

## I. EXECUTIVE SUMMARY

On October 6, 2011, FINRA filed with the SEC a proposed rule change to amend the minimum quotation sizes (or “tier sizes”) for OTC equity securities<sup>1</sup> to, among other things, simplify the tier structure, facilitate the display of customer limit orders and expand the scope of the Rule to apply to additional quoting participants. During the proposal process, the SEC received a number of comments and, in response, FINRA proposed that the new tier sizes operate on a pilot basis for one year to allow FINRA and the SEC to better analyze the impact of the revised tier sizes. During the comment process, commenters raised a variety of concerns regarding the potential impact of the revised tiers. The primary concerns raised by commenters related to: (1) market-maker behavior, (2) market quality (including on liquidity and spreads), and (3) customer limit order display. On November 12, 2012, FINRA implemented the revised tiers on a pilot basis.

As discussed more fully below and in the accompanying Cornerstone Study,<sup>2</sup> FINRA believes that the Pilot accomplished its intended objectives without adversely impacting market-maker behavior, market quality (including on liquidity and spreads), or customer limit order display. FINRA believes that the impact of the revised tier sizes on the number of customer limit orders eligible for display was positive and that the overall impact of the revised tier sizes on market maker behavior and market quality was generally neutral with some metrics reflecting positive changes. Accordingly, FINRA is recommending that the SEC approve the adoption of the revised tier sizes on a permanent basis.

## II. OVERVIEW

FINRA Rule 6433 (Minimum Quotation Size Requirements For OTC Equity Securities) (the “Rule”) sets forth the minimum quotation sizes that may be displayed on any inter-dealer quotation system that permits quotation updates on a real-time basis in OTC equity securities. Under the Rule, different minimum quotation sizes apply depending upon the price level of the bid or offer and, therefore, a different minimum quotation size can apply to each side of the market being quoted by a member in a given security.

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<sup>1</sup> An OTC equity security is an equity security that is not an “NMS Stock” as defined in Rule 600(b)(47) of SEC Regulation NMS. *See* FINRA Rule 6420(f).

<sup>2</sup> FINRA engaged Cornerstone Research (“Cornerstone”) to conduct an analysis of the impact of the Pilot on OTC market quality. A summary of the Pilot Assessment is provided in Section IV below and Cornerstone’s study is attached as Appendix A and Supplemental Exhibits 10 and 11 (“Cornerstone Study”).

On October 6, 2011, FINRA filed with the SEC SR-FINRA-2011-058, a proposed rule change to amend the minimum quotation sizes for OTC equity securities to, among other things, simplify the tier structure, facilitate the display of customer limit orders under FINRA Rule 6460 (Display of Customer Limit Orders) and expand the scope of the Rule.<sup>3</sup> The SEC received a number of comments on the Original Proposal and, in response to those concerns, FINRA ultimately proposed revised tier sizes<sup>4</sup> and further proposed that the new tier sizes operate on a pilot basis for one year (“Minimum Quotation Size Pilot” or “Pilot”)<sup>5</sup> to allow FINRA and the SEC the opportunity to better analyze the impact of the Pilot.<sup>6</sup>

The minimum quotation sizes in effect prior to the Pilot, which was implemented on November 12, 2012, consisted of nine tiers that applied only to market makers displaying quotations in OTC equity securities, and ranged in price categories from \$0.00 through \$2,500.01 (*See* TABLE 1). The Pilot provided for six revised tier sizes for quotations in OTC equity securities, whether displayed by market makers (both representing proprietary and customer interest), alternative trading systems or any other member firm. (*See* TABLE 2).

**TABLE 1**

<b>Price (Bid or Offer)</b>	<b>Minimum Quote Size (# of shares)</b>
\$0 to \$0.50	5,000
\$0.51 to \$1.00	2,500
\$1.01 to \$10.00	500
\$10.01 to \$100.00	200
\$100.01 to \$200.00	100
\$200.01 to \$500.00	25
\$500.01 to \$1,000.00	10
\$1,000.01 to \$2,500.00	5
\$2,500.01 +	1

<sup>3</sup> See Securities Exchange Act Release No. 65568 (October 14, 2011), 76 FR 65307 (October 20, 2011) (File No. SR-FINRA-2011-058; Notice of Filing of Proposed Rule Change To Amend FINRA Rule 6433 (Minimum Quotation Size Requirements for OTC Equity Securities)) (“Original Proposal”).

<sup>4</sup> See Amendment No. 1 to File No. SR-FINRA-2011-058 (“Amendment No. 1”).

<sup>5</sup> See Amendment No. 2 to File No. SR-FINRA-2011-058 (“Amendment No. 2”).

<sup>6</sup> See Securities Exchange Act Release No. 67208 (June 15, 2012), 77 FR 37458 (June 28, 2012) (File No. SR-FINRA-2011-058; Notice of Filing of Amendment No. 2 and Order Granting Accelerated Approval of a Proposed Rule Change, as Modified by Amendment Nos. 1 and 2, To Amend FINRA Rule 6433 (Minimum Quotation Size Requirements for OTC Equity Securities)) (“Minimum Quotation Size Approval Order”).

TABLE 2

Price (Bid or Offer)	Minimum Quote Size (# of shares)
\$0.0001 to \$0.0999	10,000
\$0.10 to \$0.1999	5,000
\$0.20 to \$0.5099	2,500
\$0.51 to \$0.9999	1,000
\$1.00 to \$174.99	100
\$175.00 +	1

### III. PILOT OBJECTIVES AND DATA COLLECTION

The objectives of the Minimum Quotation Size Pilot included: (1) simplifying the structure of the tiers; (2) modernizing the minimum sizes, including in light of regulatory changes; (3) providing for uniform treatment of the types and sources of quotations that would be subject to the Minimum Quotation Size Rule; and (4) facilitating greater display of customer limit orders.

The Pilot simplified the tier structure in a variety of ways. Reducing the number of tiers and conforming the minimum quotation size applicable to OTC equity securities priced between \$1.00 and \$174.99 to the one hundred share-minimum generally applicable on exchanges accomplished the structural simplification sought to be achieved. In addition, the Pilot revised the smallest price point from \$0.00 to \$0.0001 to conform to the minimum quotation increments under FINRA Rule 6434 (Minimum Pricing Increments for OTC Equity Securities), which, among other things, prohibits members from displaying a bid or offer in an OTC equity security in an increment smaller than \$0.01 if the bid or offer is priced \$1.00 or greater per share, or in an increment smaller than \$0.0001 if the bid or offer is priced below \$1.00.

FINRA also expected that the Pilot's revised tier sizes would result in benefits to investors by facilitating the display of customer limit orders under FINRA's limit order display rule,<sup>7</sup> which 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 minimis* amount). OTC market makers are not required to display a customer limit order on an inter-dealer quotation system unless doing so would comply with the minimum quotation size applicable to the price of the quotation. Therefore, although a customer limit order may otherwise have been required to be displayed under the limit order display rule because it improved the price or size more than a *de minimis* amount, if the order is less than the minimum quotation size, the member would not be required to display the order. FINRA believed that the revised tiers set forth in the Pilot would improve overall display of customer limit orders.

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<sup>7</sup> See FINRA Rule 6460.

For example, because the Pilot would reduce the tier size from 2,500 to 100 shares for securities priced at or above \$1.00, FINRA believed that competitively priced customer limit orders, which tend to be smaller sized orders, would be more likely to be displayed and potentially yield a variety of benefits, including improved price transparency, enhanced execution of customer limit orders and narrower spreads. As further discussed below in Section IV, FINRA believes that the Pilot generally resulted in the anticipated effect in this regard.

To effectively assess the impact of the Pilot on quoted OTC equity securities, FINRA collected and provided to the Commission certain pre and post-pilot data. Specifically, FINRA provided the following data to the SEC aggregated daily by symbol for those securities subject to the Pilot:<sup>8</sup>

- 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 the day that the size of the BBO (i.e., best bid and offer on FINRA's OTCBB facility and OTC Link) equals the 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.
- Liquidity/BBO metrics
  - Time-weighted quoted spread.
  - Effective spread.
  - Time-weighted quoted depth (number of shares) at the inside.
  - Time-weighted quoted depth (dollar value of shares) at the inside.<sup>9</sup>

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<sup>8</sup> If an OTC equity security was not quoted on an inter-dealer quotation system during the Pilot period, it was not subject to the Pilot.

<sup>9</sup> FINRA also provided the listed data to the SEC for five random days from each month for a one-year period prior to the effective date of the Pilot. Three months after the Pilot commenced, FINRA started to provide SEC staff with monthly reports that contained the listed data for each day during the month. The data for

FINRA also committed to providing an assessment to the SEC addressing the impact of the pilot, the validity of concerns raised by commenters during the rule filing process, whether the pilot resulted in the desired effects, conclusions regarding the impact of the pilot on liquidity (and potentially other measures of market quality) of the stocks in each tier, and whether the tier cutoffs or sizes should be revised in light of the impact of the Pilot on the over-the-counter market.

#### **IV. PILOT ASSESSMENT RESULTS**

##### **A. Overview of Market Impact**

FINRA believes that the Pilot accomplished its intended objectives without adversely impacting market-maker behavior, market quality (including on liquidity and spreads), or customer limit order display. This belief is supported by the results of the Cornerstone Study, as well as other data analyzed by FINRA. The results of the study are discussed further in Section IV.B. In addition, analysis conducted by FINRA indicates that the impact of the revised tier sizes on the number of customer limit orders eligible for display was positive. This is discussed further in Section IV.C. Importantly, the increase in the number of customer limit orders eligible for display is the most likely explanation for the decrease in quoted spreads that was observed for securities priced greater than \$0.20 and the decrease in effective spreads for retail trades in securities priced between \$1.00 and \$100.00. There also is mixed evidence with respect to market quality for securities priced less than \$0.10 (Tier 1).

##### **B. Impact on Market Quality**

FINRA believes that the Cornerstone Study generally shows that the Pilot had a neutral to positive impact on OTC market quality for the majority of OTC equity securities and tiers. While the evidence produced by the study generally supports the conclusion that the Pilot is associated with increased limit order display and narrower spreads, evidence for Tier 1 securities is mixed. Evidence suggested that effective spreads have widened, but also no significant reduction in quoted depth at the BBO was observed. As a result, the results are not conclusive. The study found evidence that some large market makers initially responded to the Pilot by reducing the number of OTC equity securities for which they displayed a priced quotation, and instead quoted on a name-only basis in the vast majority of these cases. While some large market makers reduced the number of securities actively quoted on a priced basis, Cornerstone's analysis suggests that many of these same market makers were continuing to provide liquidity throughout the Pilot. Moreover, notwithstanding the initial decline in the number of quoting market maker positions, the number of market makers providing quotes increased over the duration of the Pilot.

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each month was provided to the SEC within 20 business days of the beginning of the following month.

The study investigated whether the Pilot had a statistically significant impact on market quality by comparing a number of important quality measures during the Pilot to those measures during the pre-Pilot period.<sup>10</sup> Since the minimum quotation size increased for one price level, remained the same for some price levels, and decreased for most price levels during the Pilot, the study controlled for this variation in treatment by comparing market quality measures within tier size categories pre- and post-Pilot. Also, since the tier size categories and price ranges during the pre-Pilot did not directly match up with the Pilot tier size categories and price ranges, the study matched pre-Pilot and Pilot data by price level to maintain consistency across every variation in Pilot treatment. Among other things, this resulted in the Pilot's Tier 5 (\$1.00 to \$175.00) being decomposed into three subcategories for analysis.<sup>11</sup>

The results of the study suggest that the Pilot had a neutral to positive impact on market quality for OTC equity securities where the minimum quotation size decreased (Tiers 3, 4, 5a, and 5b).<sup>12</sup> The study found that effective spreads generally remained the same or decreased, quoted spreads decreased, and price impact generally decreased for these tiers.

However, the study also found that displayed depth at the BBO declined, while an alternative displayed depth measure, one that assesses depth beyond the BBO and provides a fairer comparison of depth when quoted spreads narrow, remained the same or declined. The study also indicated that the ability to execute trades larger than the displayed depth remained essentially unchanged during the Pilot.

The effective spread and price impact results are particularly important because these measures are more comprehensive, better represent the experience of investors in the market and implicitly take into account the contemporaneous decline in quoted spreads (positive toward market quality) and the decline in displayed depth (negative toward market quality). The results generally show declines in effective spreads and price impact for Tiers 5a and 5b, suggesting an overall positive impact on market quality.

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<sup>10</sup> Due to the small number of securities within the Pilot's Tier 6 (which previously was comprised of higher priced issues in Tiers 5 through 9 in the pre-Pilot tier structure), Tier 6 was omitted from the study. Please see footnote 14 of the Cornerstone Study for further information.

<sup>11</sup> The Pilot's Tier 5, which included securities priced between \$1.00 and \$175.00, was divided into three subcategories – 5a, 5b and 5c – for analysis in the Cornerstone Study. The resulting categories are Tier 5a, which ranged from \$1.00 to \$10.00; Tier 5b, which ranged from \$10.00 to \$100.00; and Tier 5c, which ranged from \$100.00 to \$175.00. *See* Table 1 of Appendix A for further information.

<sup>12</sup> *See* Table 3 of Appendix A for a comprehensive overview of the results.

The results generally show no change in effective spreads and a decline in price impact for Tiers 3 and 4, suggesting a more neutral or slightly positive impact on market quality.

The results of the study also suggest that the Pilot had a neutral or negative impact on market quality for OTC equity securities where the minimum quote size requirement increased (Tier 1). The study found that quoted spreads remained the same, displayed depth at the BBO remained the same, and price impact generally remained the same or decreased. However, the study also found that effective spreads remained the same or increased and the alternative displayed depth measure remained the same or decreased. Since the two more comprehensive measures (effective spreads and price impact) offer somewhat contradictory results, the overall evidence is not conclusive with regard to market quality with respect to Tier 1.

The results of the study also suggest that the Pilot had a neutral impact on market quality for securities where the minimum quote size requirement remained the same (Tiers 2 and 5c). The study found that effective spreads remained the same, quoted spreads remained the same or decreased, displayed depth at the BBO remained the same, the alternative displayed depth measure generally remained the same, and price impact remained the same or decreased for these tiers. As expected, the Pilot appears to have had very little effect on these tiers.

There was also some evidence that some large market makers reduced the number of securities they actively quoted upon the initiation of the Pilot.<sup>13</sup> The observed behavior occurred in securities in all tiers, regardless of whether the minimum quotation size increased, decreased or remained the same. FINRA concludes that the large reduction in the number of securities actively quoted by certain market makers appears to have been temporary and gradually reversed over time. The market making data is consistent with the explanation that the Pilot initially gave some market makers a reason to re-evaluate their market making risk and drop active quoting in securities to reduce risk. But when the Pilot did not have dire consequences on market making, these same market makers expanded their breadth of active quoting during the Pilot. The market quality metrics analyzed and discussed previously would have encompassed any impacts on market quality due to changes in market maker quoting.

### **C. Impact on Customer Limit Order Display**

FINRA analyzed the number of customer limit orders that would be eligible for display under both the Pilot and pre-Pilot tier sizes and observed that for all tier sizes combined, there was a 13% increase in the number of customer limit orders that met the minimum quotation sizes to be eligible for display under the Pilot tiers. While the 13%

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<sup>13</sup> See page 5, #16 and Exhibit 1 of the Cornerstone Study. Many market makers continued to quote in name only; this behavior is not reflected in the actively quoted numbers.

overall increase is meaningful, FINRA observed a significant increase in the number of customer limit orders in securities priced between \$0.20 and \$100.00 that became eligible for display. TABLE 3 below reflects the percentage of customer limit orders that were equal to or greater than the minimum quotation size under both the Pilot and pre-Pilot tier sizes for each defined price range included in either the Pilot or pre-Pilot tier size levels.

**TABLE 3**

<b>Price Range</b>	<b>Pilot Tier Size</b>	<b>Customer Limit Orders <math>\geq</math> Tier Size</b>	<b>Pre-Pilot Tier Size</b>	<b>Customer Limit Orders <math>\geq</math> Tier Size</b>
0.0001-0.0999	10,000	78.29%	5,000	86.30%
0.10-0.1999	5,000	56.89%	5,000	56.89%
0.20-0.5099	2,500	57.35%	5,000	43.30%
0.51-0.9999	1,000	72.81%	2,500	46.05%
1.00-10.00	100	97.86%	500	74.73%
10.01-100.00	100	98.24%	200	87.93%
100.01-174.99	100	90.49%	100	90.49%
175.00-200.00	1	100%	100	96.71%
200.01-500.00	1	100%	25	90.74%
500.01-1,000.00	1	100%	10	64.62%
1,000.00-2,500.00	1	100%	5	61.38%
2,500.00+	1	100%	1	100.00%

FINRA notes that, of the 301,628,686 customer limit orders reported to FINRA's Order Audit Trail System ("OATS") between November 1, 2012 and June 30, 2013, over 86.6% were priced between 0.20 and 100.00. Of particular note, 58.7 million customer limit orders, or almost 20% of all customer limit orders, were priced between \$1.00 and \$10.00.<sup>14</sup> This price range experienced an increase of almost 24% in the number of customer limit orders that met the minimum quotation size to be eligible for display under the Pilot. Further, 181.6 million customer limit orders, or over 60% of all customer limit orders, were priced between \$10.01 and \$100.00. This price range experienced an increase of over 10% in the number of customer limit orders that met the tier sizes and were eligible for display under the Pilot tier sizes. Consequently, an additional 32 million customer limit orders priced between \$1.00 and \$100.00 became eligible for display during the Pilot that otherwise would not have been displayable.

<sup>14</sup> In performing these calculations and arriving at the described results, as noted in Amendment No. 2, FINRA calculated the percentage of customer limit orders at or above the minimum tier size by using all limit orders reported to OATS as being received by a FINRA member, including those received from other FINRA members. FINRA excluded all proprietary orders originated by a member from its calculations.

FINRA believes the material increase in the number of customer limit orders eligible for display directly contributed to the decrease in quoted spreads that were observed for OTC equity securities priced greater than \$0.20 and the decrease in effective spreads for retail trades in securities priced between \$1.00 and \$100.00.

#### **D. Discussion of Comments**

During the notice and comment process for the proposed changes to Rule 6433, commenters raised a variety of concerns regarding the potential impact of the Pilot. The SEC received eight comment letters on the Original Proposal and two comment letters on Amendment No. 1.<sup>15</sup> The primary concerns raised by commenters related to: (1) market-maker behavior, (2) market quality (including on liquidity and spreads), and (3) customer limit order display.<sup>16</sup> As discussed more fully above (*See* Section IV) and in the Cornerstone Study, FINRA believes that the overall impact of the Pilot on market maker behavior and market quality was neutral to positive, and that the Pilot's impact on customer limit order display was positive.

##### Market Maker Behavior

Commenters raised concerns that the Pilot would result in a reduction in market makers quoting OTC equity securities, which, in turn, could erode liquidity in the marketplace.<sup>17</sup>

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<sup>15</sup> See Letters to Elizabeth M. Murphy, Secretary, Commission, from Suzanne H. Shatto, Seattle, Washington, dated October 20, 2011; Naphtali M. Hamlet, Seattle, Washington, dated October 21, 2011; Daniel Zinn, General Counsel, OTC Markets Group, Inc., dated November 10, 2011; Michael T. Corrao, Managing Director, Knight Capital Group, Inc., dated November 16, 2011; R. Cromwell Coulson, President and CEO, OTC Markets, dated November 18, 2011; Daniel Zinn, General Counsel, OTC Markets Group, Inc., dated December 29, 2011; Michael T. Corrao, Managing Director, Knight Capital Group, Inc., dated January 13, 2012 and Daniel Zinn, General Counsel, OTC Markets Group, Inc., dated February 14, 2012 on the Original Proposal. See Letter from Daniel Zinn, General Counsel, OTC Markets Group, Inc., dated May 7, 2012 and Michael T. Corrao, Managing Director, Knight Capital Group, Inc., dated May 7, 2012 on Amendment No. 1. (All of the letters from Knight Capital Group, Inc. are collectively referred to as "Knight letters." All of the letters from OTC Markets Group, Inc. are collectively referred to as "OTC Markets letters.").

<sup>16</sup> FINRA notes that the majority of the comments received related to FINRA's Original Proposal. FINRA revised the originally proposed tiers in Amendment No. 1 and proposed to adopt those tiers on a pilot basis in Amendment No. 2. FINRA's summary and responses to comments are available at <http://www.finra.org/Industry/Regulation/RuleFilings/2011/P124615>.

<sup>17</sup> See Knight letters.

As noted above, there was an initial move to name-only quotations by some market makers, but as the Pilot progressed FINRA saw an overall increase in the number of market makers quoting OTC equity securities over the duration of the Pilot. Accordingly, because the concern about the departure of quoting market makers did not materialize, FINRA does not believe there is evidence to support the position that market liquidity was harmed by fewer market makers.

#### Impact on Market Quality

Certain commenters also believed that reduced minimum tier sizes would lead to reduced displayed liquidity and less efficient, more-costly trading.<sup>18</sup> FINRA notes that the evidence collected during the Pilot indicates that, as was previously the case, market makers largely tended to quote at the required minimum size. In addition, the data shows that displayed depth at the inside market decreased for those securities whose minimum quote size decreased. While displayed liquidity at the inside market declined for these issues due to narrower spreads, Cornerstone found that there was not a significant reduction in total depth displayed within consistent price bands at 1%, 2%, 5% and 10% surrounding the midpoint. Moreover, based on the number of trades executed in amounts exceeding the minimum quote sizes, Cornerstone also concluded that “liquidity continued 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.” Therefore, FINRA does not believe there is sufficient evidence to suggest that trading was either less efficient or more costly as a result of the revised minimum quotation sizes.

Concerns also were raised that the revised tier sizes could increase realized spreads.<sup>19</sup> As discussed in Section IV.A. and in the Cornerstone Study, FINRA believes the Pilot had a neutral to positive impact on market quality, including on liquidity and effective spreads, for the large majority of OTC issues.<sup>20</sup>

#### Limit Order Display

Comments also were raised regarding whether the Pilot would positively impact limit order display as FINRA anticipated. In particular, one commenter stated that the proposal would have a negligible effect on the display of customer limit orders in OTC equity securities, and questioned whether such change in display would offset the negative consequences on other aspects of market quality.<sup>21</sup>

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<sup>18</sup> See Knight letters and OTC Markets letters.

<sup>19</sup> See OTC Markets letters.

<sup>20</sup> See Section IV and the Cornerstone Study.

<sup>21</sup> See OTC Markets letters.

As discussed above in Section IV, the decrease in the minimum quotation size substantially increased the number of customer limit orders eligible for display. Specifically, under the Pilot, FINRA calculated that there was a 13% increase in the number of limit orders eligible for display, with the most significant increases in securities priced between \$0.20 and \$100.00.

## **V. FINRA RECOMMENDATION**

Based upon FINRA's experience to date with the tier sizes operational during the Pilot and the information reflected above and in Appendix A, FINRA believes that the Pilot has accomplished its original objectives of: (1) simplifying the structure of the tiers; (2) modernizing the minimum sizes; (3) providing for uniform treatment of types and sources of quotations that would be subject to the Minimum Quotation Size Rule; and (4) improving display eligibility for customer limit orders.

In addition, as discussed above, while FINRA believes that the Cornerstone Study generally shows that the Pilot had a neutral to positive impact on OTC market quality for the majority of OTC equity securities and tiers, evidence for Tier 1 securities was mixed though not conclusive. Thus, recommends that the Pilot tiers be adopted for all OTC equity securities on a permanent basis.

