0200	0.0150	(4.38)	<0.001
3	Decreased	1,752	0.0506	0.0324	1,643	0.0429	0.0291	(5.33)	<0.001
4	Decreased	1,537	0.0969	0.0619	1,267	0.0834	0.0500	(3.73)	<0.001
5a	Decreased	3,038	0.3295	0.1479	2,726	0.2543	0.1294	(7.23)	<0.001
5b	Decreased	2,026	1.1630	0.3739	2,046	1.0625	0.3803	(1.48)	0.138
5c	Maintained	177	4.8322	2.3511	187	4.8921	2.0866	0.08	0.938

## Set Trade Size × 10

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	3,273	0.0050	0.0020	3,272	0.0047	0.0020	(1.58)	0.115
2	Maintained	880	0.0229	0.0159	998	0.0199	0.0150	(3.41)	<0.001
3	Decreased	1,379	0.0496	0.0329	1,253	0.0423	0.0296	(4.28)	<0.001
4	Decreased	1,208	0.0968	0.0612	988	0.0836	0.0496	(3.18)	0.002
5a	Decreased	2,880	0.3084	0.1419	2,514	0.2512	0.1393	(5.72)	<0.001
5b	Decreased	1,759	1.1131	0.5000	1,759	1.0565	0.5000	(0.87)	0.386
5c	Maintained	104	3.7889	2.2923	127	3.7797	2.2375	(0.01)	0.991

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Trade size is defined by the lowest minimum share requirement over the two periods. Subsequent iterations of this analysis take various multiples of this amount. Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

# Executability of Hypothetical Large Market Sell Orders

## Set Trade Size

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,422	0.9846	1.0000	3,961	0.9824	1.0000	(1.01)	0.313
2	Maintained	2,092	0.9870	1.0000	2,013	0.9898	1.0000	0.98	0.325
3	Decreased	2,330	0.9848	1.0000	2,254	0.9894	1.0000	1.62	0.105
4	Decreased	1,776	0.9837	1.0000	1,654	0.9935	1.0000	3.23	0.001
5a	Decreased	3,128	0.9928	1.0000	2,955	0.9963	1.0000	2.66	0.008
5b	Decreased	2,241	0.9946	1.0000	2,345	0.9961	1.0000	1.10	0.273
5c	Maintained	347	0.9903	1.0000	318	0.9895	1.0000	(0.14)	0.886

## Set Trade Size × 2

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,422	0.8401	1.0000	3,961	0.9819	1.0000	32.48	<0.001
2	Maintained	2,092	0.8042	1.0000	2,013	0.9668	1.0000	21.65	<0.001
3	Decreased	2,330	0.9842	1.0000	2,254	0.9571	1.0000	(6.68)	<0.001
4	Decreased	1,776	0.9827	1.0000	1,654	0.9733	1.0000	(2.29)	0.022
5a	Decreased	3,128	0.9905	1.0000	2,955	0.9465	1.0000	(13.01)	<0.001
5b	Decreased	2,241	0.9930	1.0000	2,345	0.9148	1.0000	(16.40)	<0.001
5c	Maintained	347	0.9683	1.0000	318	0.9115	1.0000	(4.04)	<0.001

## Set Trade Size × 5

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,422	0.6768	0.9998	3,961	0.7601	1.0000	11.20	<0.001
2	Maintained	2,092	0.4781	0.3808	2,013	0.6344	0.9997	12.63	<0.001
3	Decreased	2,330	0.6250	0.9991	2,254	0.6909	1.0000	5.83	<0.001
4	Decreased	1,776	0.9549	1.0000	1,654	0.8367	1.0000	(14.18)	<0.001
5a	Decreased	3,128	0.9897	1.0000	2,955	0.8337	1.0000	(26.99)	<0.001
5b	Decreased	2,241	0.8410	1.0000	2,345	0.7181	1.0000	(12.22)	<0.001
5c	Maintained	347	0.5634	0.9042	318	0.6500	1.0000	2.94	0.003