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

**Cornerstone Research**

September 13, 2013

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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:

$$t = \frac{x_1 - x_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

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,

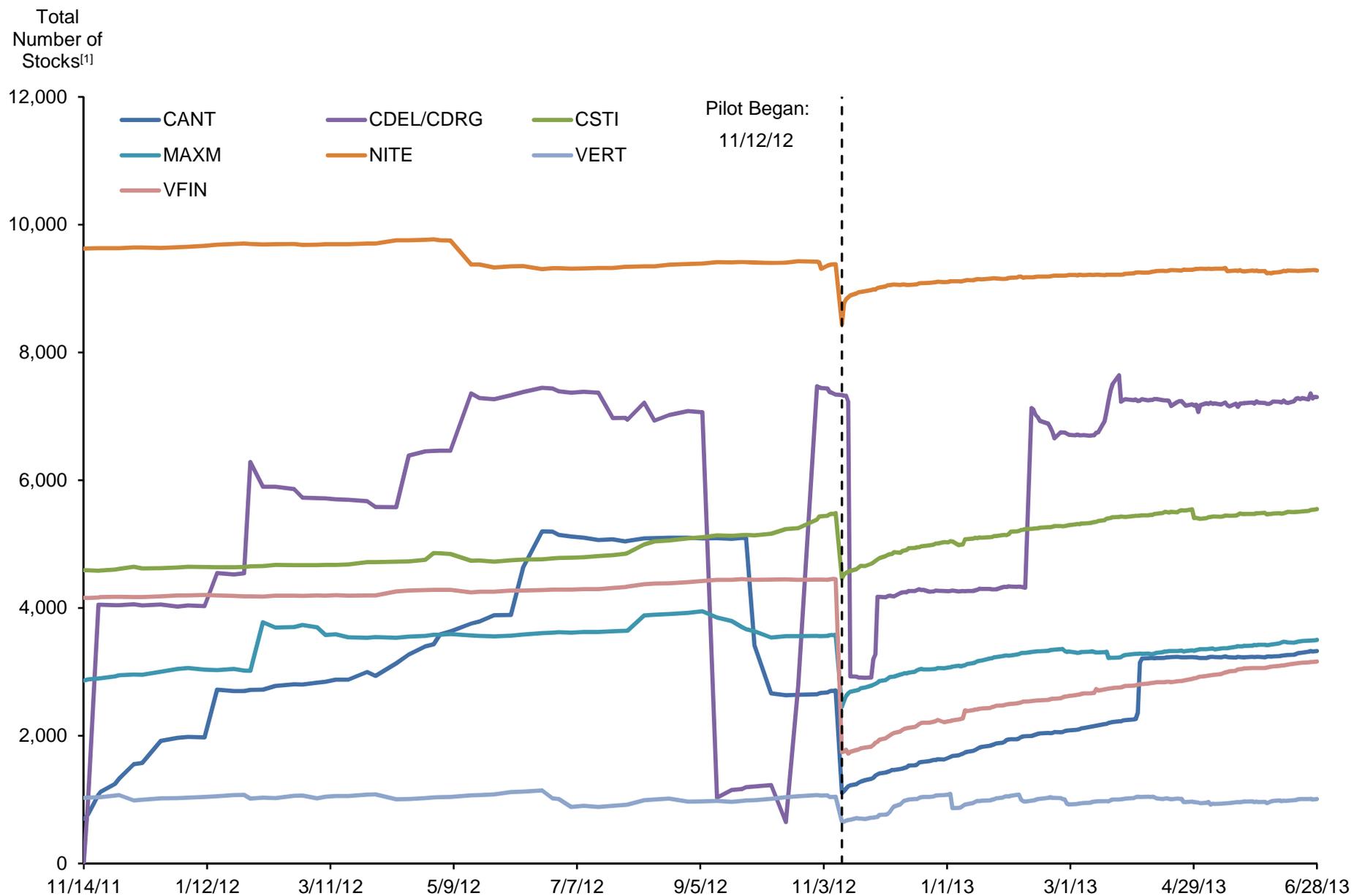
where there was a statistically significant increase the executability of hypothetical large market orders on the bid side. For these tiers there was also a statistically significant decrease in the price impact measure described above. For Tiers 1 and 2, there were statistically significant increases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



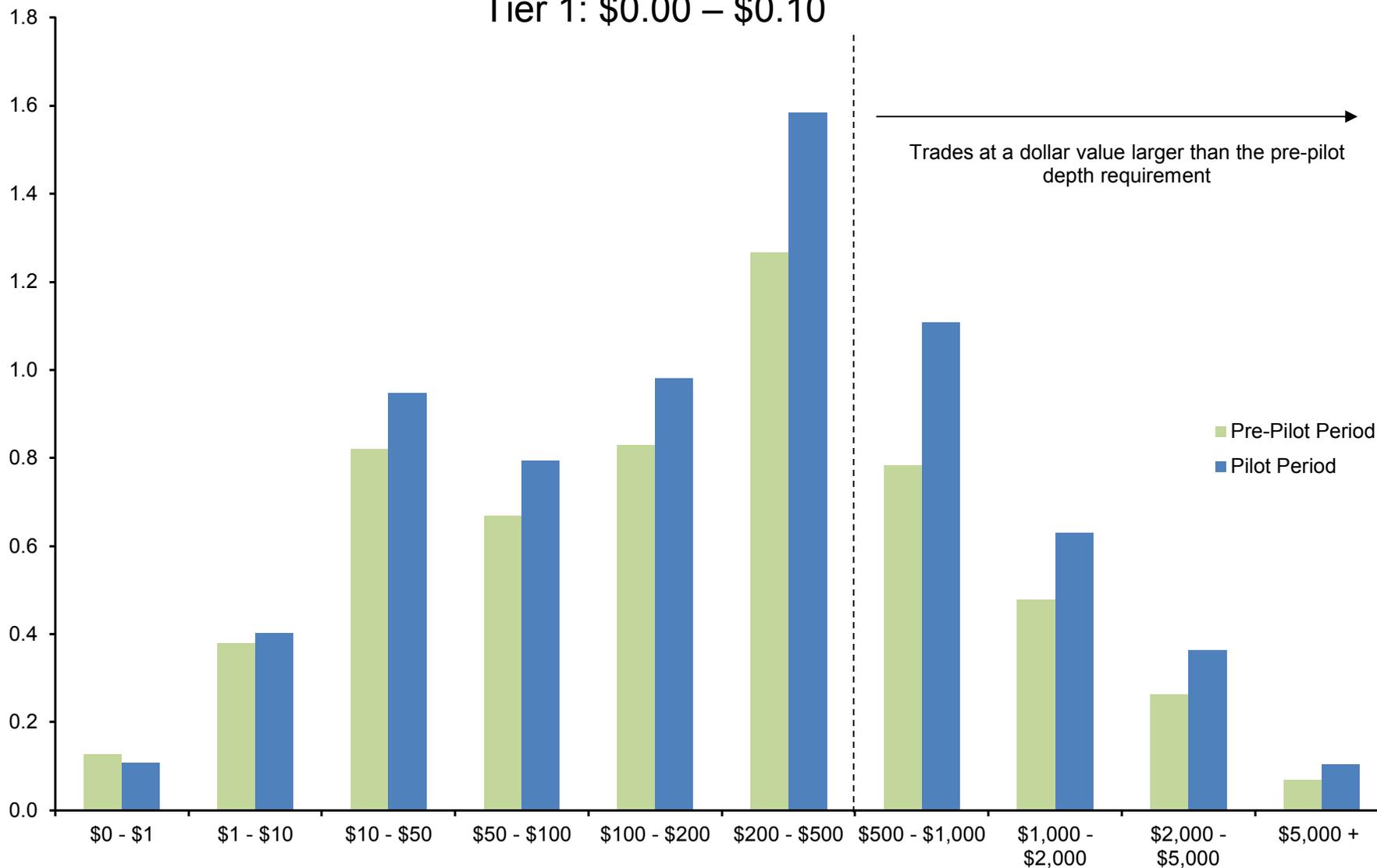
Note:

[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

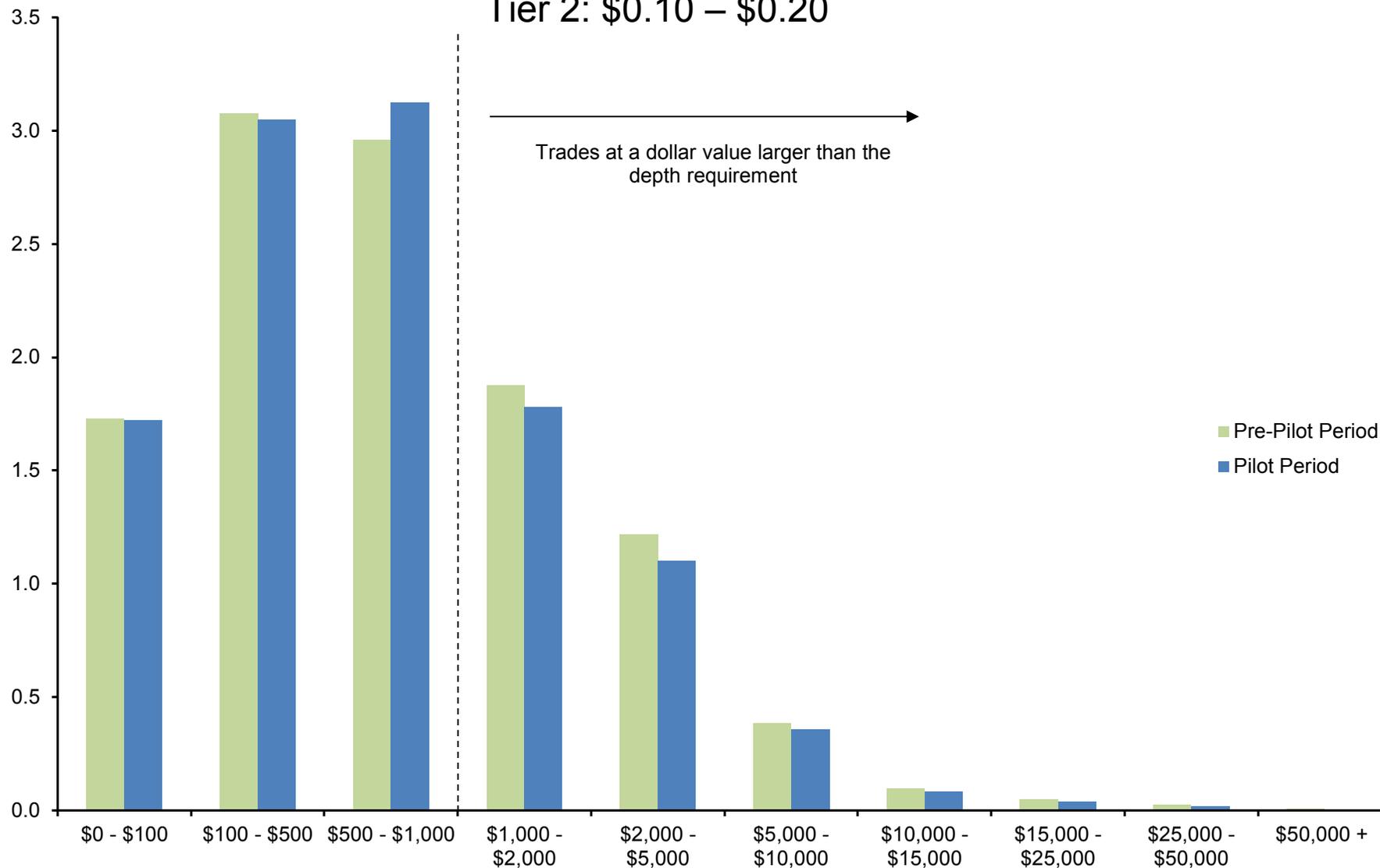
Note:

- [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.

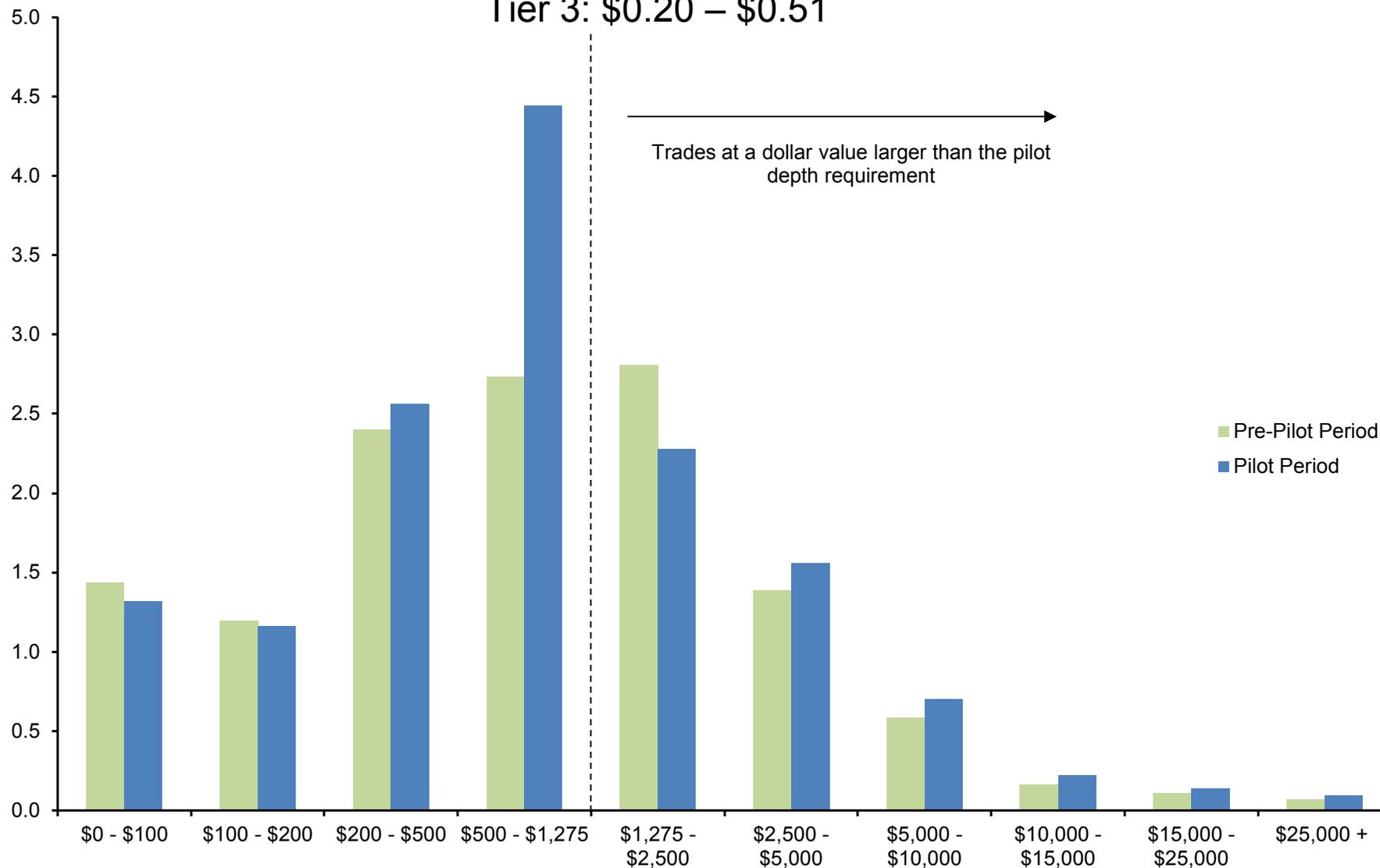
[2] For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirement of 5,000 shares.

[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

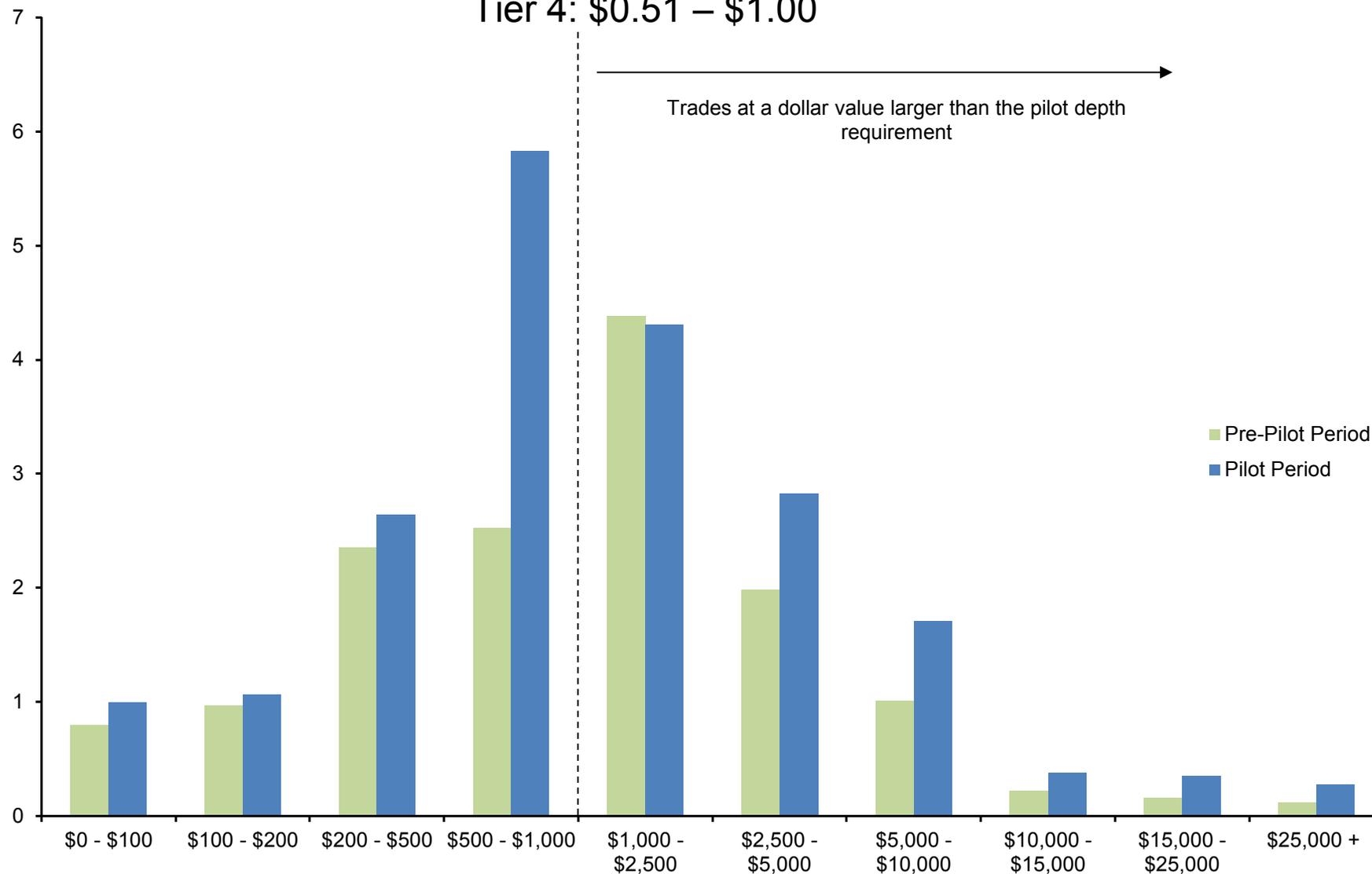
Note:

- [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

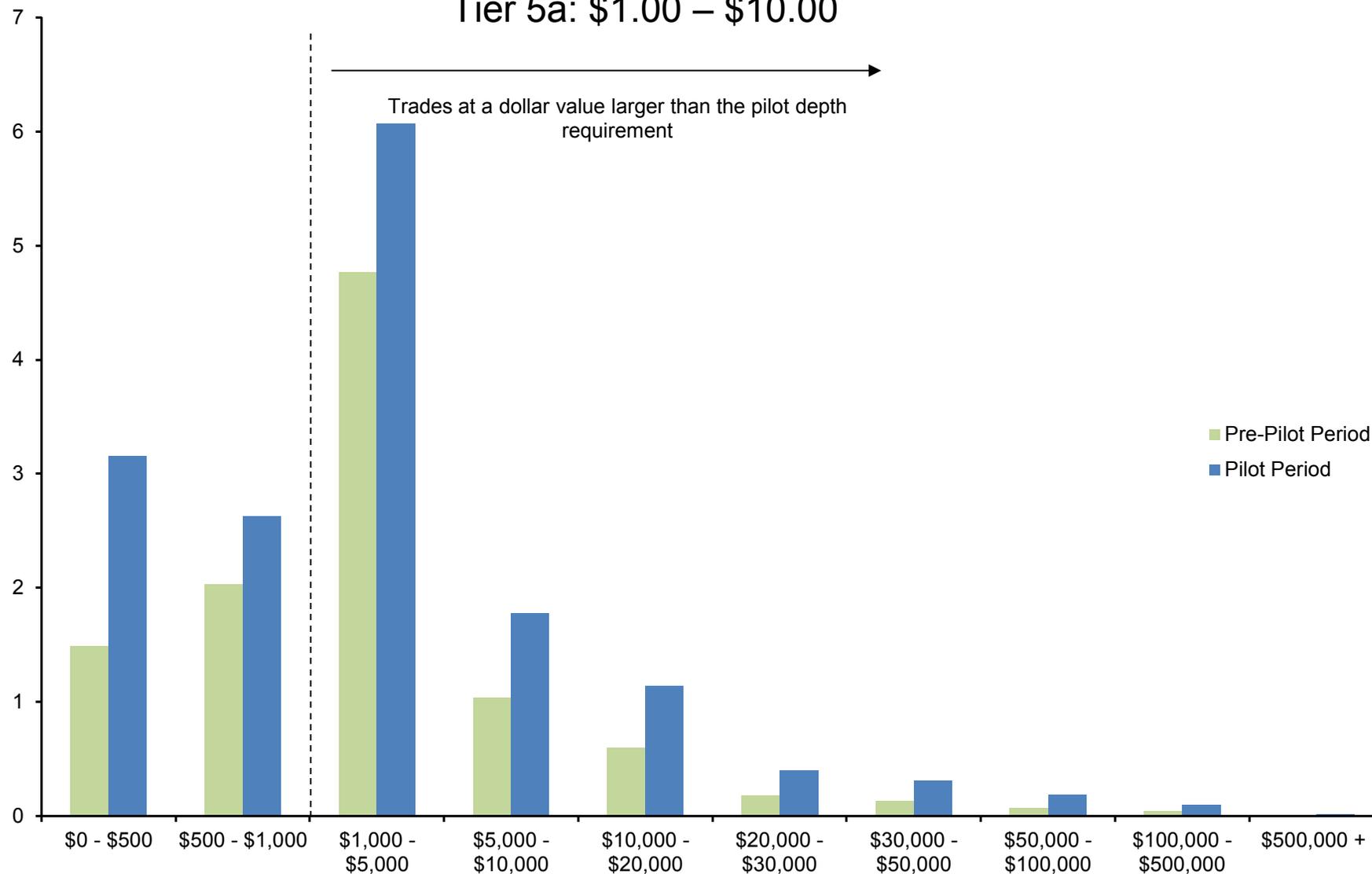
Note:

- [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

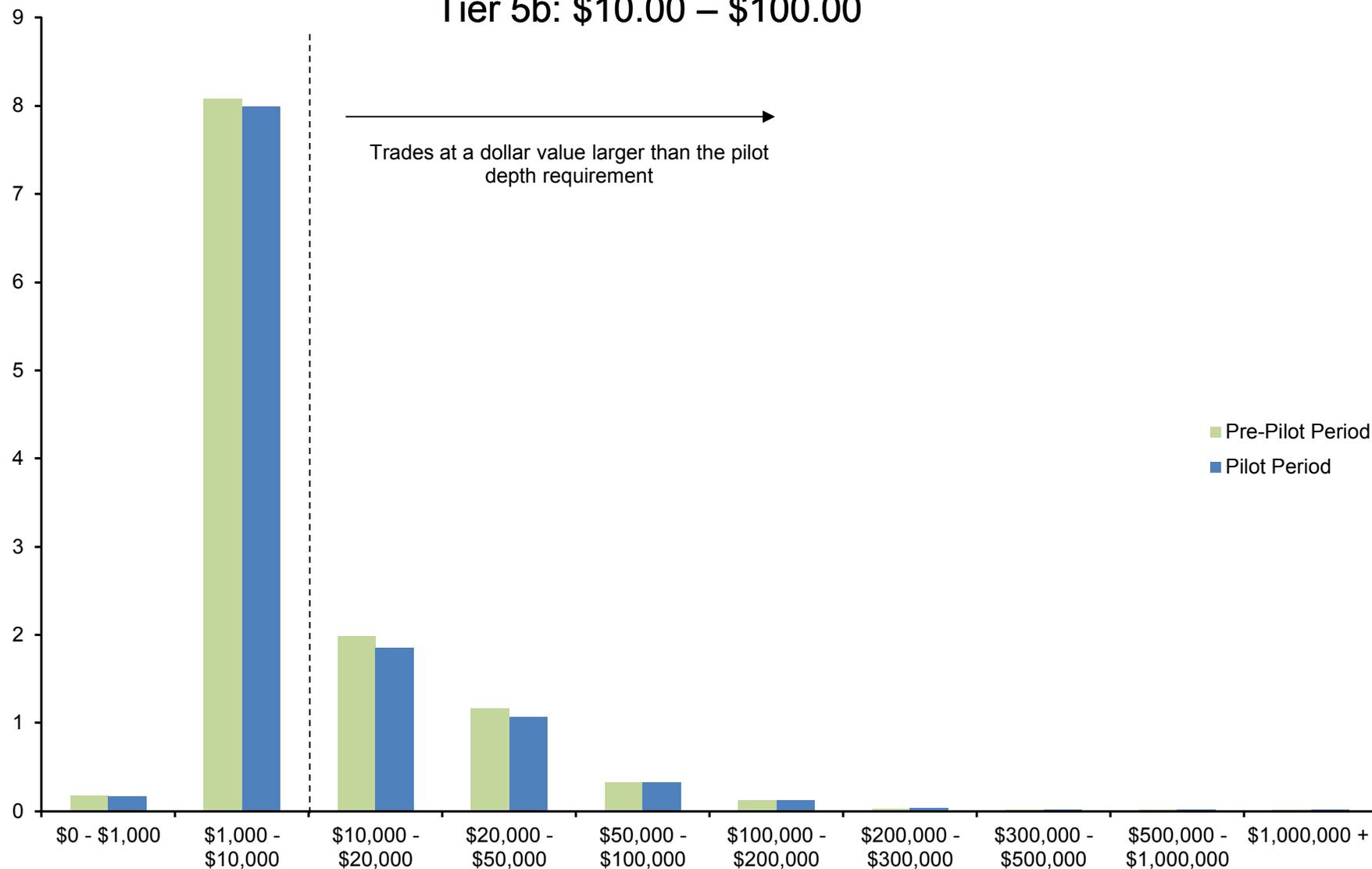
Note:

- [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:

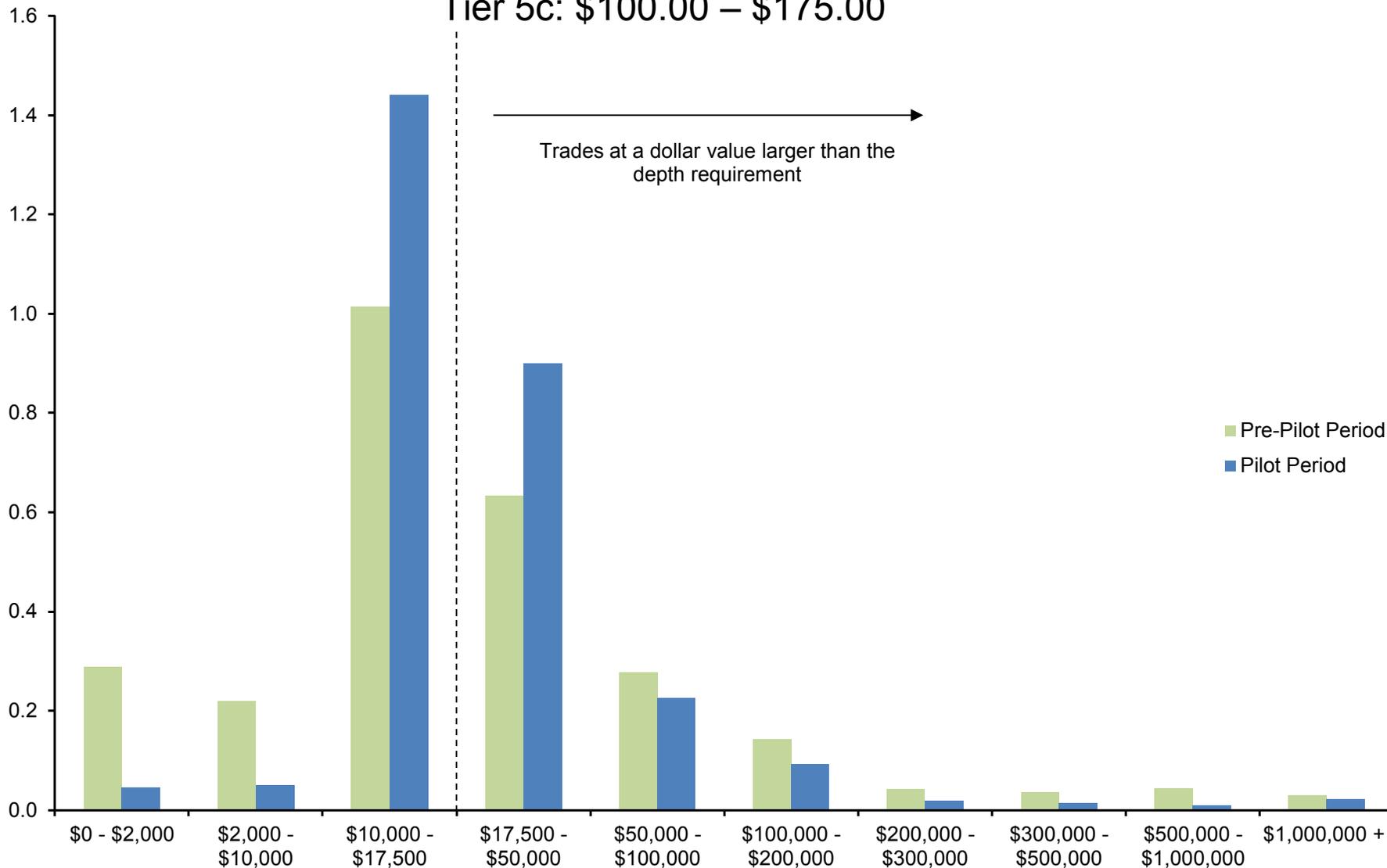
- [1] A stock/day is day for a given stock where the quote data does not span a tier.
- [2] For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.
- [3] Trades executed between November 1, 2012 and November 11, 2012 are excluded.