## Set Trade Size × 10

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,422	0.5599	0.9949	3,961	0.6248	0.9997	7.91	<0.001
2	Maintained	2,092	0.2816	0.0000	2,013	0.3981	0.0000	10.08	<0.001
3	Decreased	2,330	0.4190	0.0131	2,254	0.4640	0.2236	3.81	<0.001
4	Decreased	1,776	0.6802	0.9998	1,654	0.5818	0.9935	(7.48)	<0.001
5a	Decreased	3,128	0.9052	1.0000	2,955	0.6821	1.0000	(27.67)	<0.001
5b	Decreased	2,241	0.6274	1.0000	2,345	0.4370	0.0134	(15.70)	<0.001
5c	Maintained	347	0.2425	0.0000	318	0.2656	0.0000	0.88	0.379

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Trade size is defined by the lowest minimum share requirement was over the two periods. Subsequent iterations of this analysis take various multiples of this amount. Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.

# Executability of Hypothetical Large Market Buy Orders

## Set Trade Size

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,363	0.9875	1.0000	3,960	0.9893	1.0000	0.90	0.369
2	Maintained	2,069	0.9845	1.0000	2,008	0.9818	1.0000	(0.85)	0.397
3	Decreased	2,307	0.9722	1.0000	2,251	0.9800	1.0000	2.13	0.033
4	Decreased	1,744	0.9635	1.0000	1,652	0.9814	1.0000	4.06	<0.001
5a	Decreased	3,091	0.9916	1.0000	2,954	0.9951	1.0000	2.29	0.022
5b	Decreased	2,227	0.9908	1.0000	2,340	0.9931	1.0000	1.25	0.211
5c	Maintained	342	0.9436	1.0000	317	0.9605	1.0000	1.29	0.199

## Set Trade Size × 2

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,363	0.7817	1.0000	3,960	0.9853	1.0000	42.23	<0.001
2	Maintained	2,069	0.7656	1.0000	2,008	0.8084	1.0000	4.17	<0.001
3	Decreased	2,307	0.9541	1.0000	2,251	0.7997	1.0000	(20.08)	<0.001
4	Decreased	1,744	0.9549	1.0000	1,652	0.8105	1.0000	(16.24)	<0.001
5a	Decreased	3,090	0.9899	1.0000	2,954	0.8693	1.0000	(23.52)	<0.001
5b	Decreased	2,227	0.9733	1.0000	2,340	0.8611	1.0000	(17.92)	<0.001
5c	Maintained	342	0.6064	0.9850	317	0.6668	1.0000	2.11	0.036

## Set Trade Size × 5

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,363	0.5805	0.9984	3,960	0.6652	0.9997	10.38	<0.001
2	Maintained	2,069	0.4329	0.0962	2,008	0.4628	0.2188	2.36	0.018
3	Decreased	2,307	0.5709	0.9826	2,251	0.5094	0.6128	(5.13)	<0.001
4	Decreased	1,744	0.7841	1.0000	1,652	0.5670	0.9696	(16.96)	<0.001
5a	Decreased	3,091	0.9724	1.0000	2,954	0.7154	1.0000	(35.82)	<0.001
5b	Decreased	2,227	0.7203	1.0000	2,340	0.6105	1.0000	(9.28)	<0.001
5c	Maintained	342	0.2550	0.0000	317	0.2821	0.0000	0.94	0.350

## Set Trade Size × 10

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)				
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median	t-statistic	p-value
1	Increased	4,363	0.4609	0.1936	3,960	0.4965	0.7129	4.15	<0.001
2	Maintained	2,069	0.2551	0.0000	2,008	0.2588	0.0000	0.34	0.732
3	Decreased	2,307	0.3499	0.0000	2,251	0.2958	0.0000	(4.87)	<0.001
4	Decreased	1,744	0.5118	0.5714	1,652	0.3584	0.0000	(11.25)	<0.001
5a	Decreased	3,091	0.8150	1.0000	2,954	0.5215	0.8080	(31.54)	<0.001
5b	Decreased	2,227	0.5186	0.8237	2,340	0.3491	0.0000	(13.62)	<0.001
5c	Maintained	342	0.0950	0.0000	317	0.1019	0.0000	0.37	0.711

Source: OTC Link

Note:

[1] Only five dates for each month, as selected by FINRA, are included.

Trade size is defined by the lowest minimum share requirement was over the two periods. Subsequent iterations of this analysis take various multiples of this amount. Quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Observations were also removed if the quotes used in a given metric on a given day spanned tiers.