# 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:

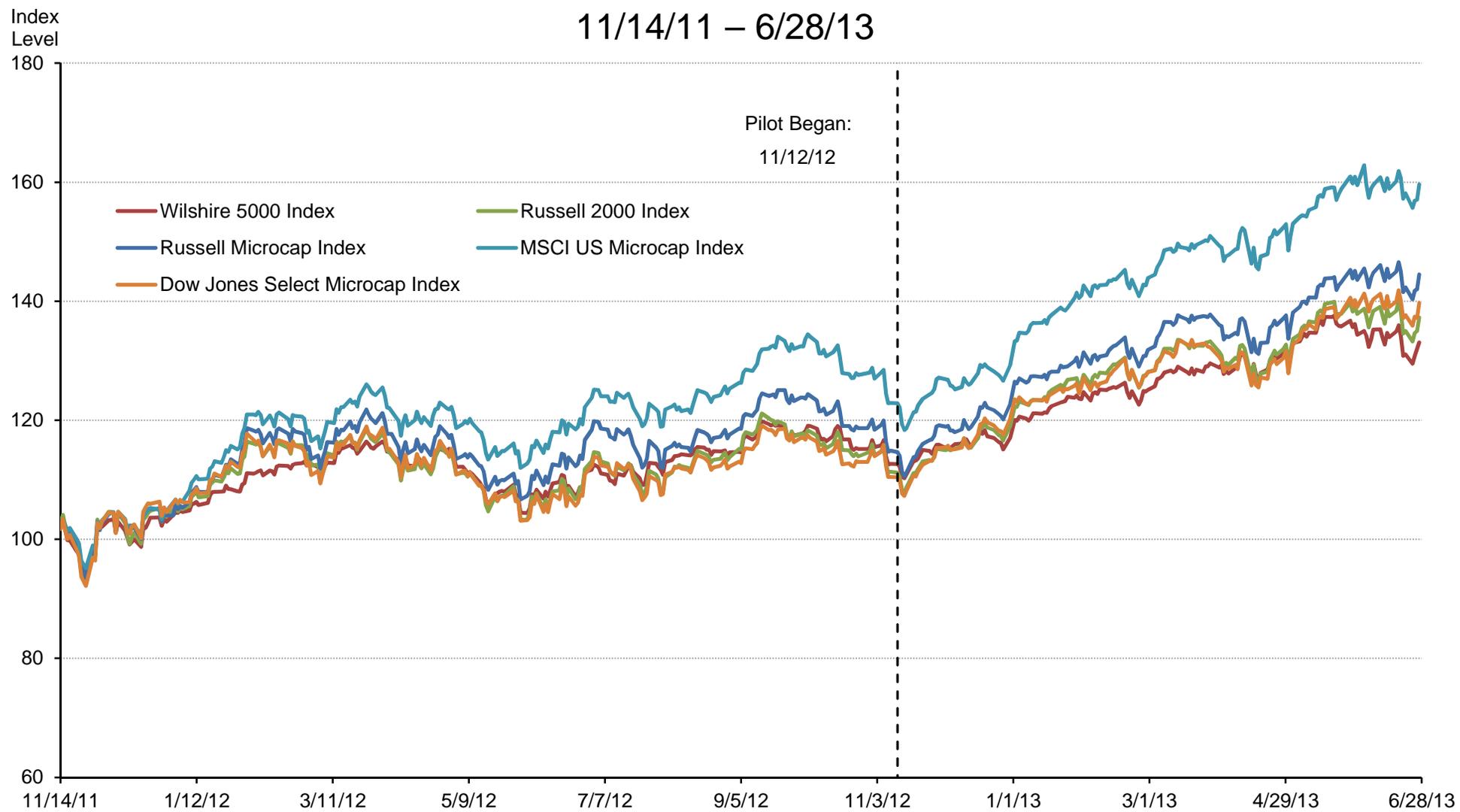
[1] A stock/day is day for a given stock where the quote data does not span a tier.

[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

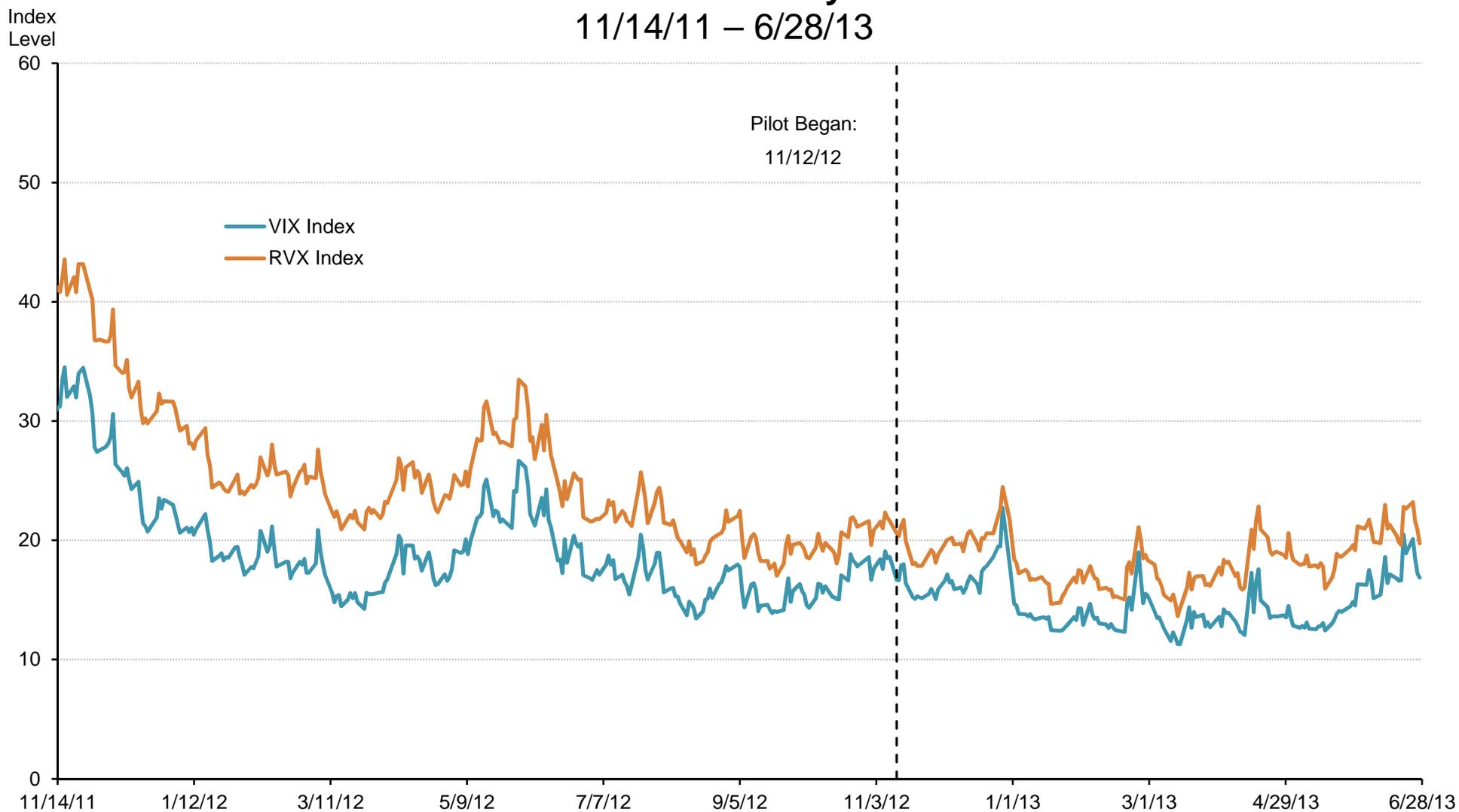
## 11/14/11 – 6/28/13



Source: Bloomberg

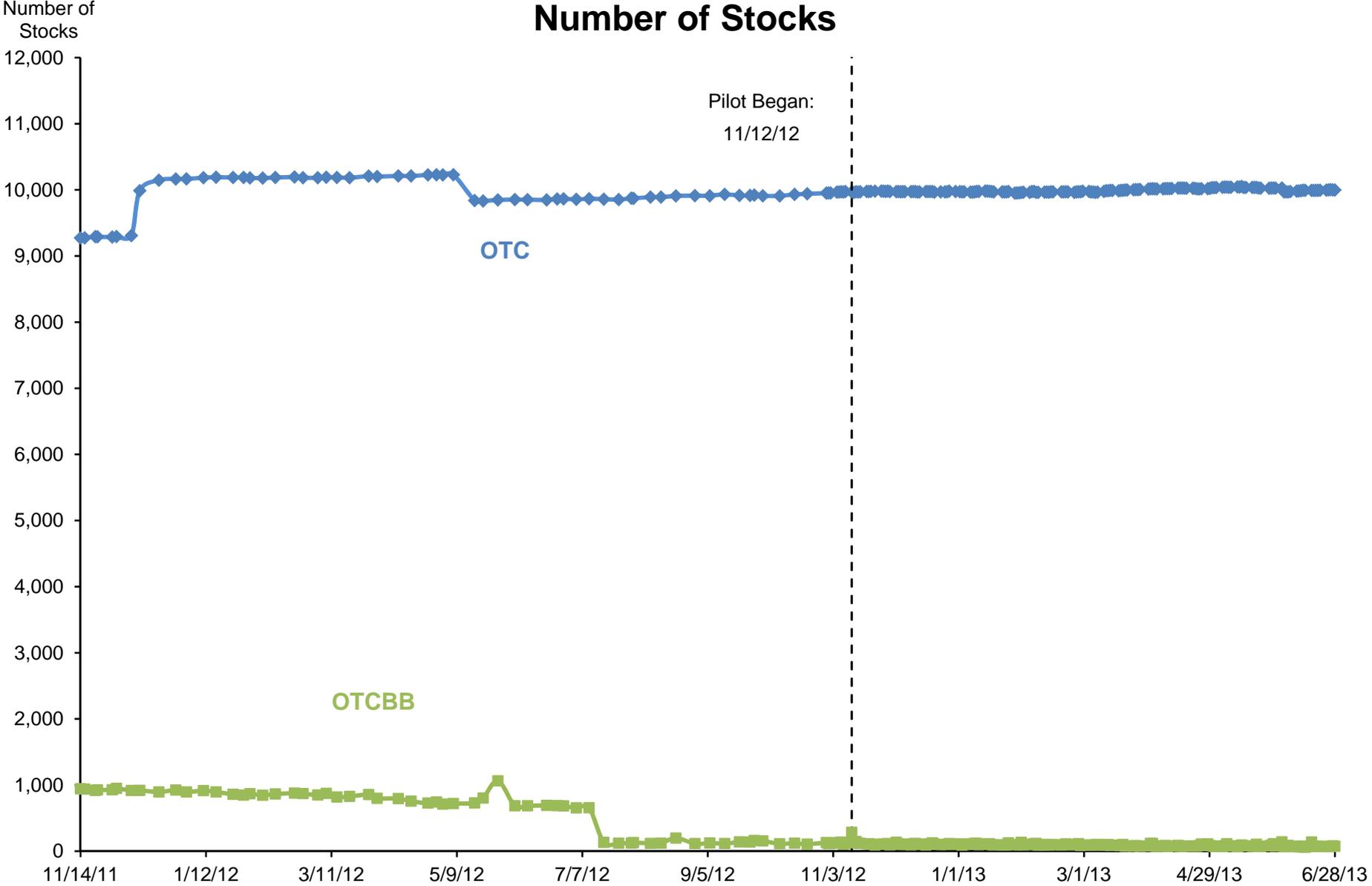
Note: The indices are scaled down by a constant deflator. The deflator is chosen for each index such that the index price on 11/1/11 is 100.

## VIX and RVX Volatility Indices 11/14/11 – 6/28/13



Source: Bloomberg

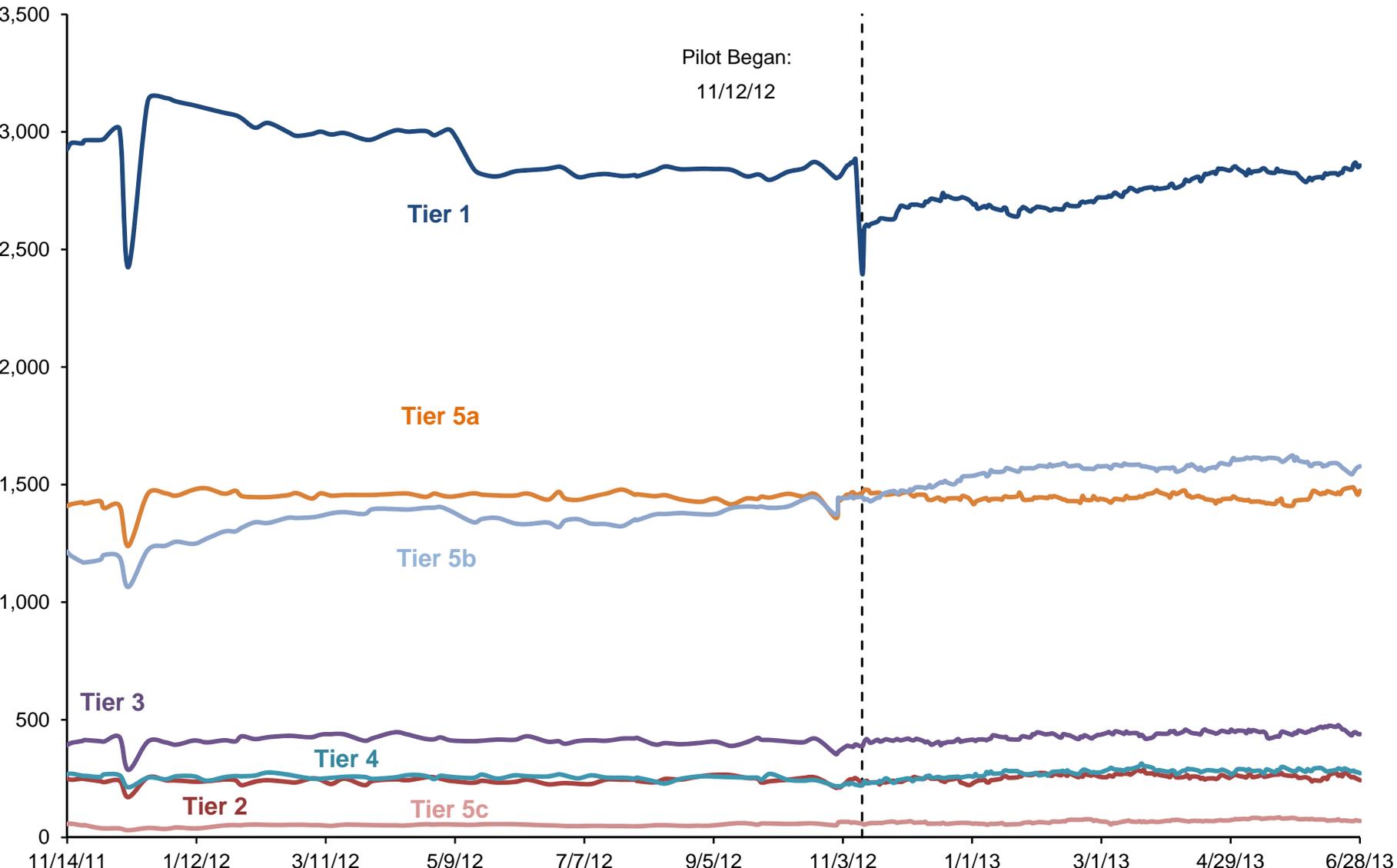
Note: VIX is the CBOE SPX Volatility Index and reflects implied volatilities for first-and-second-month options on the S&P 500 Index. RVX is the Russell Small Cap Volatility Index and reflects implied 30-day volatilities on Russell 2000 index options.



Source: OTC Link

Number of Stocks

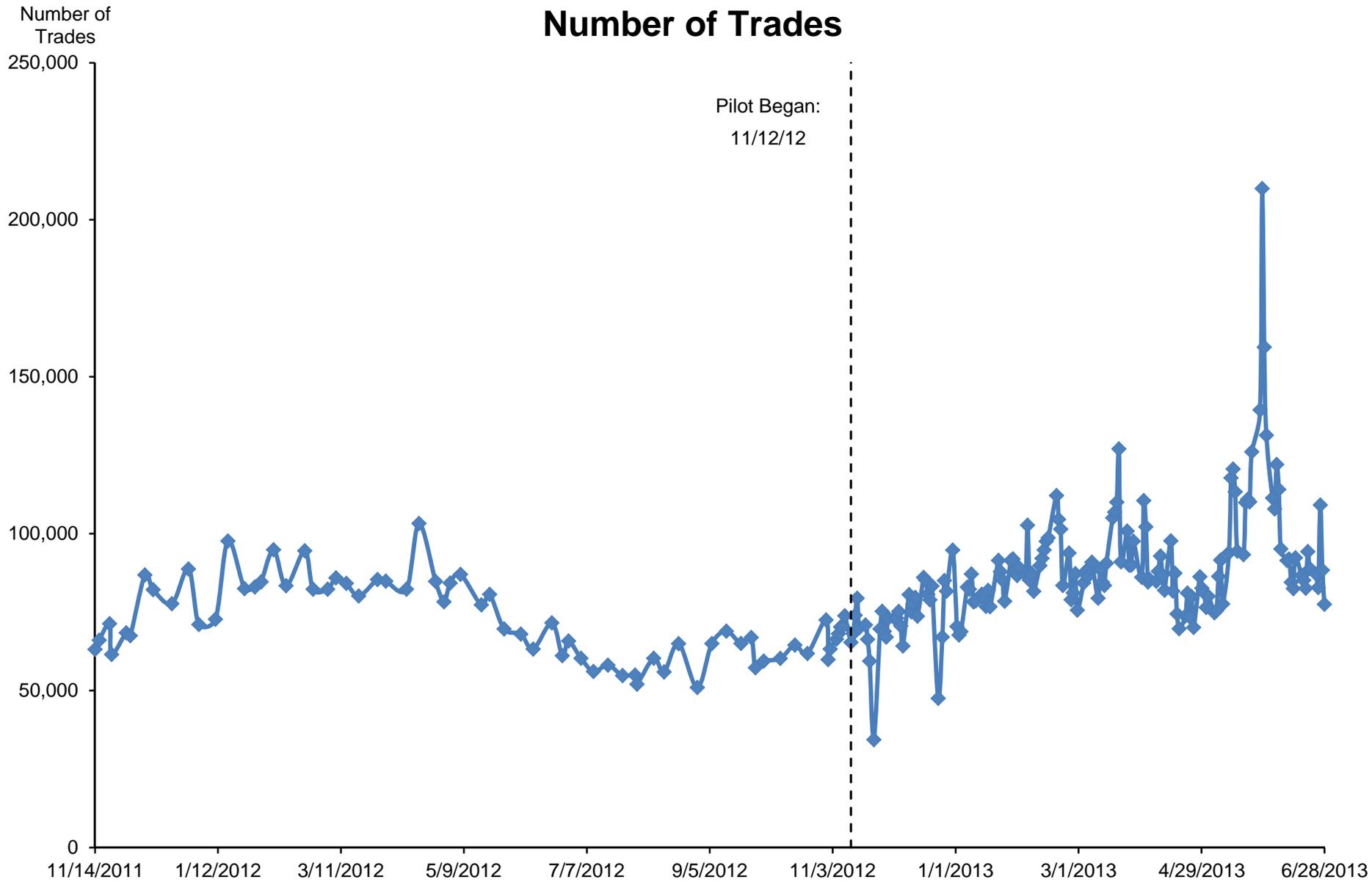
# Number of Stocks By Tier



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.

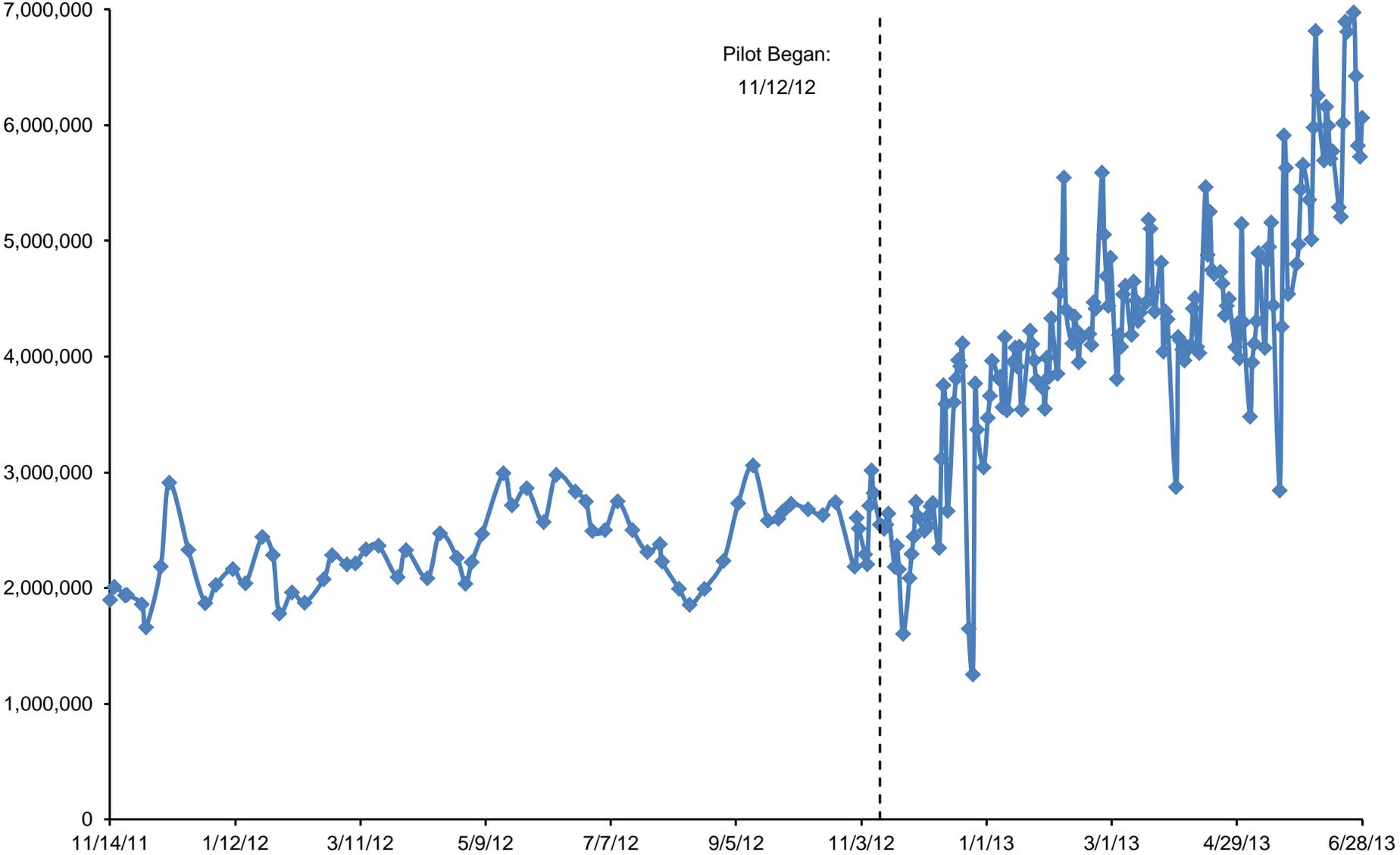
# Number of Trades



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

Number of Quotes

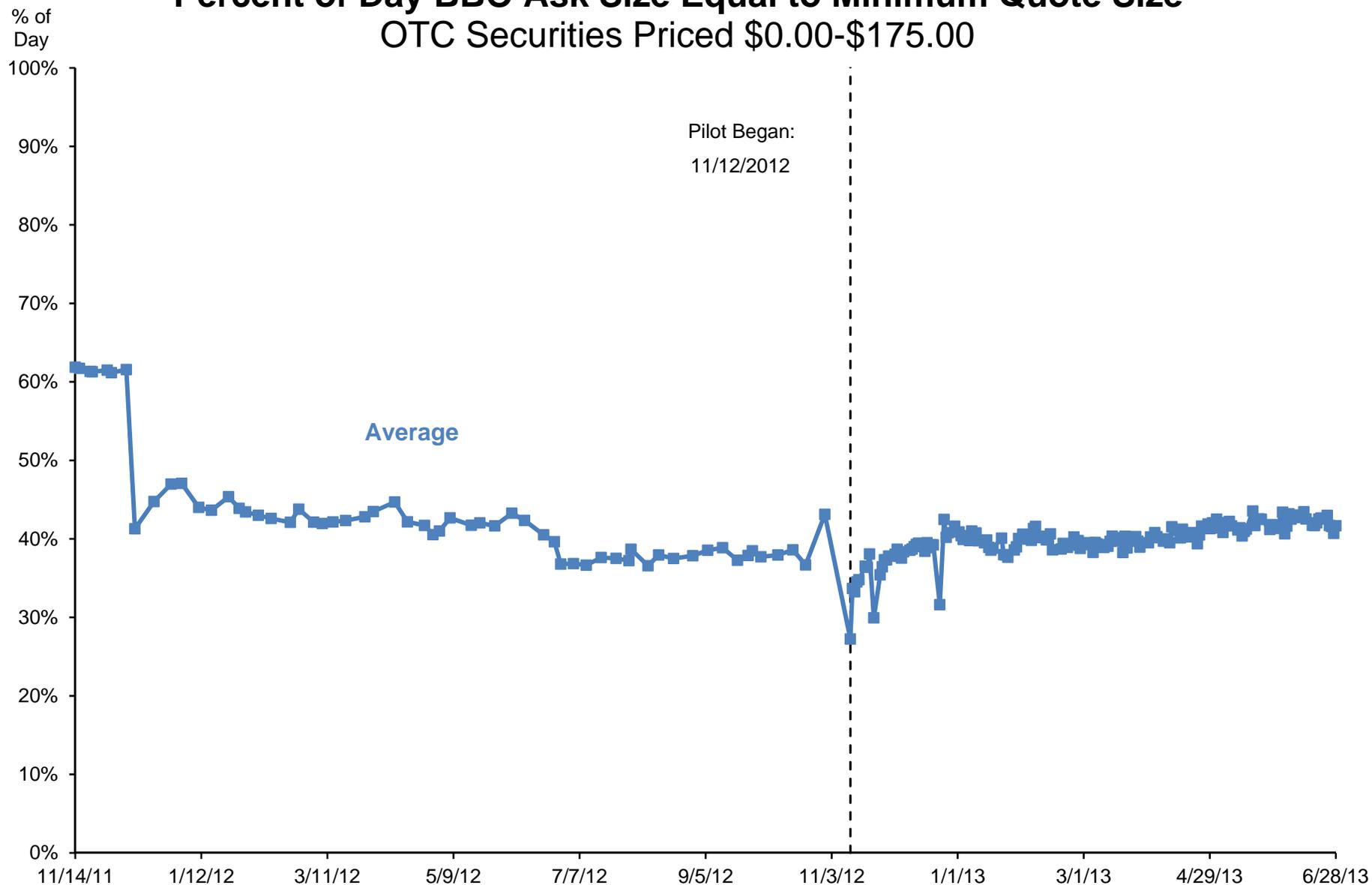
# Number of BBO Quotes



Pilot Began:  
11/12/12

Source: OTC Link

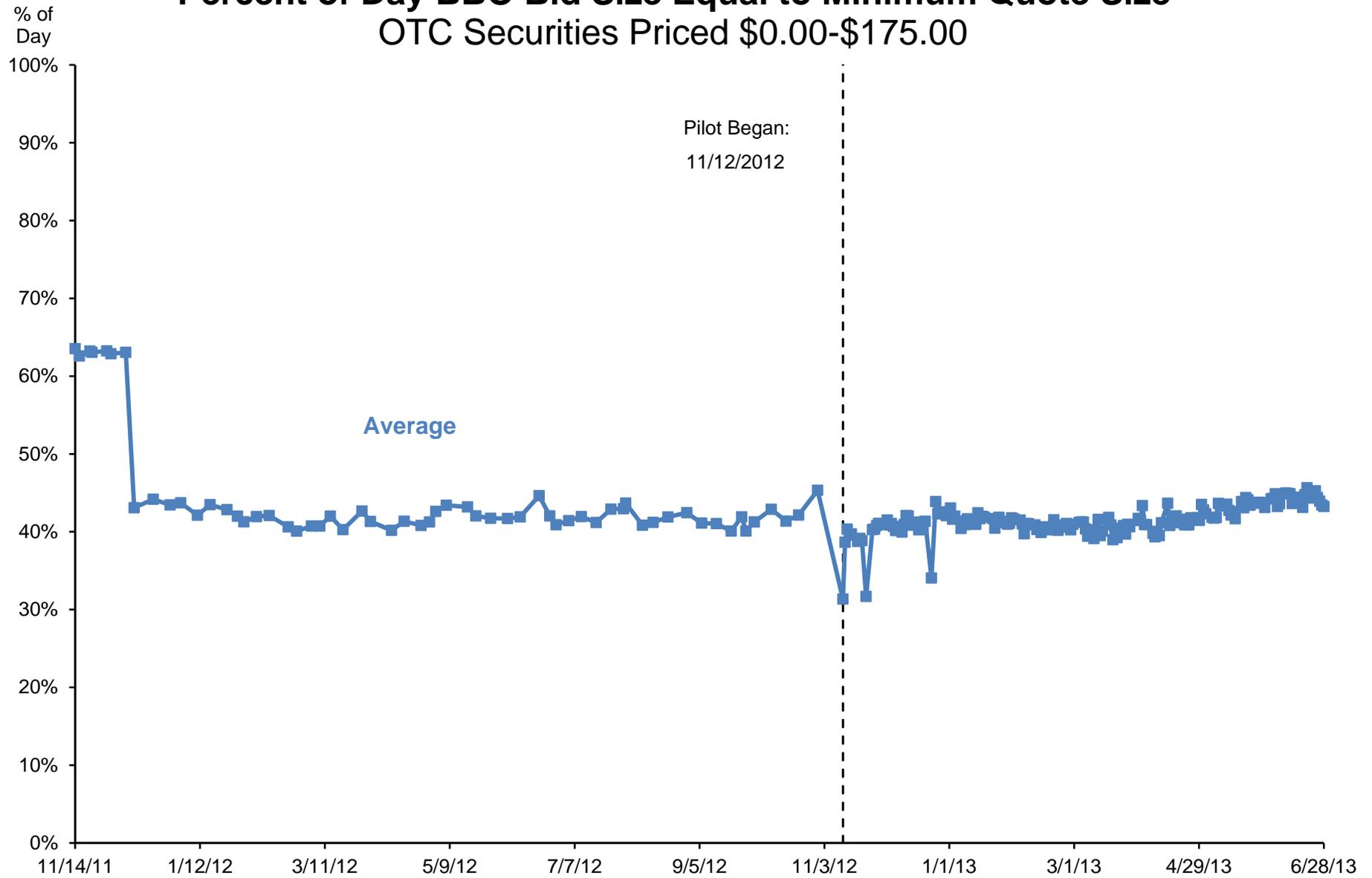
# Percent of Day BBO Ask Size Equal to Minimum Quote Size OTC Securities Priced \$0.00-\$175.00



Source: OTC Link

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

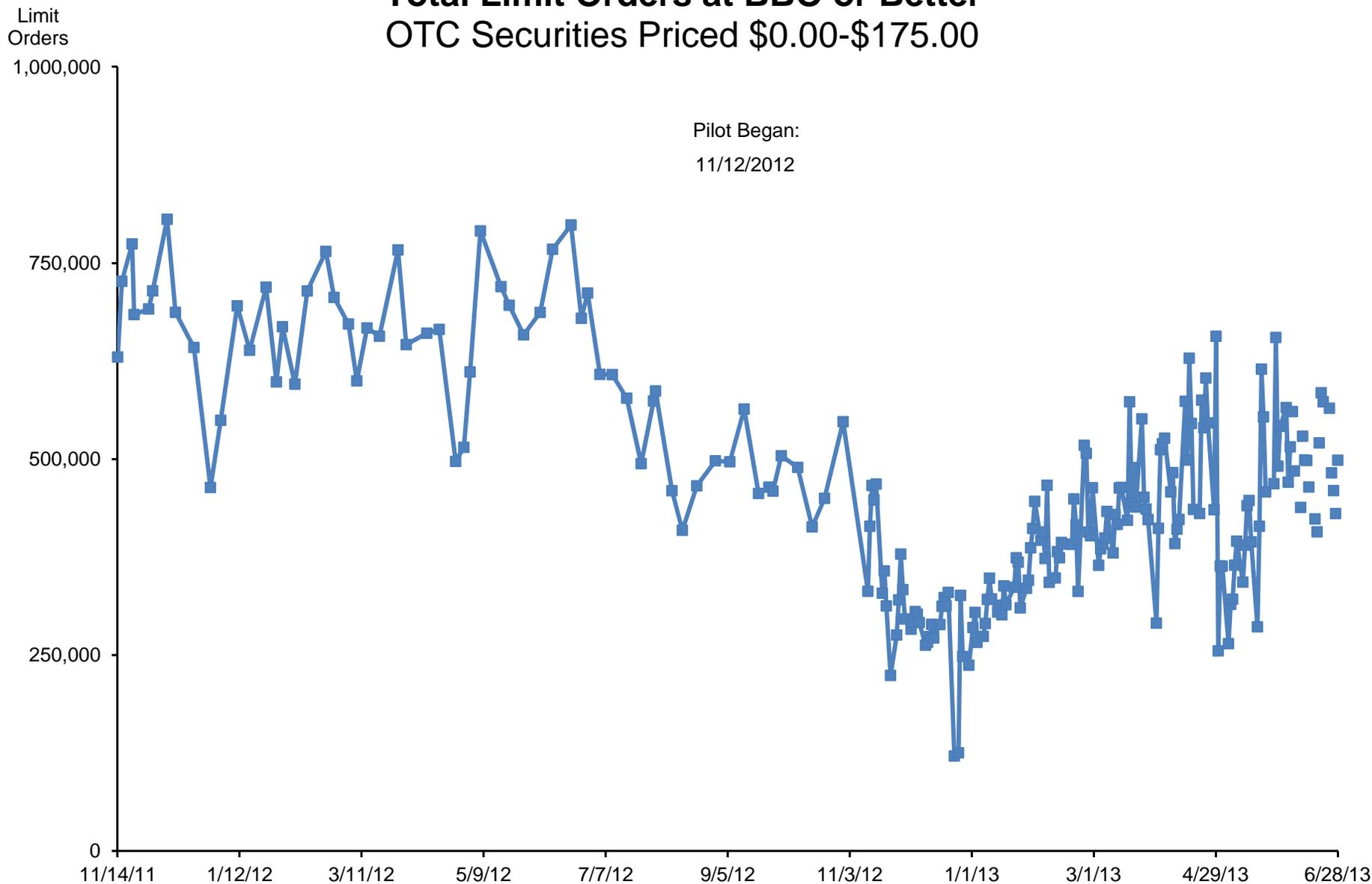
# Percent of Day BBO Bid Size Equal to Minimum Quote Size OTC Securities Priced \$0.00-\$175.00



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

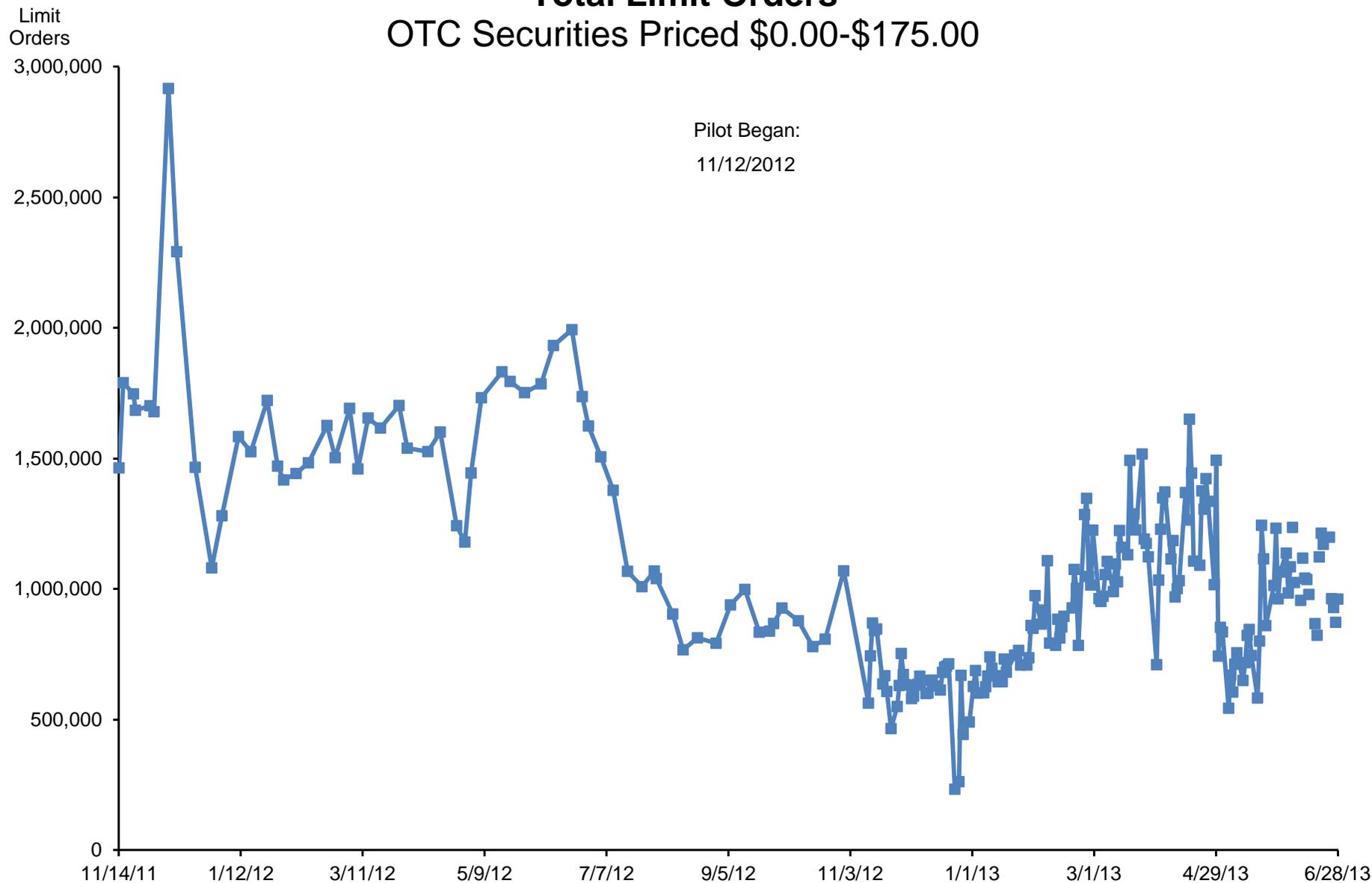


Source: OTC Link

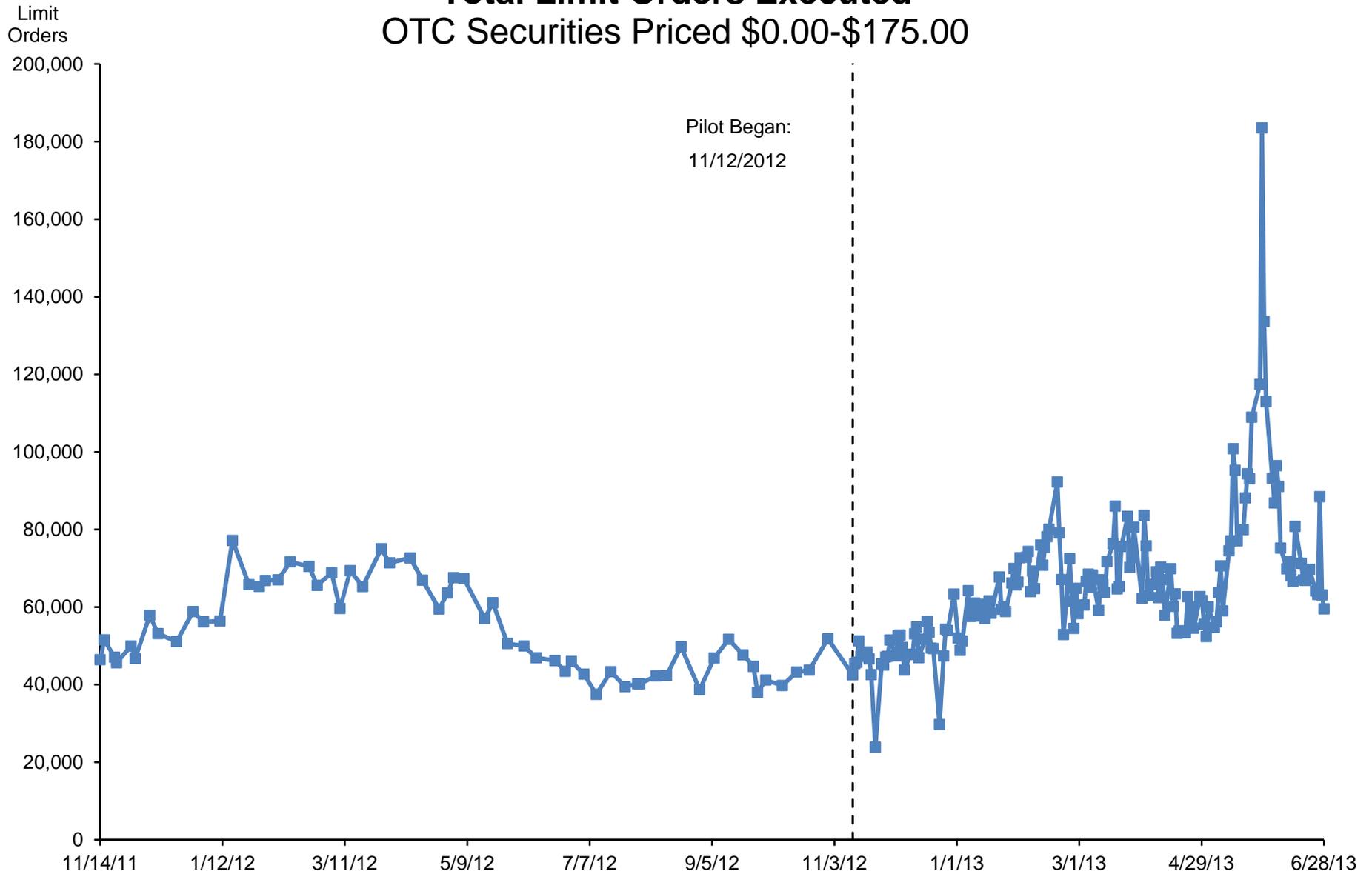
Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO for stocks priced according to amended tier definitions.

# 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

## Pre-Rule Randomly Selected Dates

<b>Month</b>	<b>Date 1</b>	<b>Date 2</b>	<b>Date 3</b>	<b>Date 4</b>	<b>Date 5</b>
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	<i>Increased</i>	<i>Maintained</i>	<i>Decreased</i>	<i>Decreased</i>	<i>Decreased</i>	<i>Decreased</i>	<i>Maintained</i>
<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.

## Time-Weighted Quoted Spread

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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.

## Volume-Weighted Effective Spread

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – June 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

## 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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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.

## 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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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.

## 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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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.

## 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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

Tier	Minimum Quotation Size Change	Pre-Rule Sample (Nov 2011 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
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

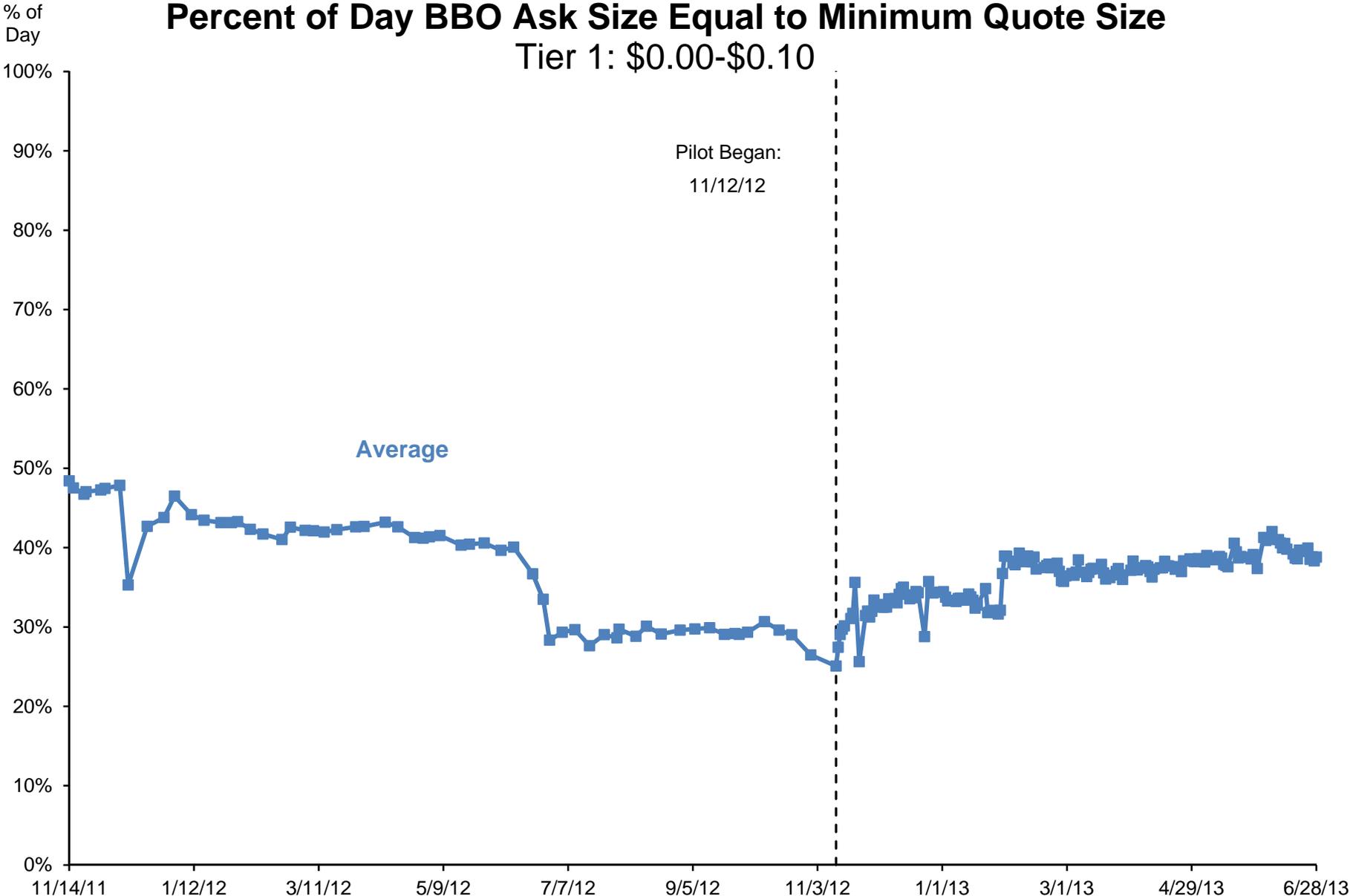
Tier	Minimum Quotation Size Change	Pre-Rule Sample (Mar 2012 – Oct 2012) [1]			Post-Rule (Nov 12, 2012 – Jun 2013)			t-statistic	p-value
		Number of Stocks	Mean	Median	Number of Stocks	Mean	Median		
1	Increased	4,363	0.4609	0.1936	3,960	0.4965	0.7129	4.15	<0.001
2	Maintained	2,069	0.2551	0.0000	2,008	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

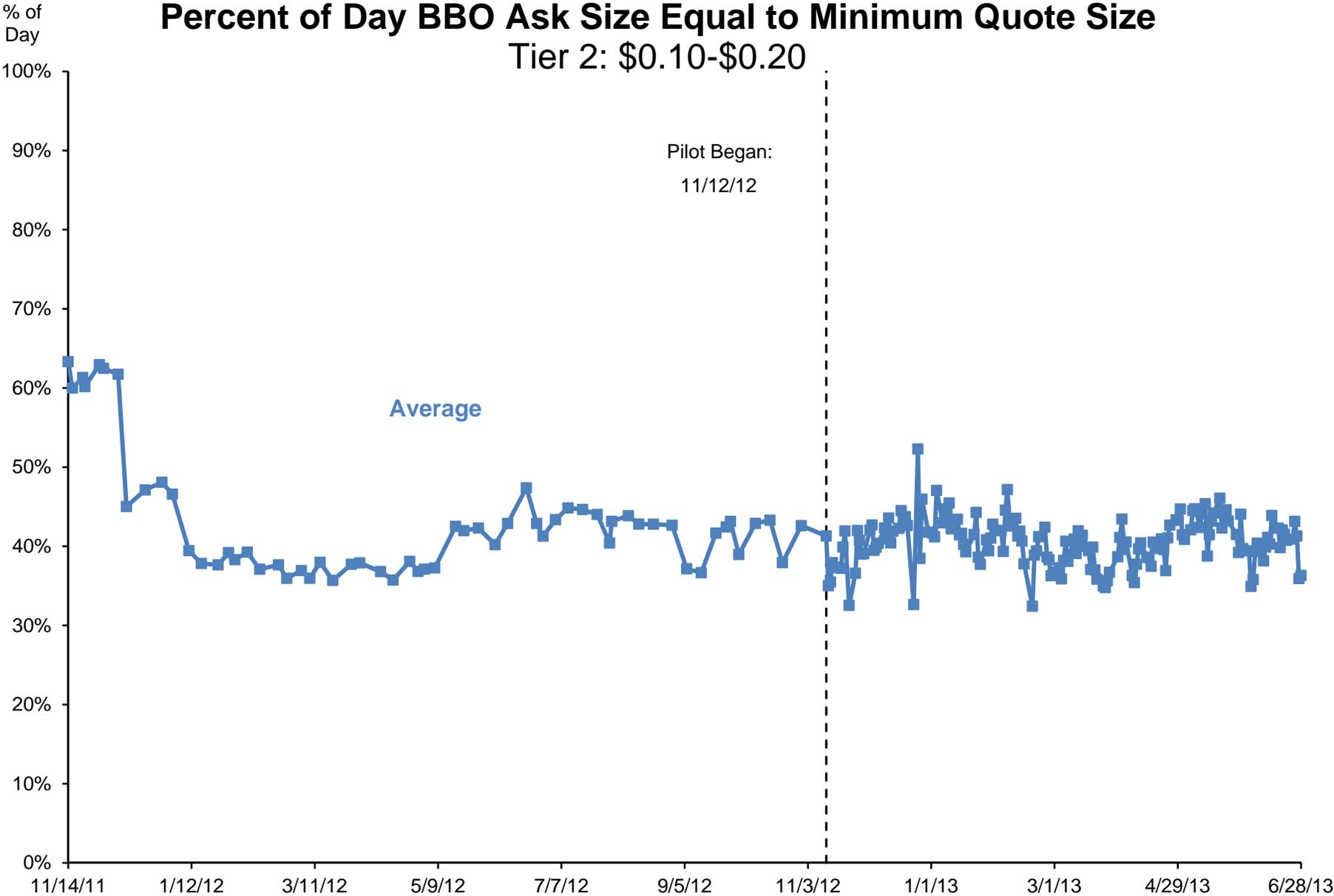
Note:

[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.



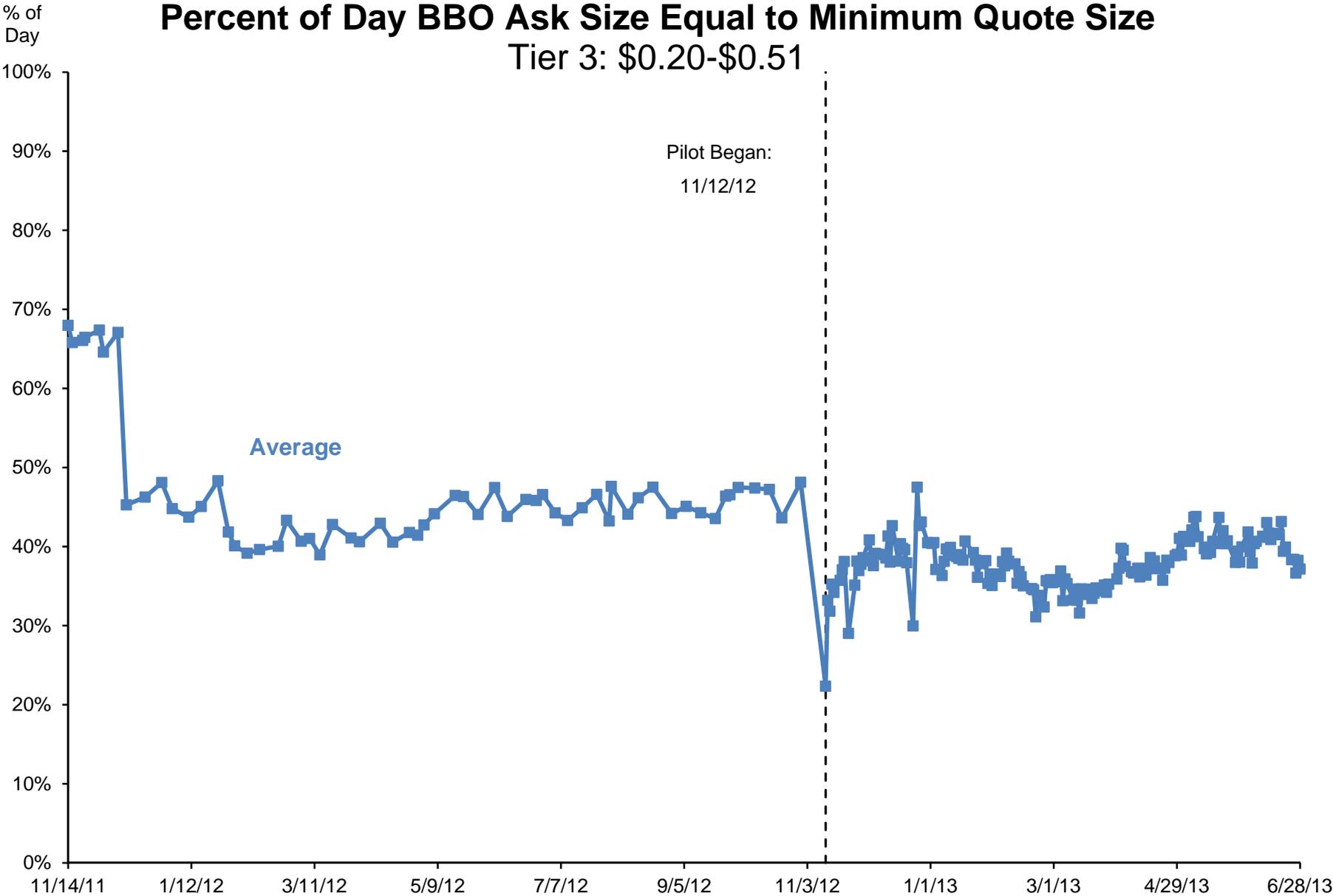
Source: OTC Link  
Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.



Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

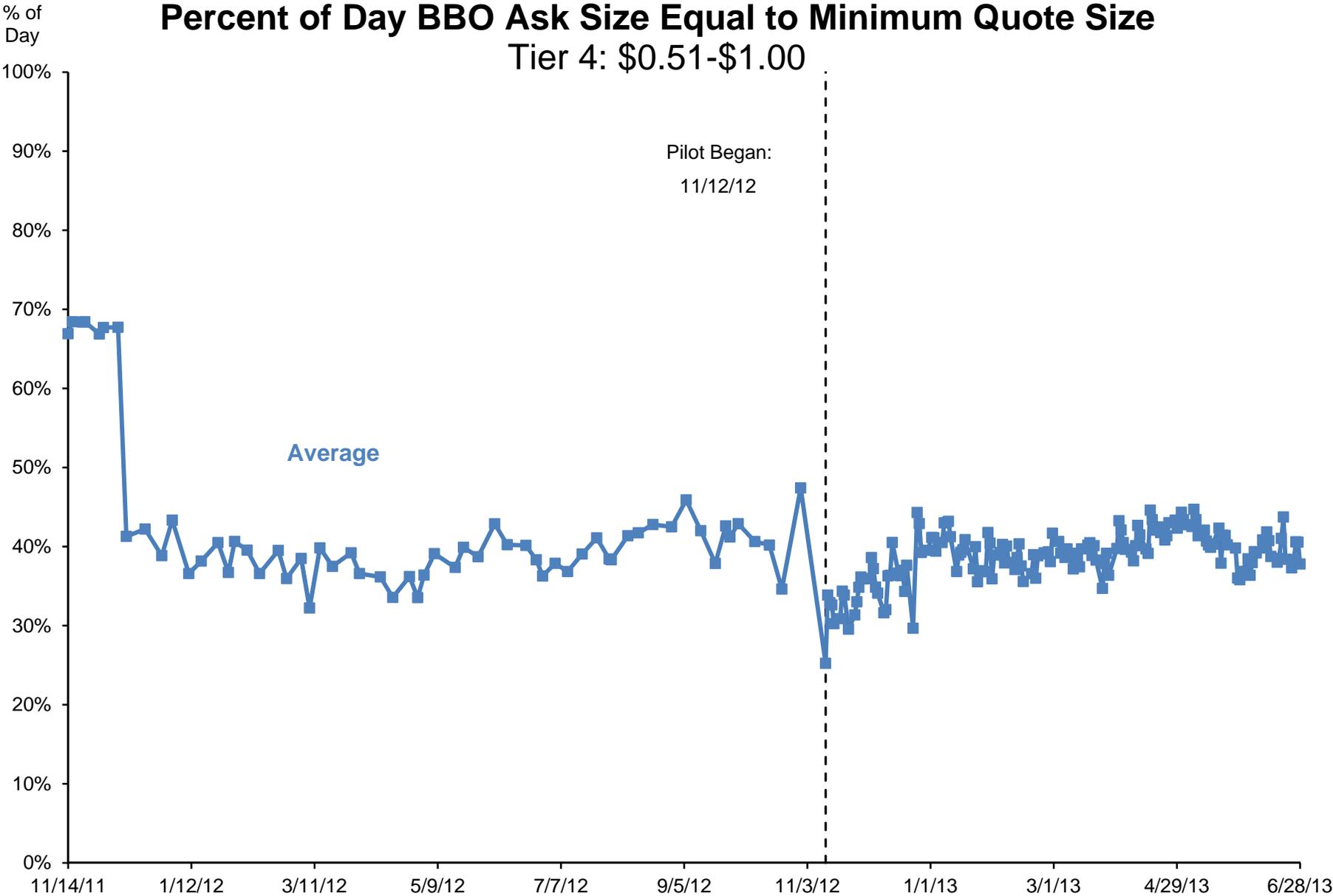
# Percent of Day BBO Ask Size Equal to Minimum Quote Size Tier 3: \$0.20-\$0.51



Source: OTC Link

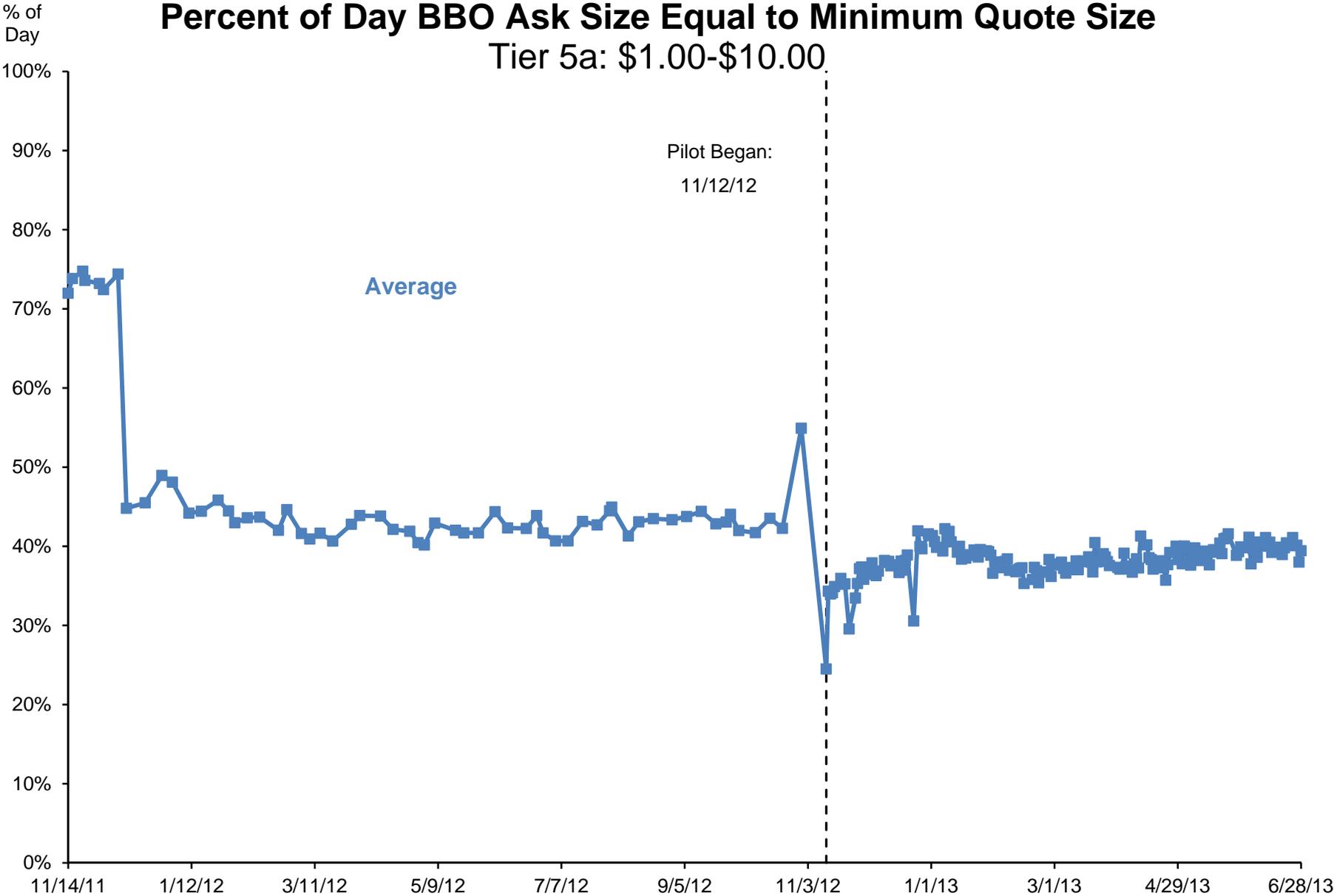
Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

# Percent of Day BBO Ask Size Equal to Minimum Quote Size Tier 4: \$0.51-\$1.00



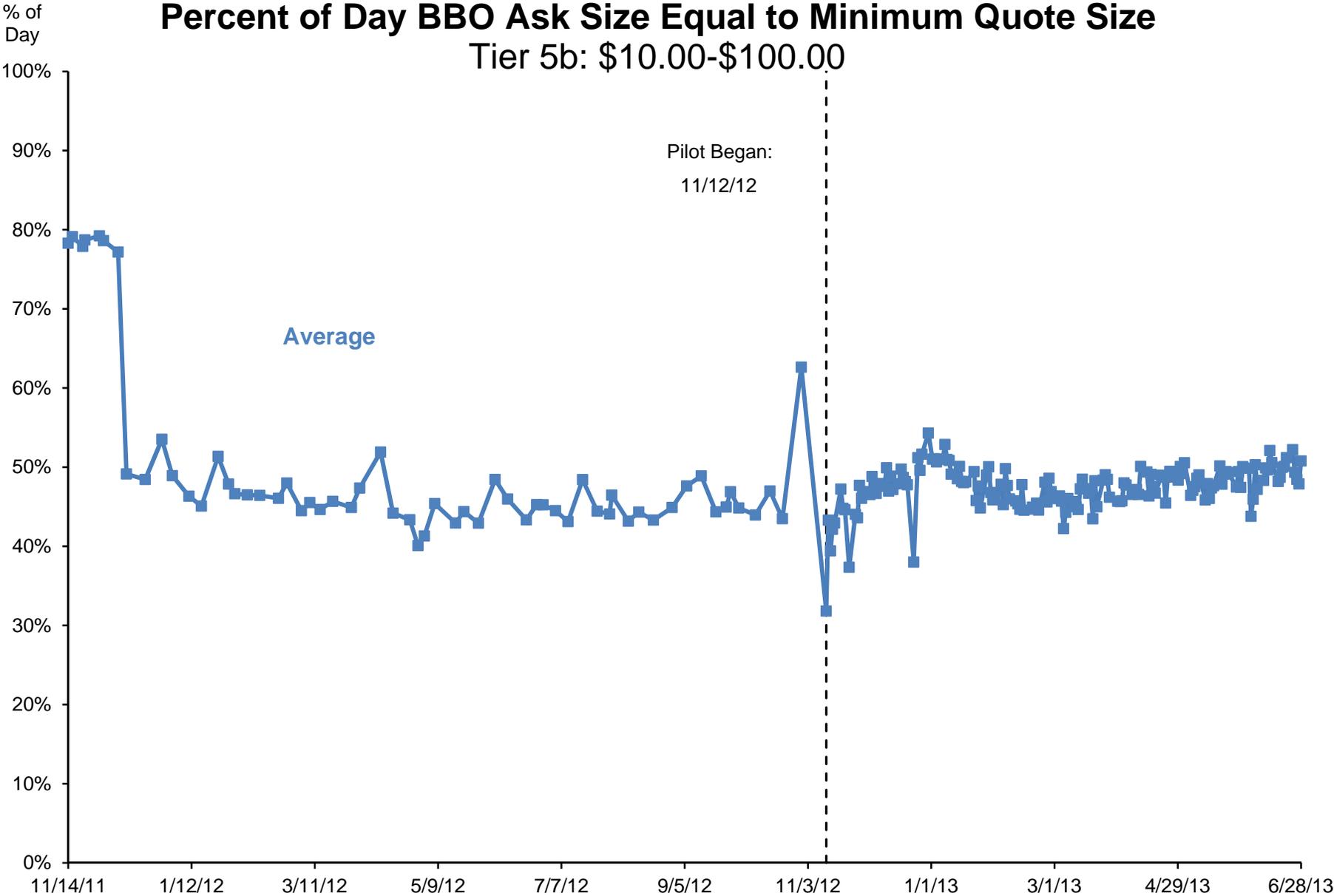
Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.



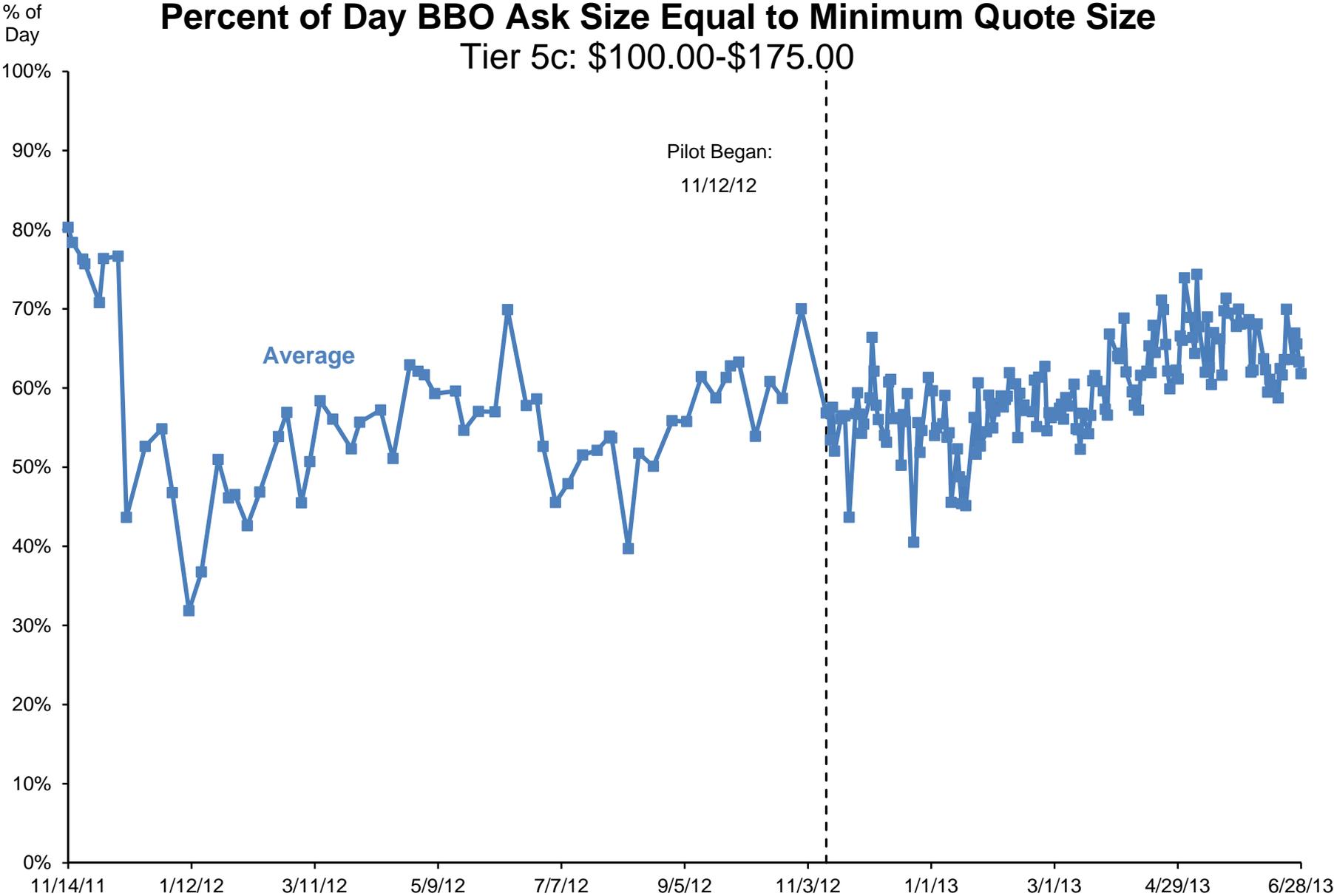
Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.



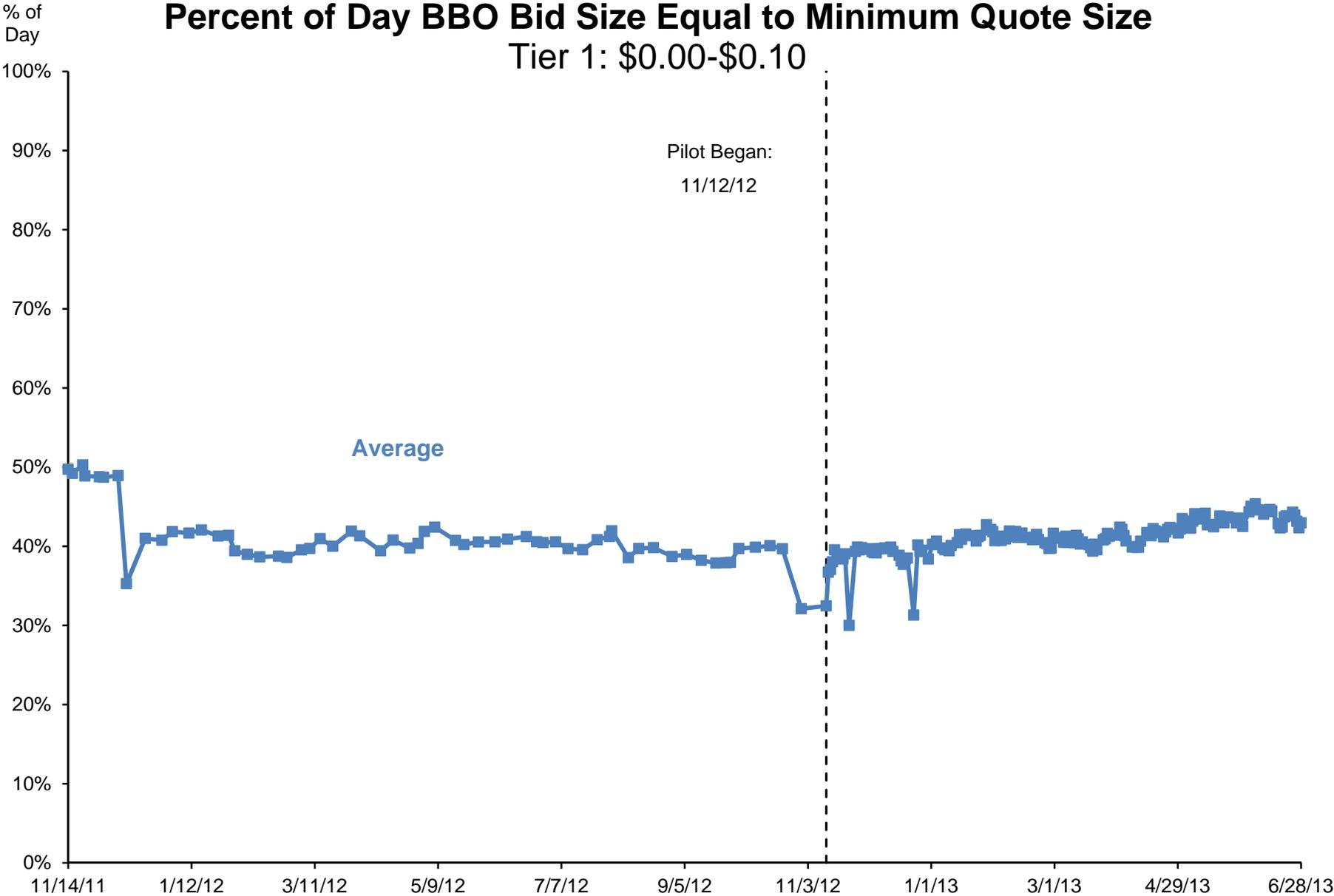
Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.



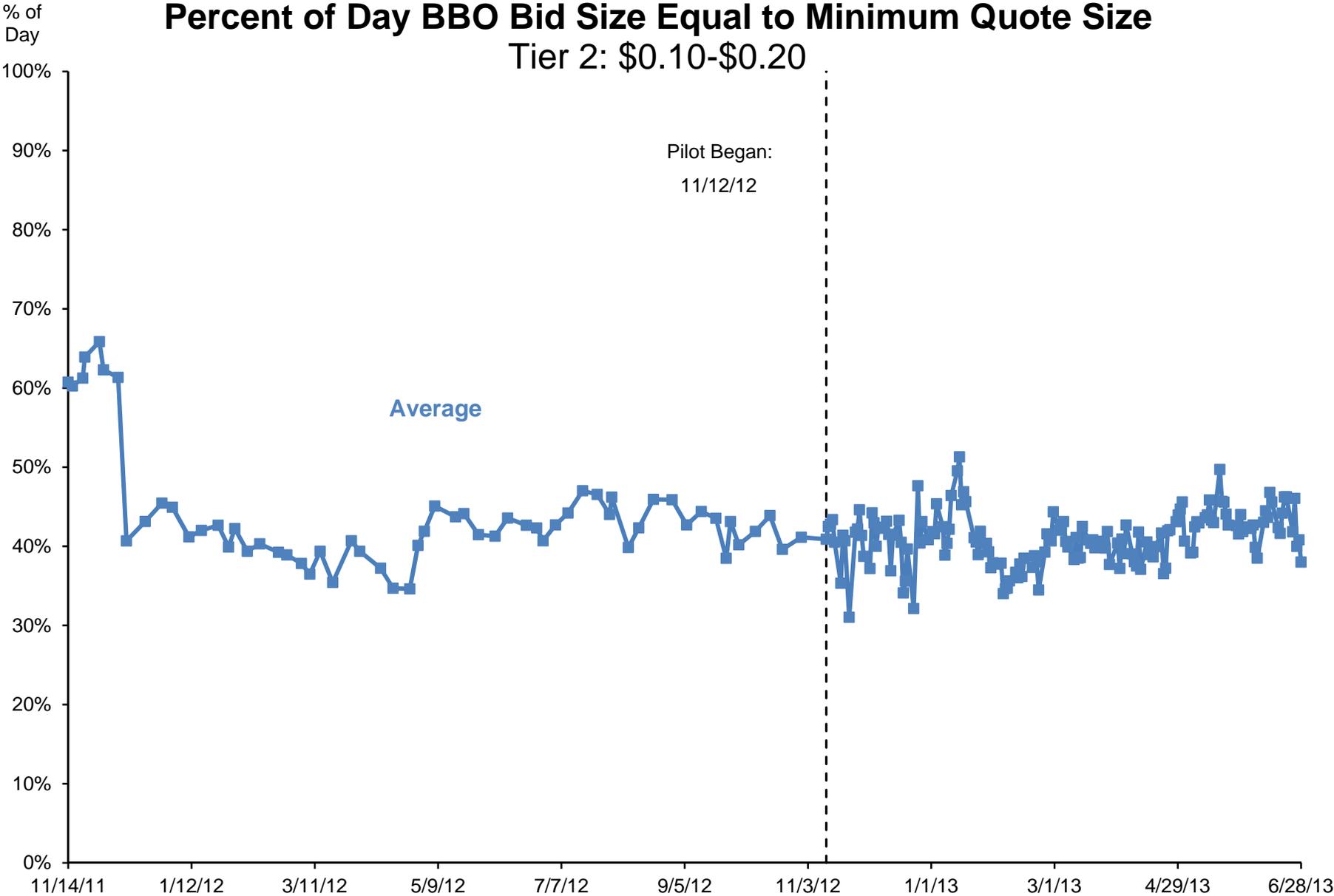
Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.



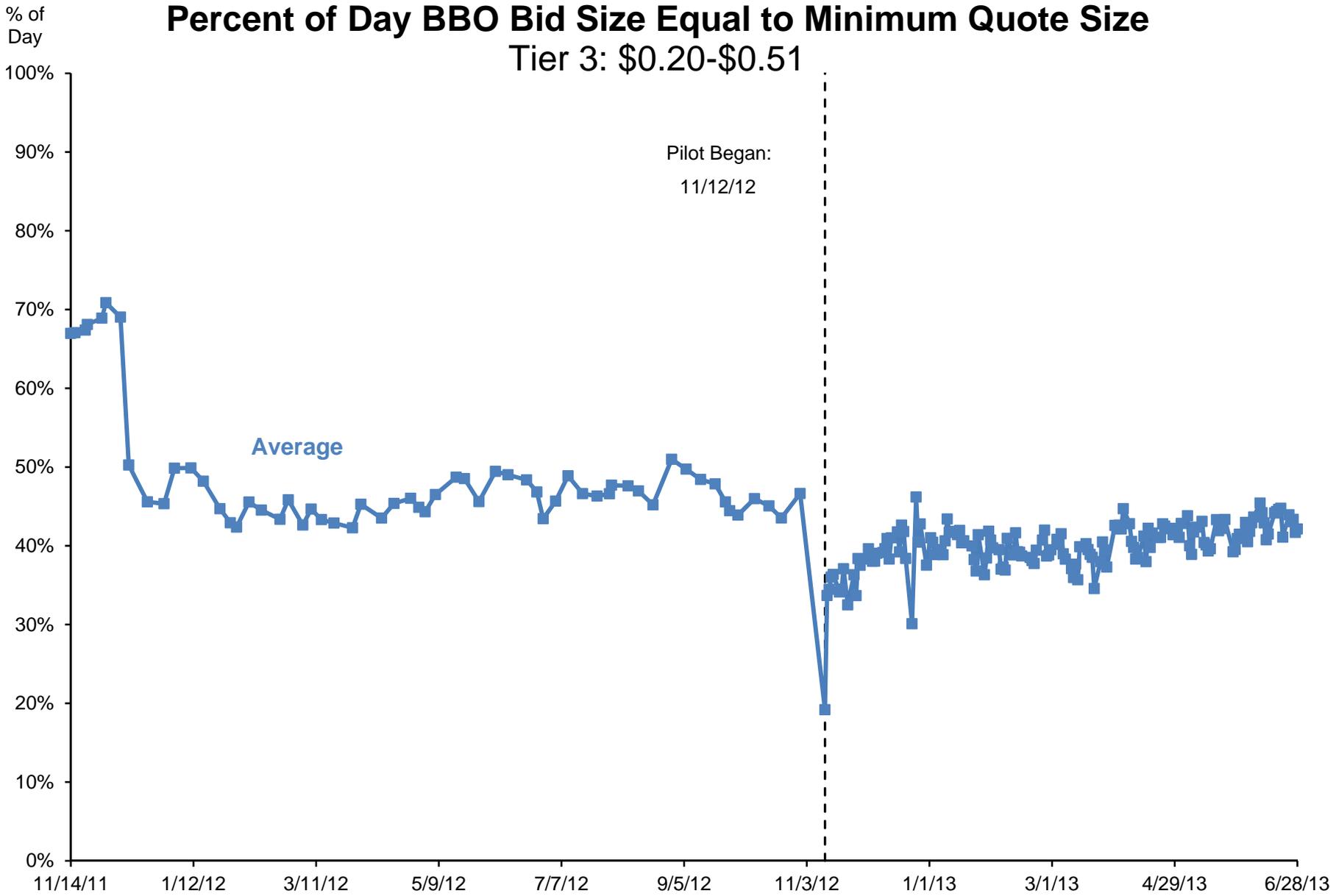
Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

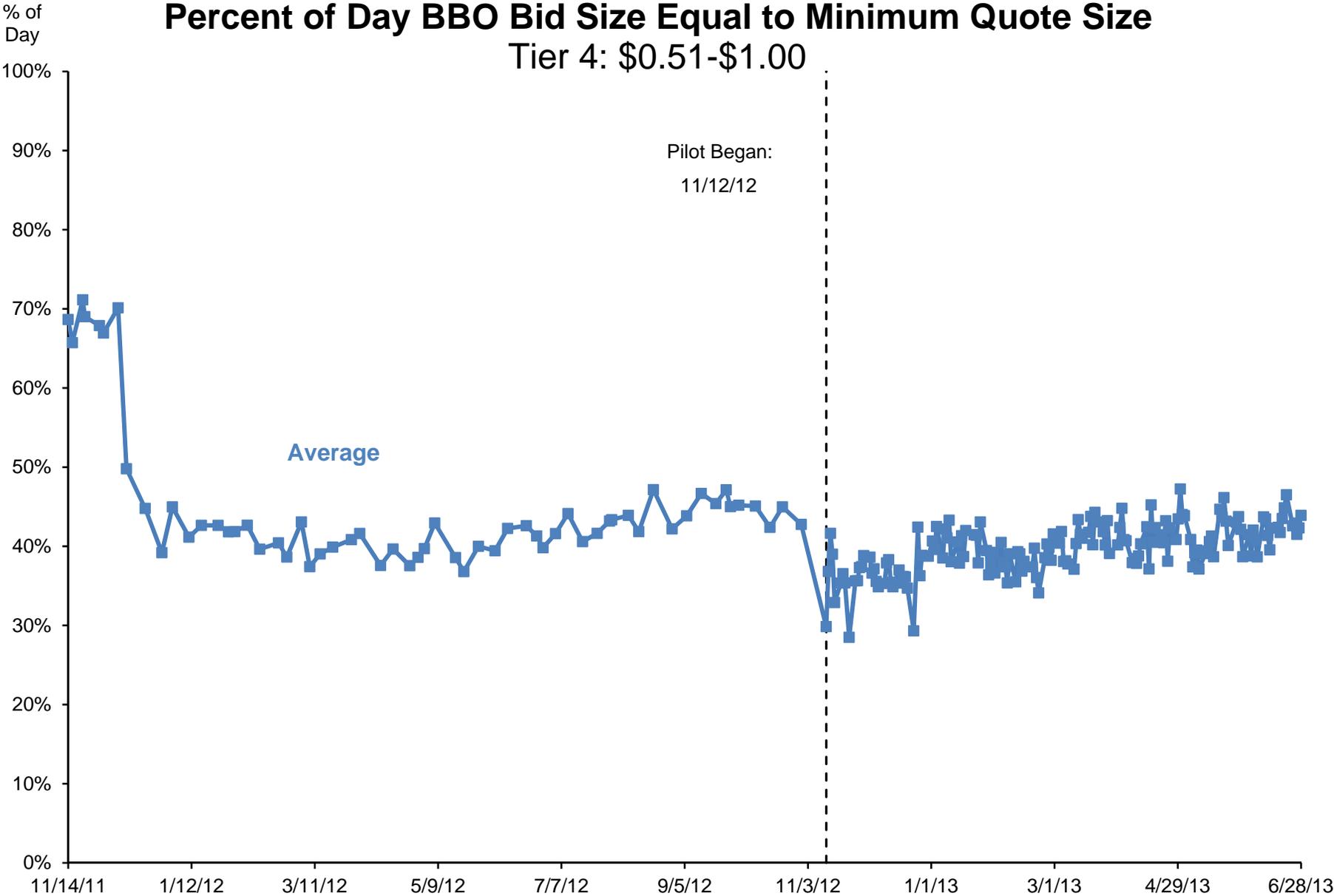


Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

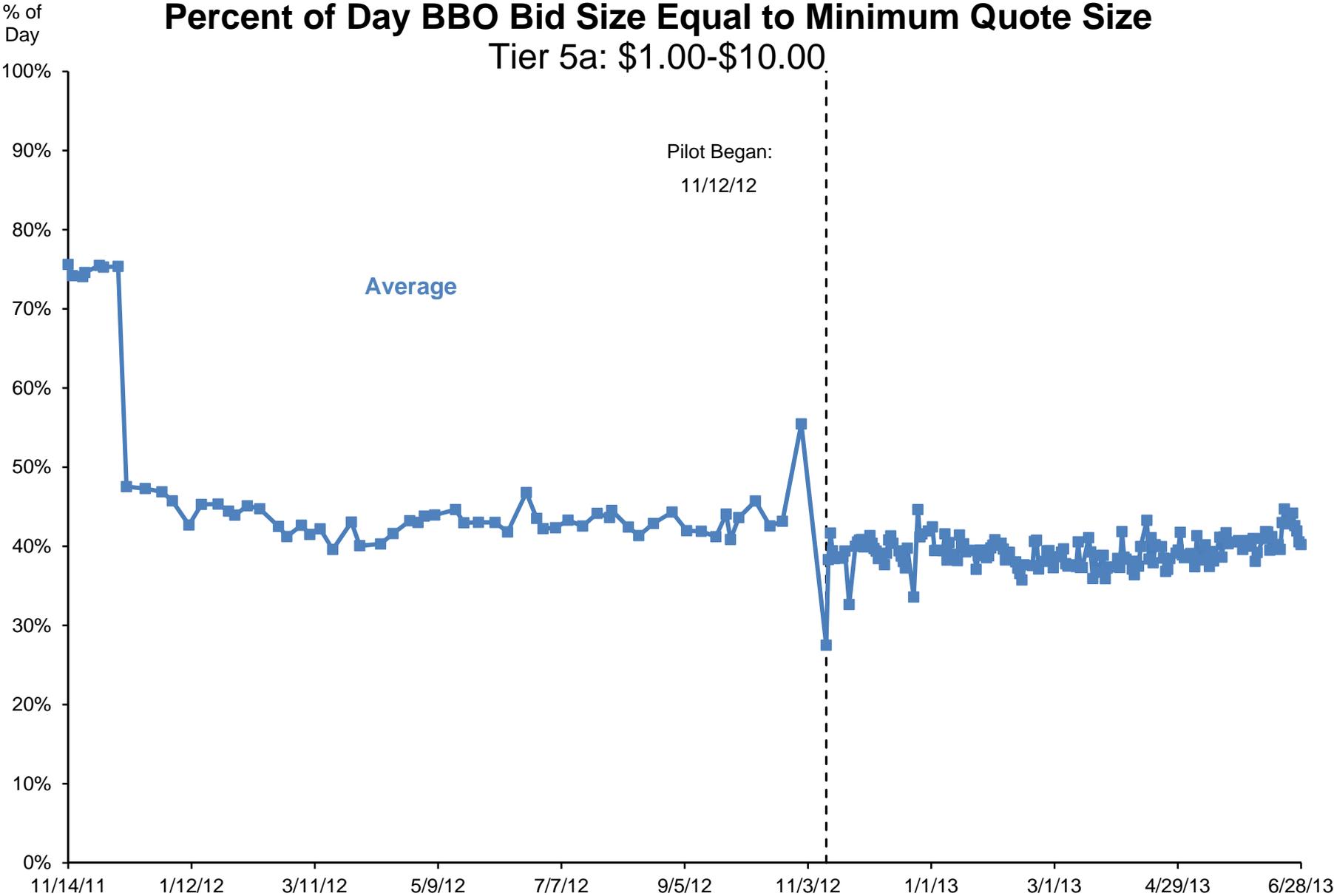


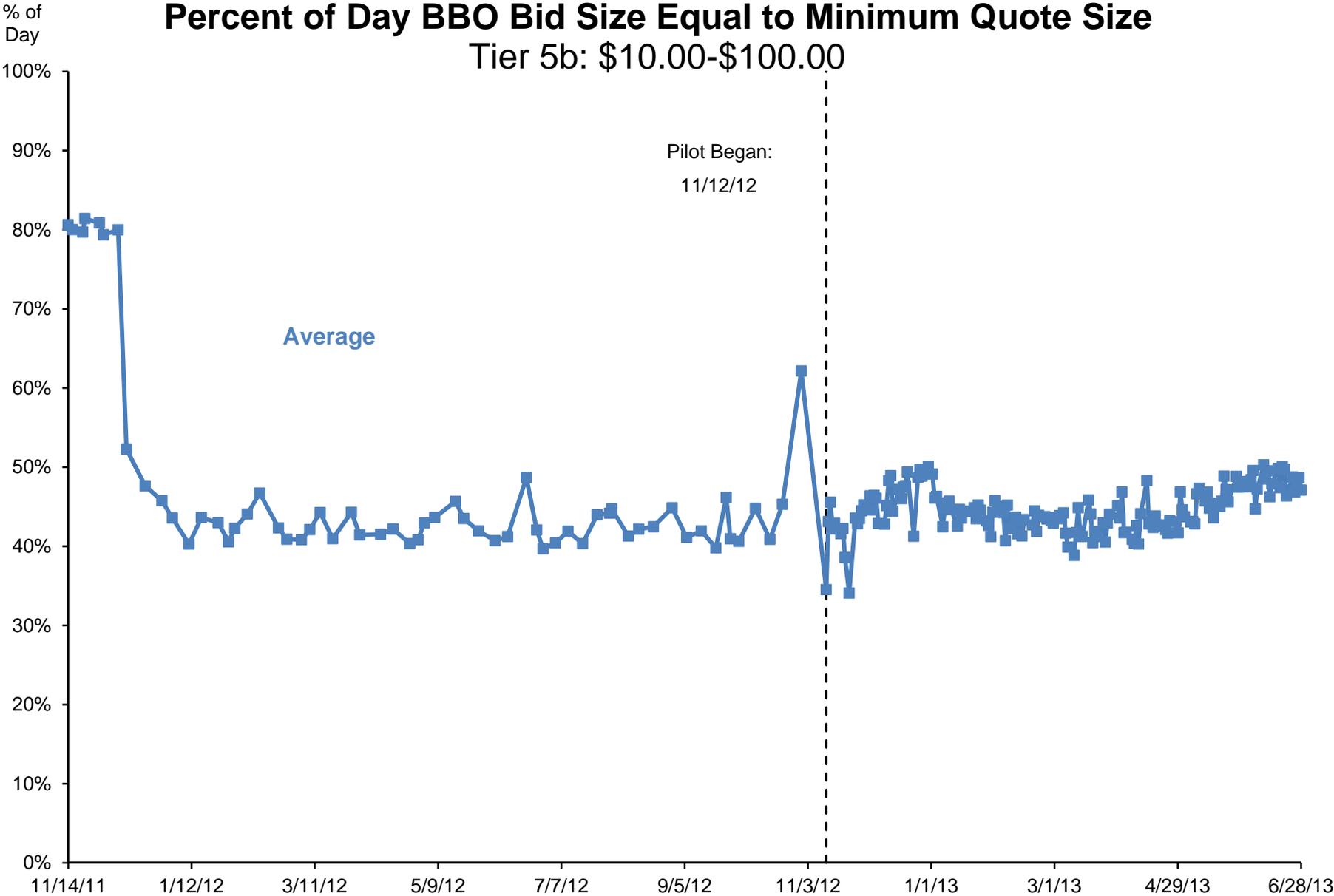
Source: OTC Link  
Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.



Source: OTC Link

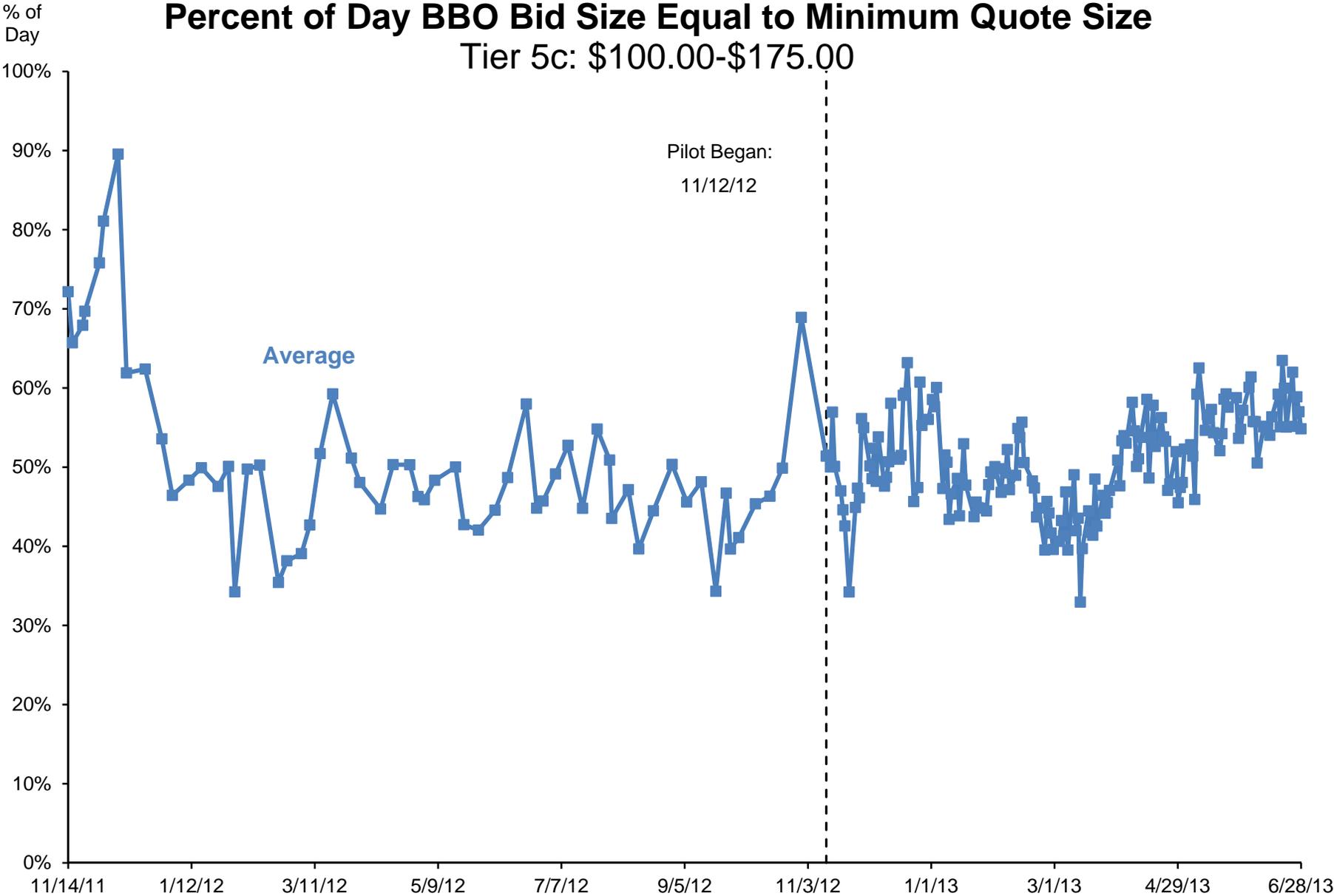
Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.



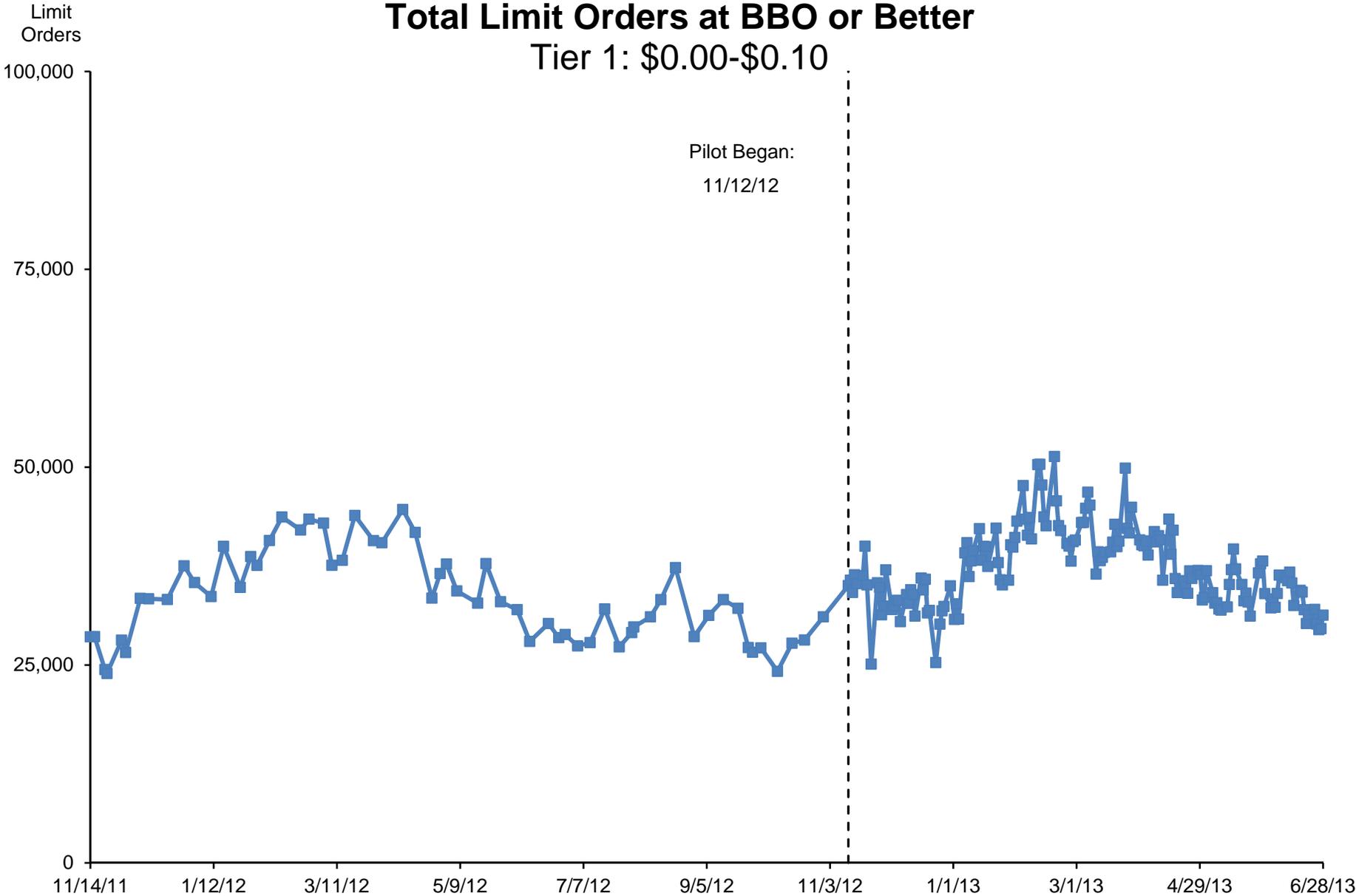


Source: OTC Link

Note: Percents are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.



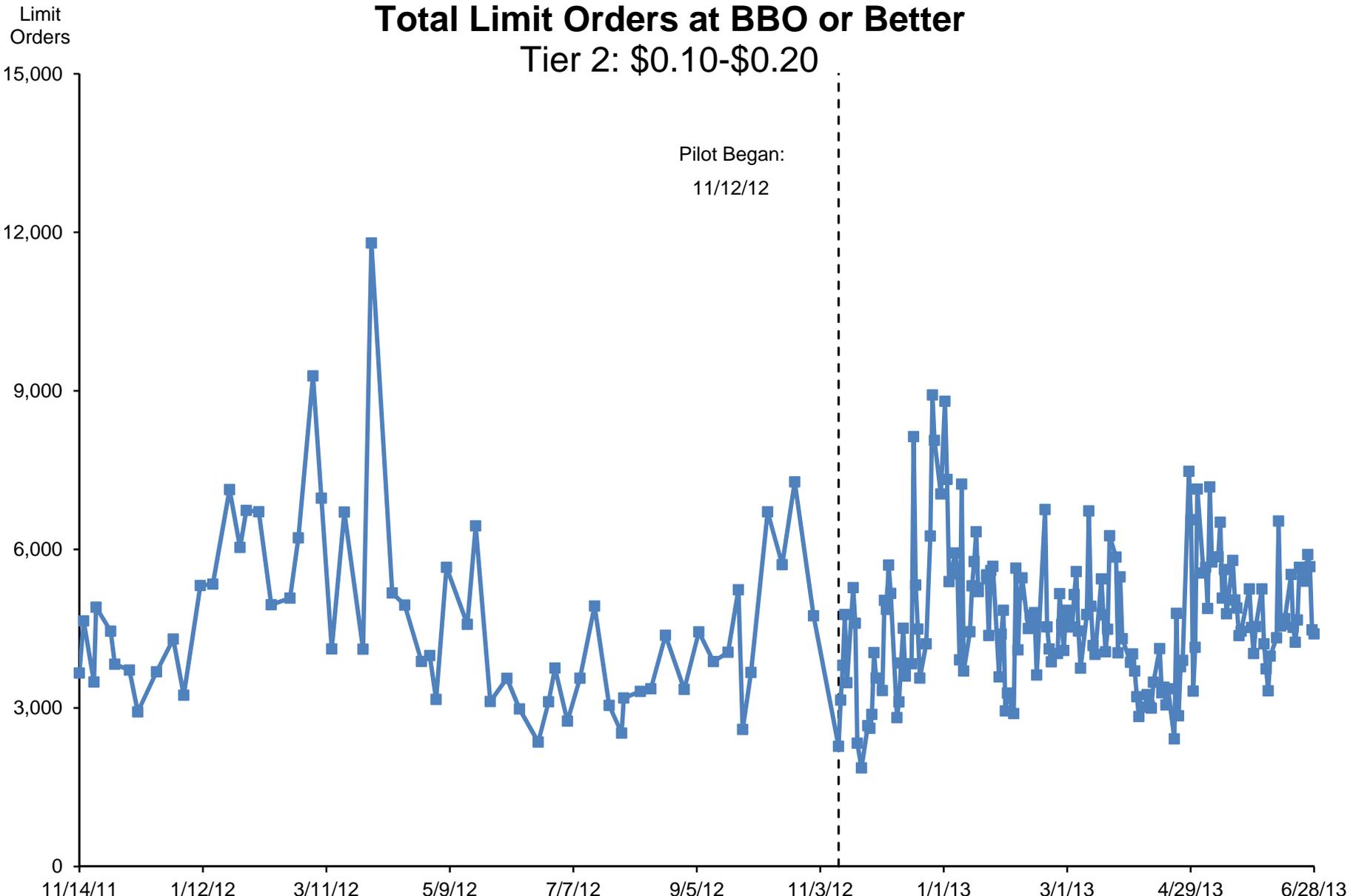
# Total Limit Orders at BBO or Better Tier 1: \$0.00-\$0.10



Source: OTC Link

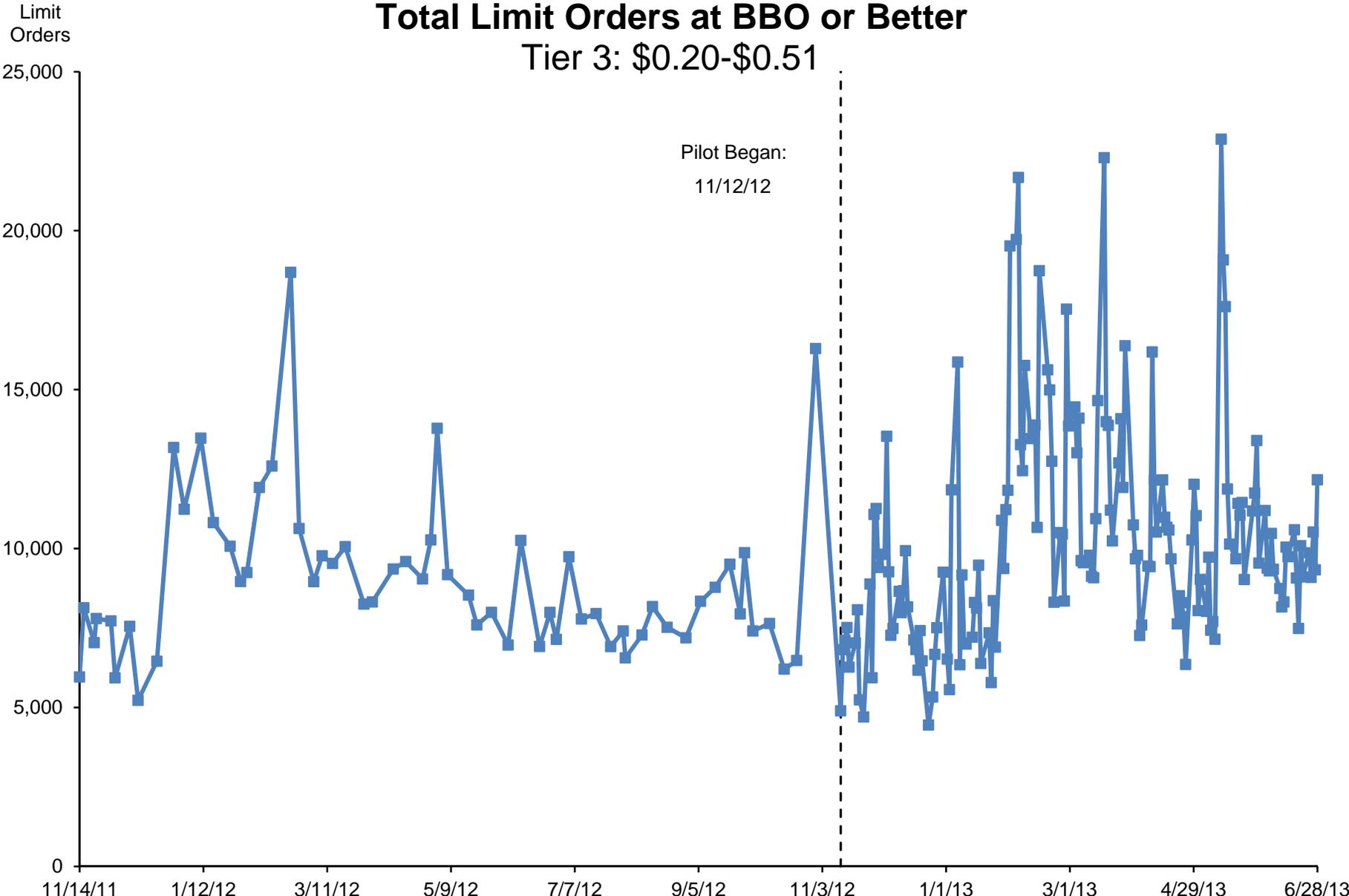
Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO or better for stocks priced according to amended tier definitions. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

### Total Limit Orders at BBO or Better Tier 2: \$0.10-\$0.20



Source: OTC Link  
Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO or better for stocks priced according to amended tier definitions. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

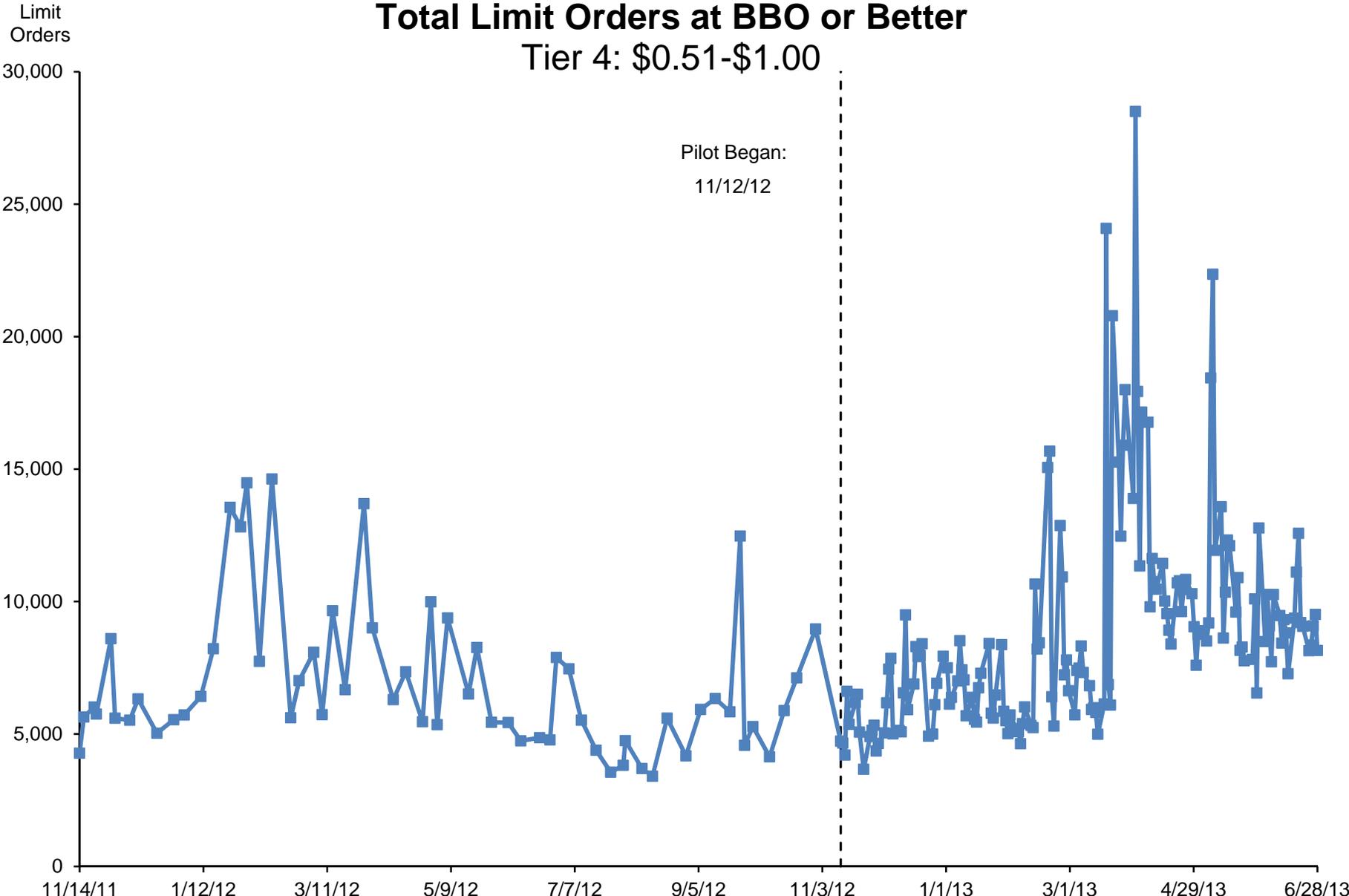
# Total Limit Orders at BBO or Better Tier 3: \$0.20-\$0.51



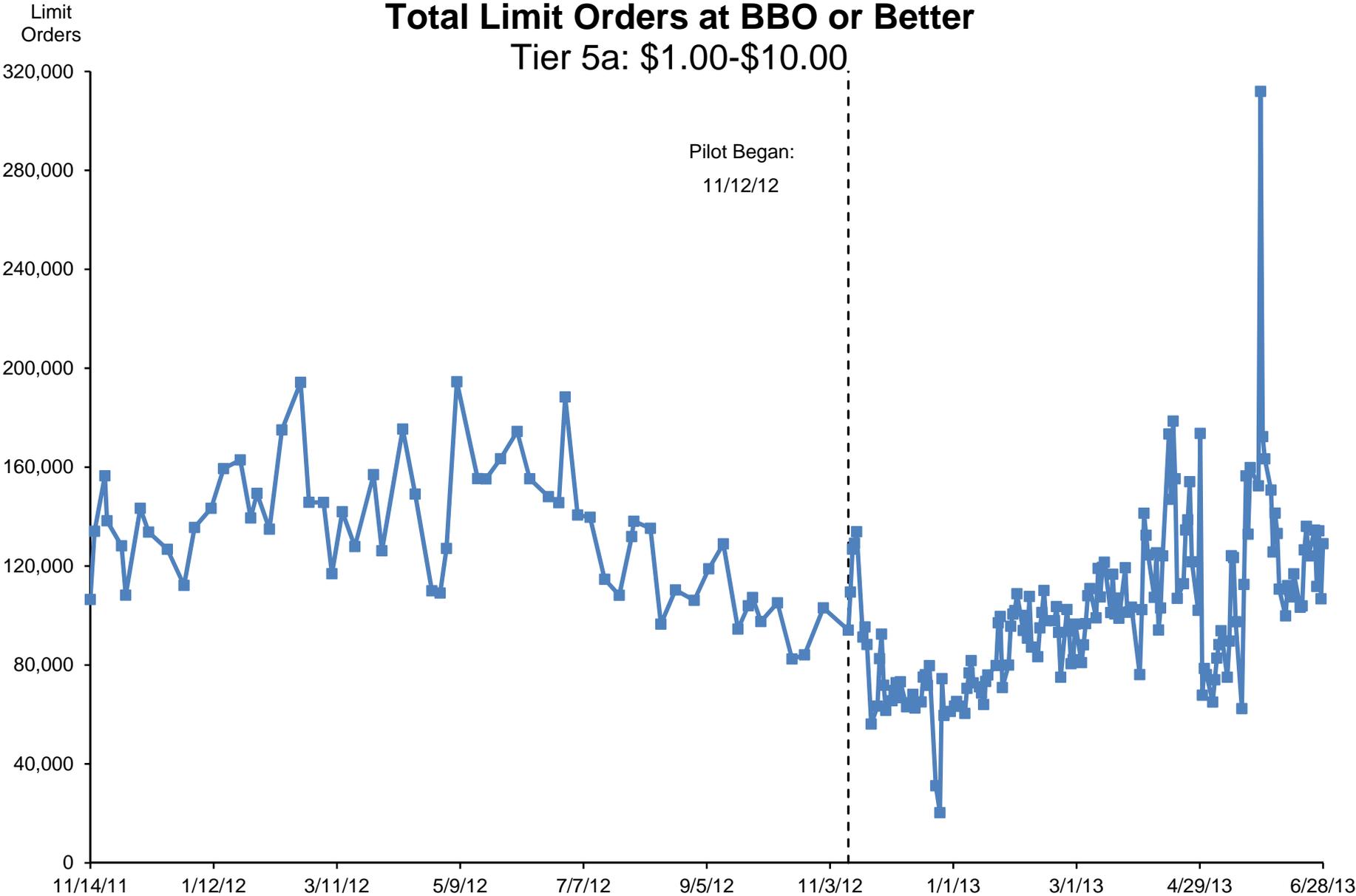
Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO or better for stocks priced according to amended tier definitions. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

# Total Limit Orders at BBO or Better Tier 4: \$0.51-\$1.00



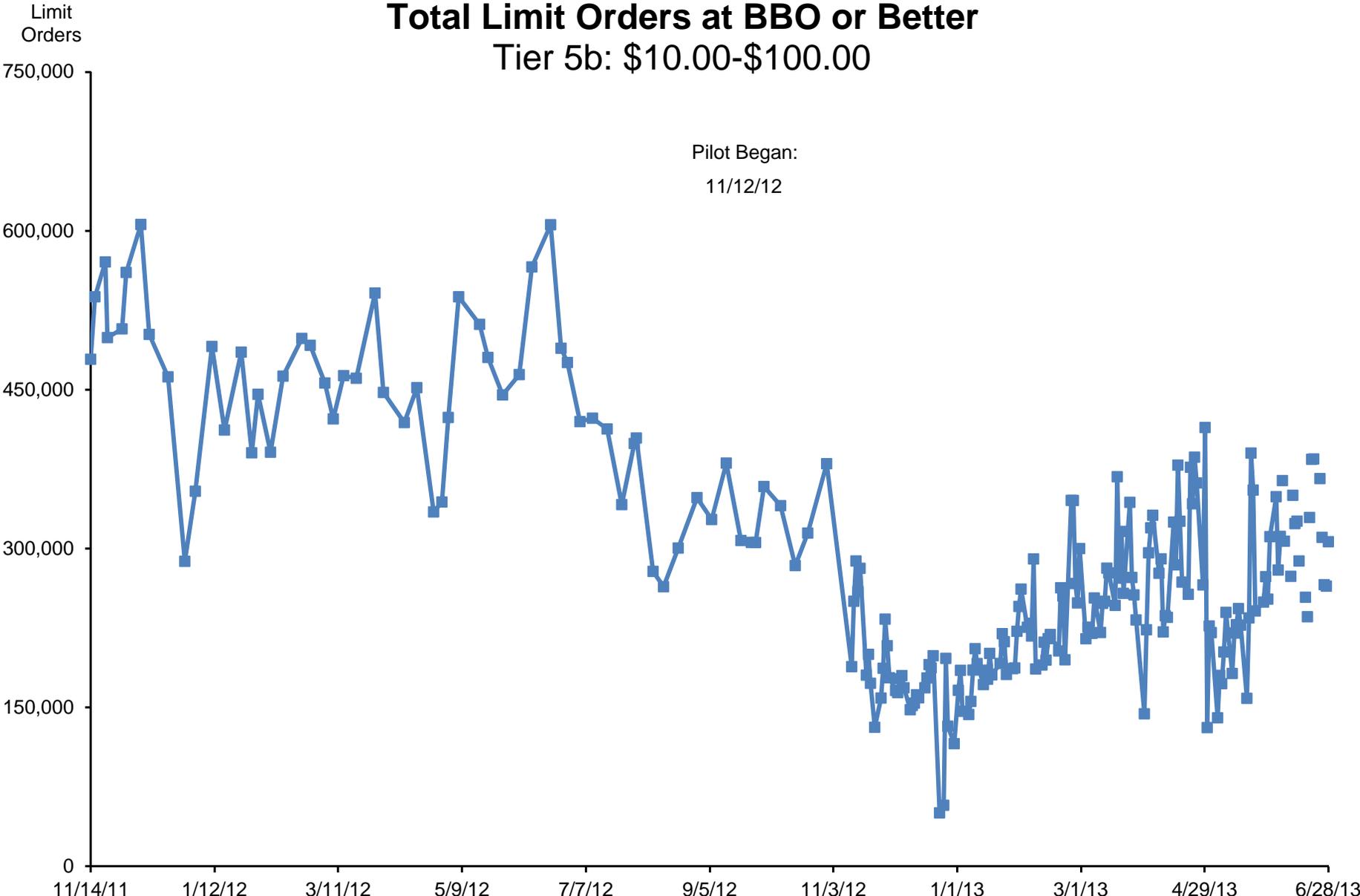
# Total Limit Orders at BBO or Better Tier 5a: \$1.00-\$10.00



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO or better for stocks priced according to amended tier definitions. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.

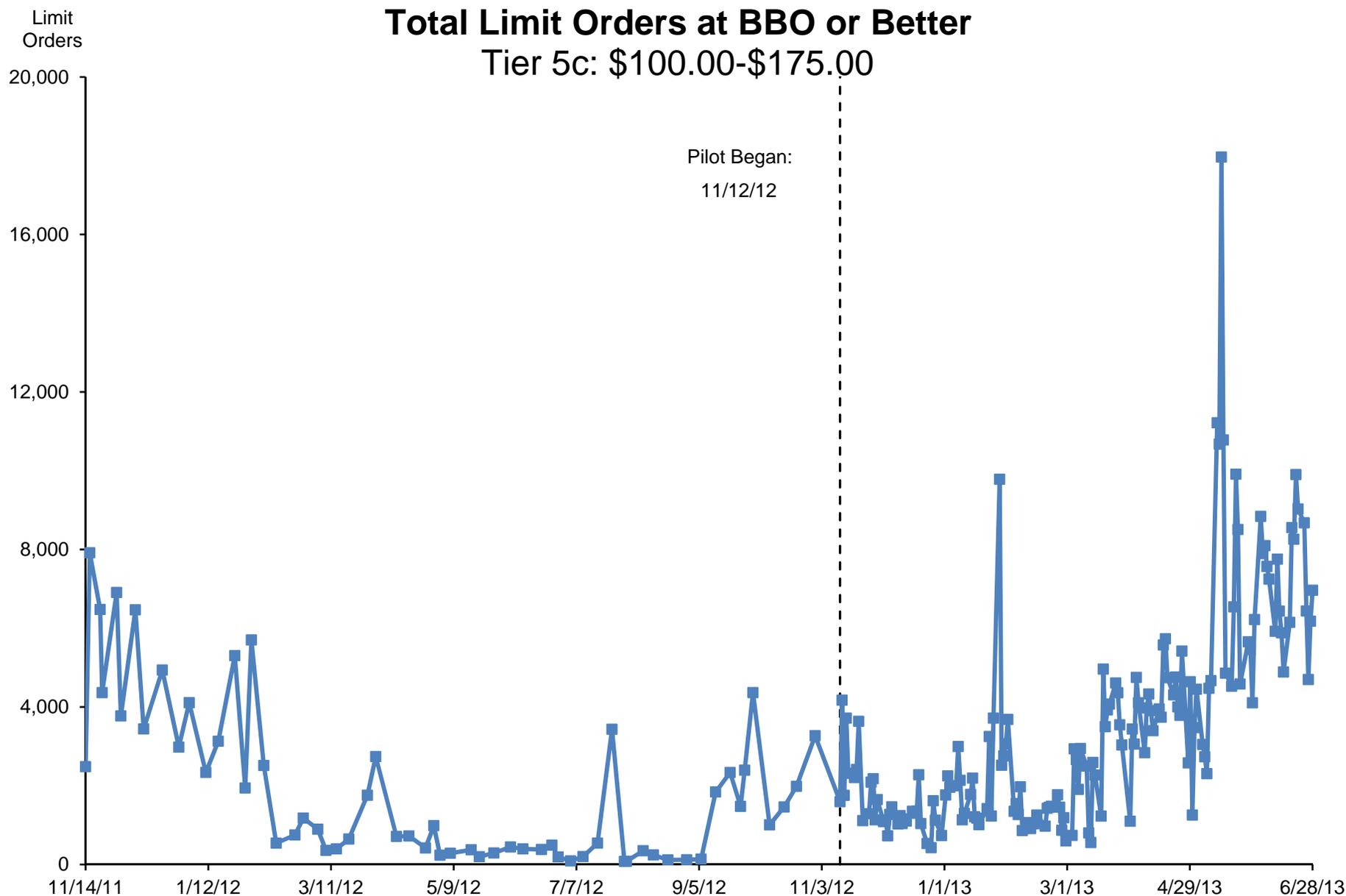
### Total Limit Orders at BBO or Better Tier 5b: \$10.00-\$100.00

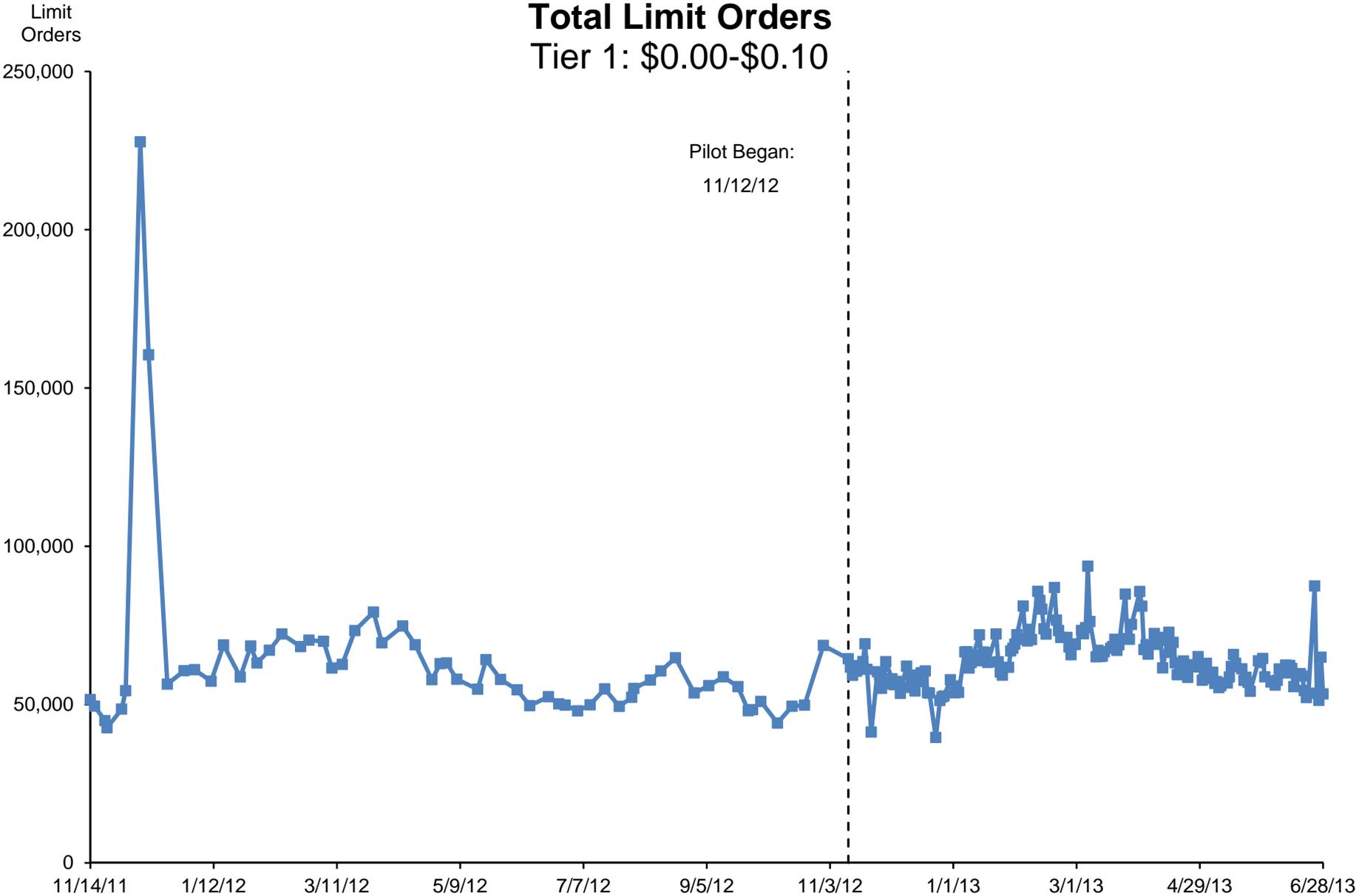


Pilot Began:  
11/12/12

Source: OTC Link  
Note: Orders are excluded if valid quotes during the day span more than one tier. Includes limit orders at BBO or better for stocks priced according to amended tier definitions. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.

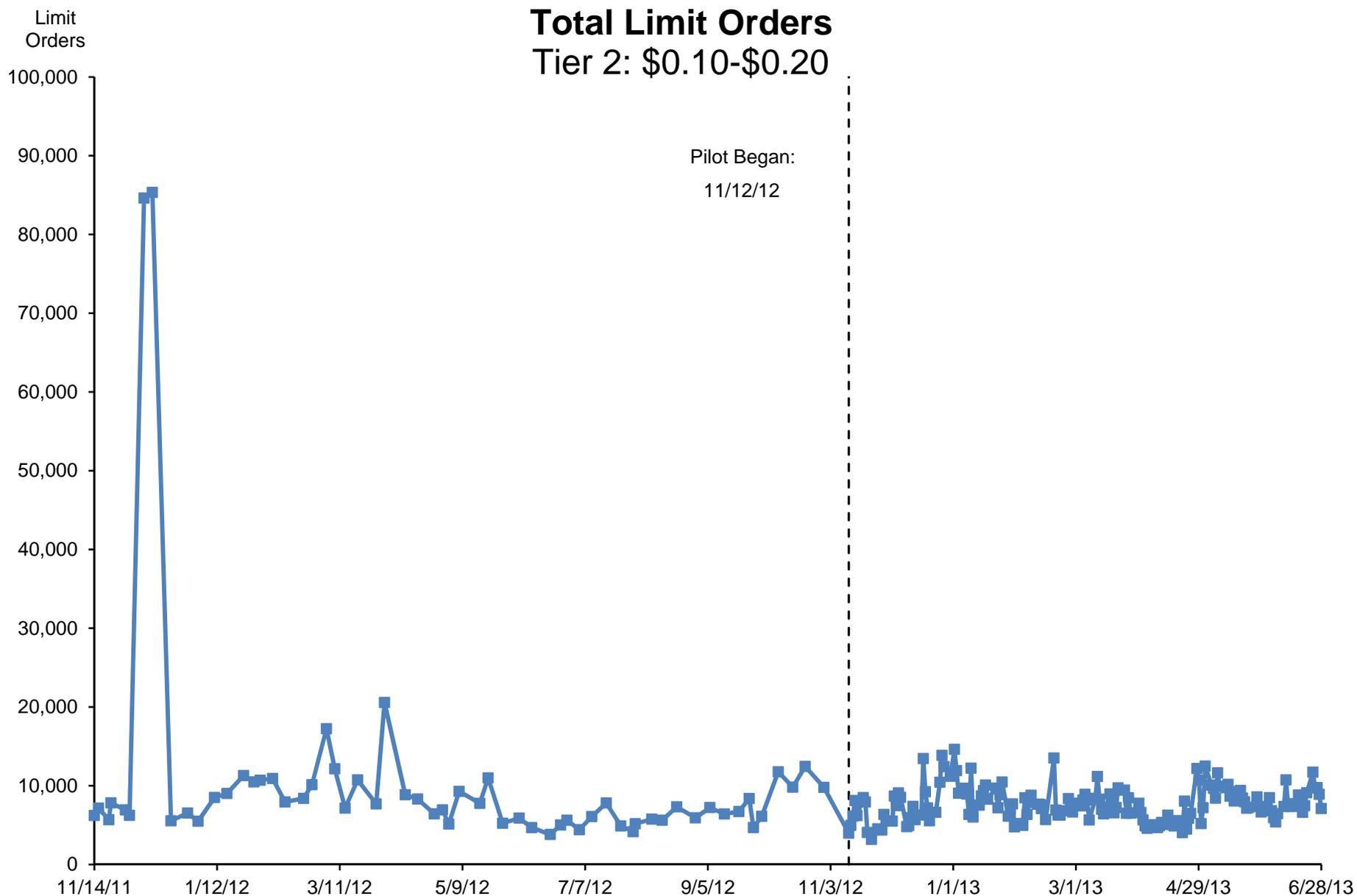
## Total Limit Orders at BBO or Better Tier 5c: \$100.00-\$175.00





Source: OTC Link

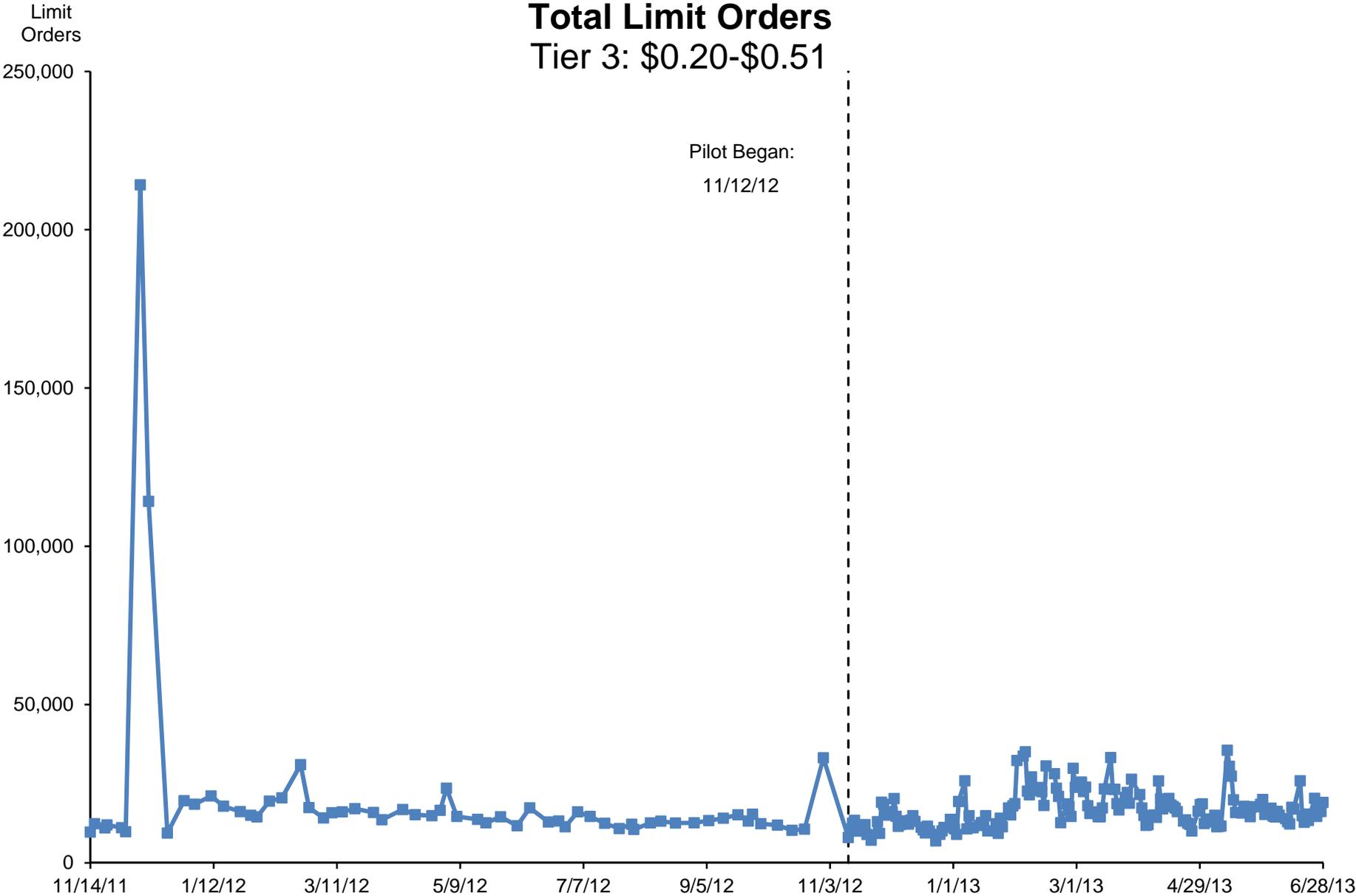
Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

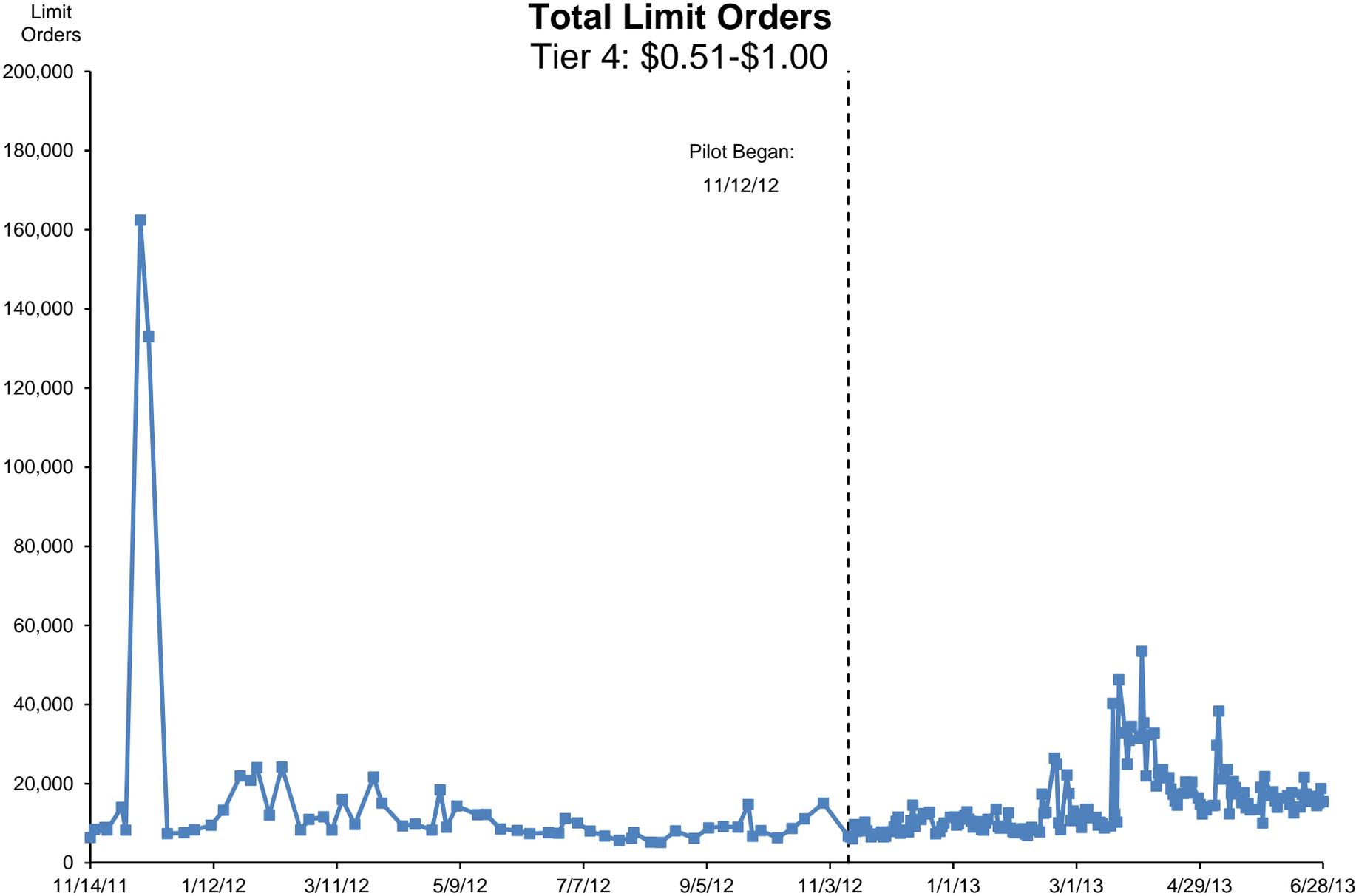
# Total Limit Orders Tier 3: \$0.20-\$0.51



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

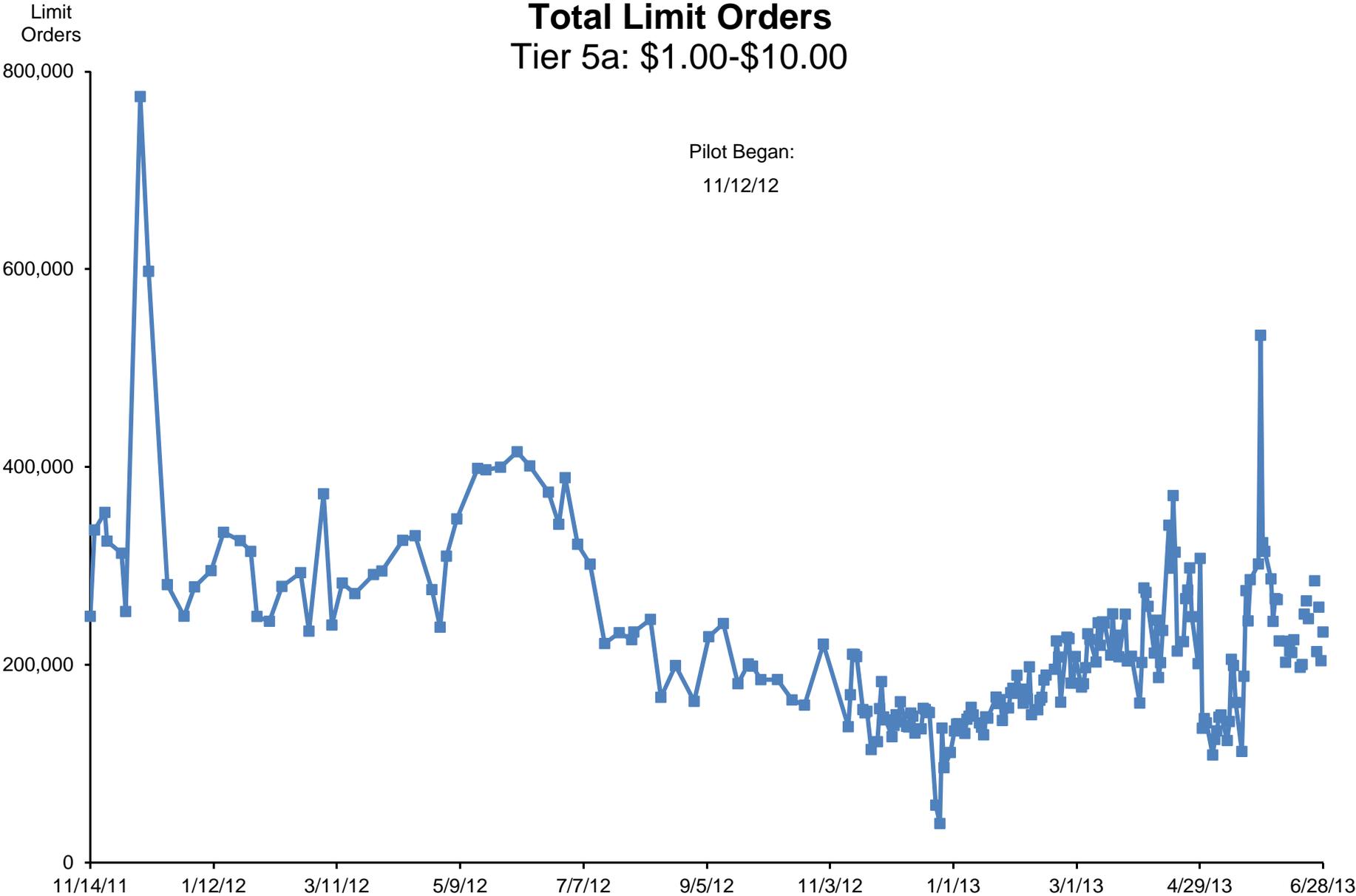
# Total Limit Orders Tier 4: \$0.51-\$1.00



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

# Total Limit Orders Tier 5a: \$1.00-\$10.00

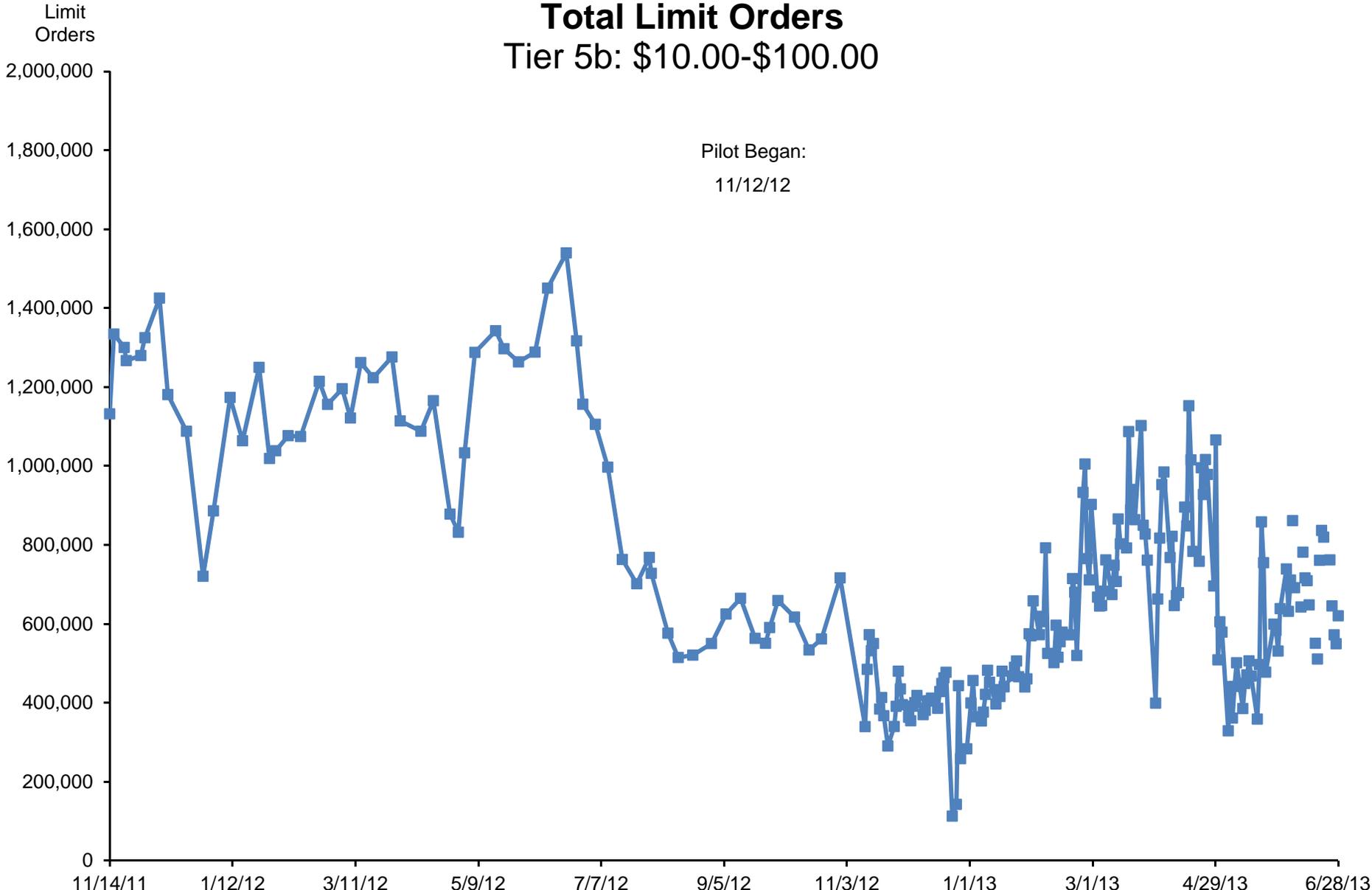


Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.

# Total Limit Orders

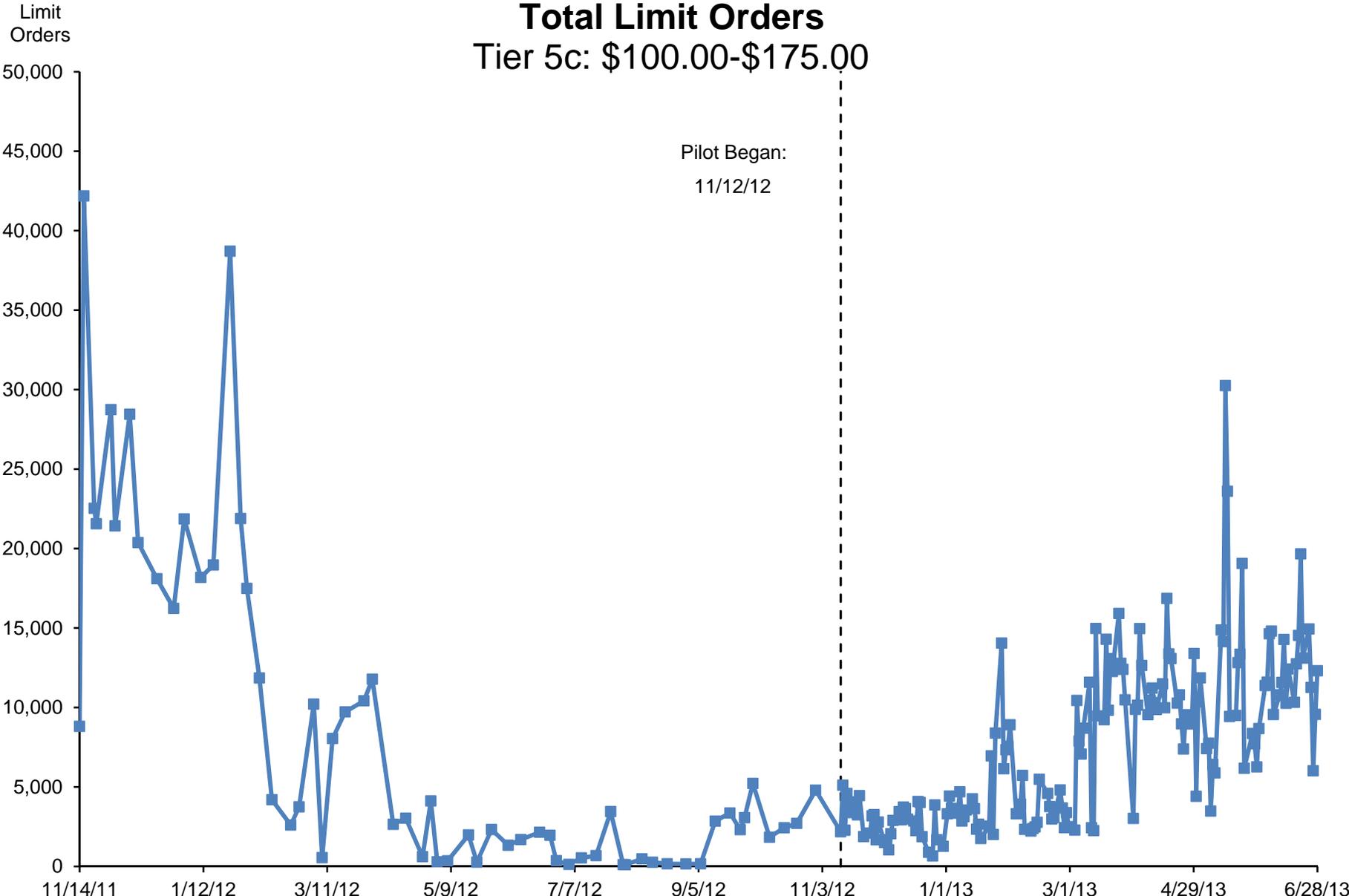
## Tier 5b: \$10.00-\$100.00



Source: OTC Link

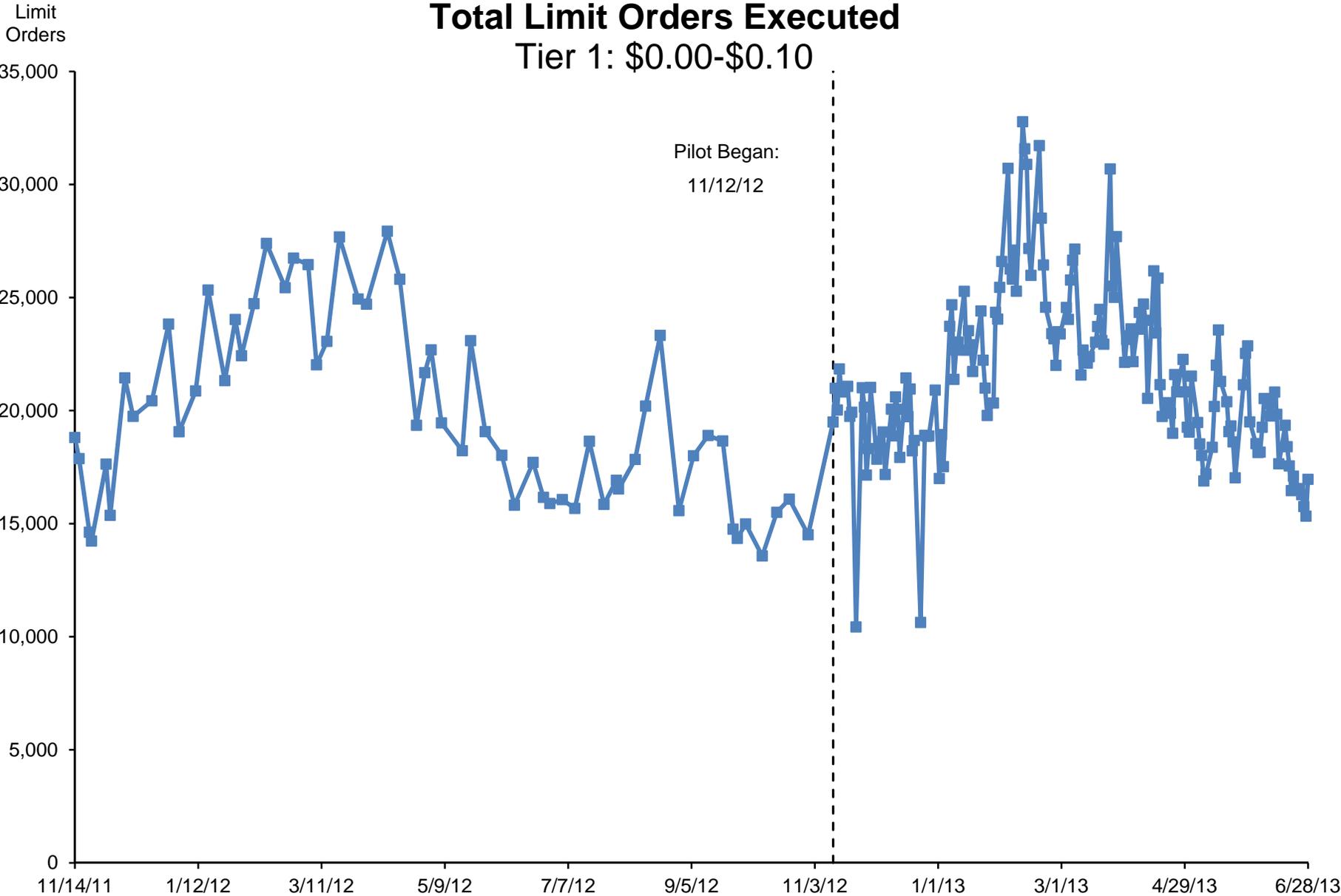
Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.

### Total Limit Orders Tier 5c: \$100.00-\$175.00



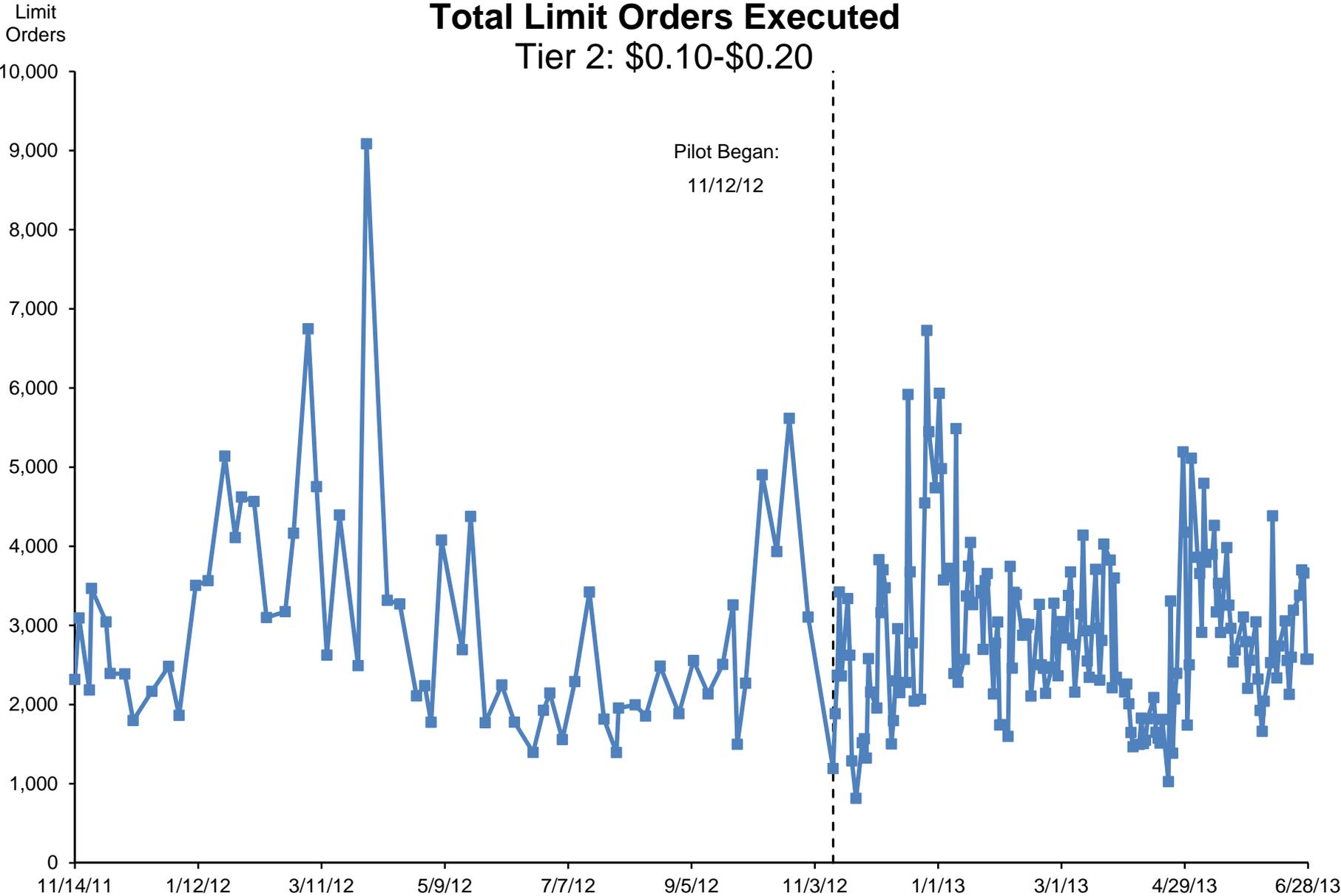
Source: OTC Link  
Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

# Total Limit Orders Executed Tier 1: \$0.00-\$0.10



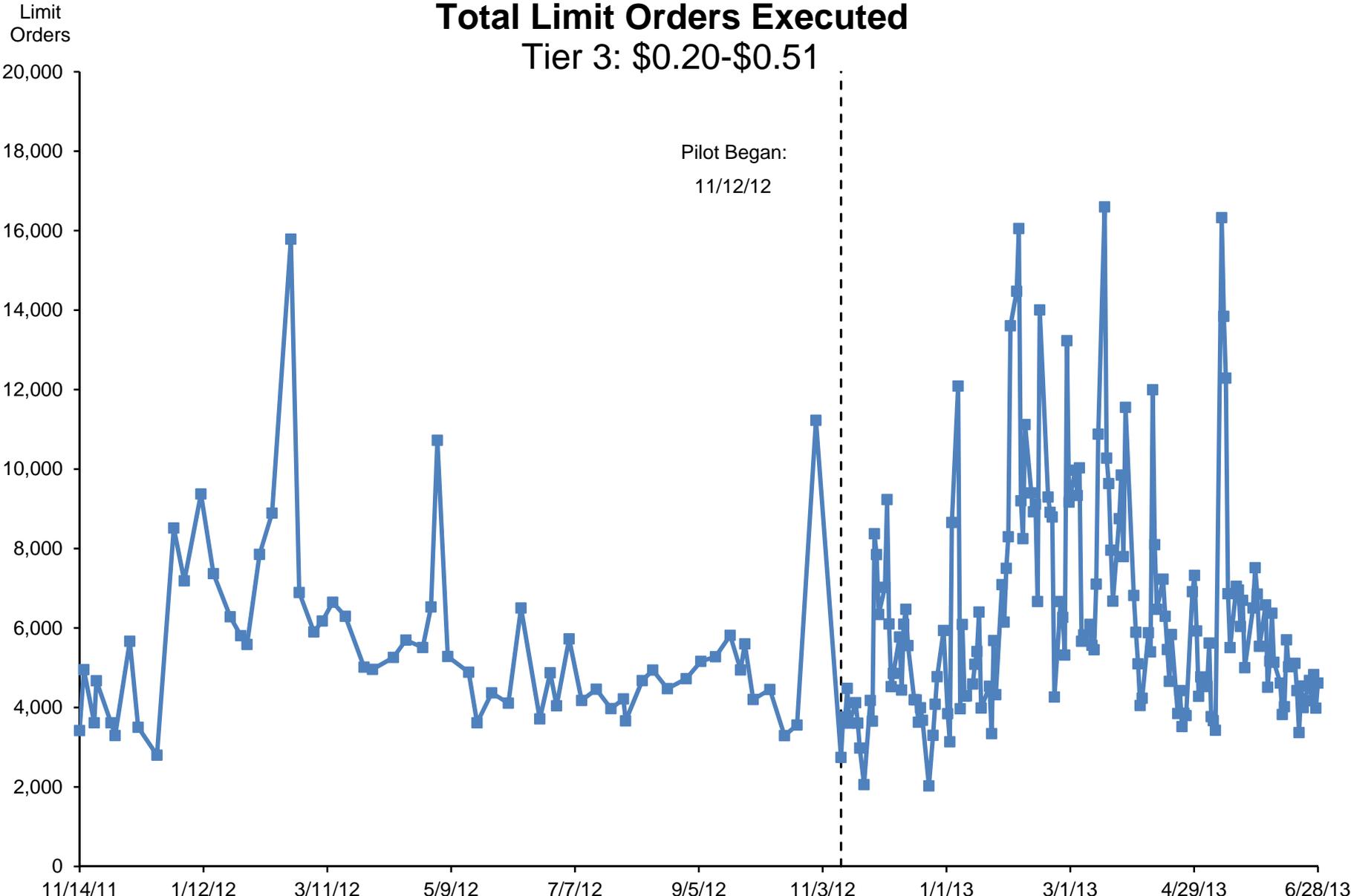
Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.



Source: OTC Link  
Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

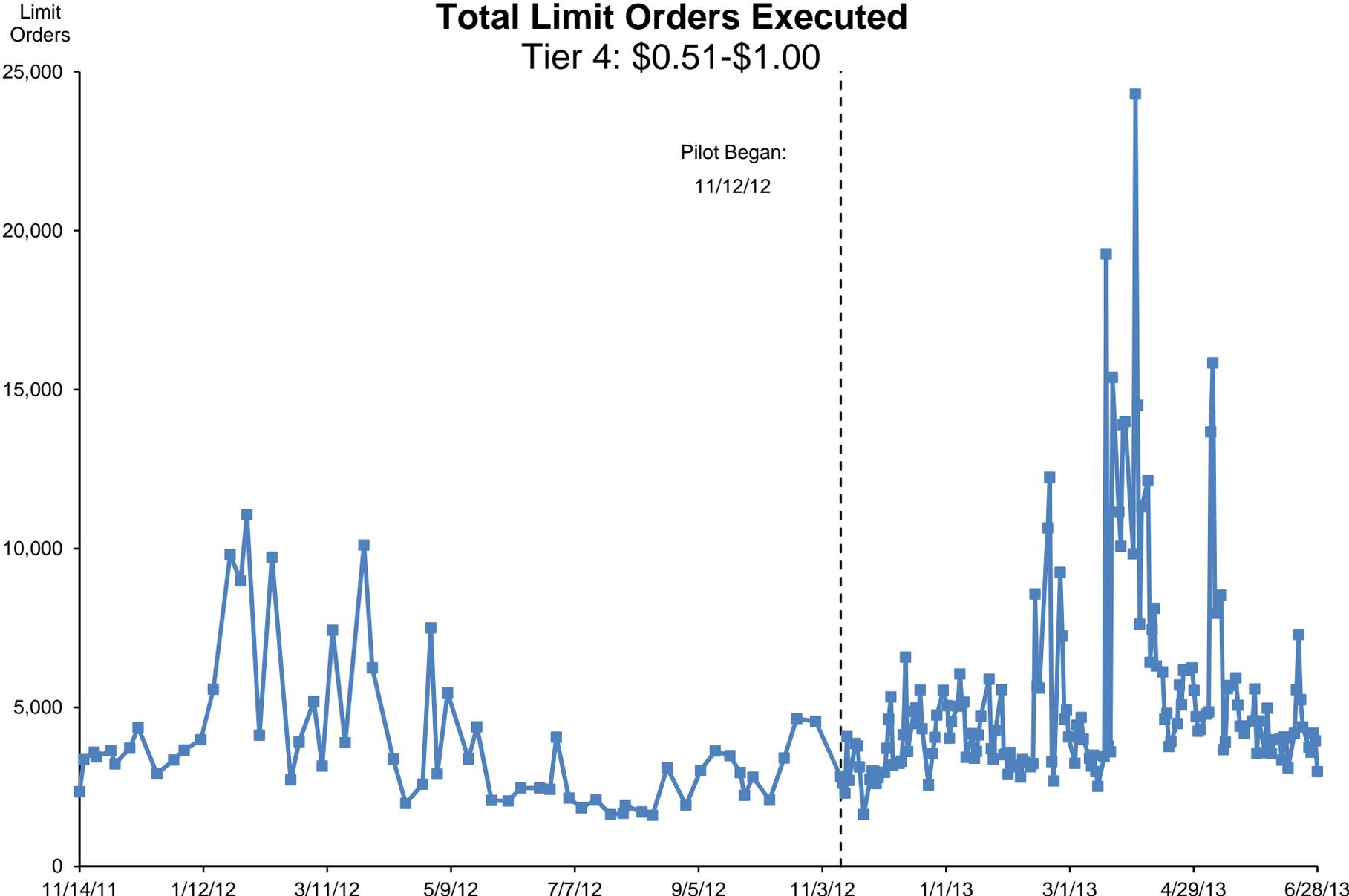
# Total Limit Orders Executed Tier 3: \$0.20-\$0.51



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

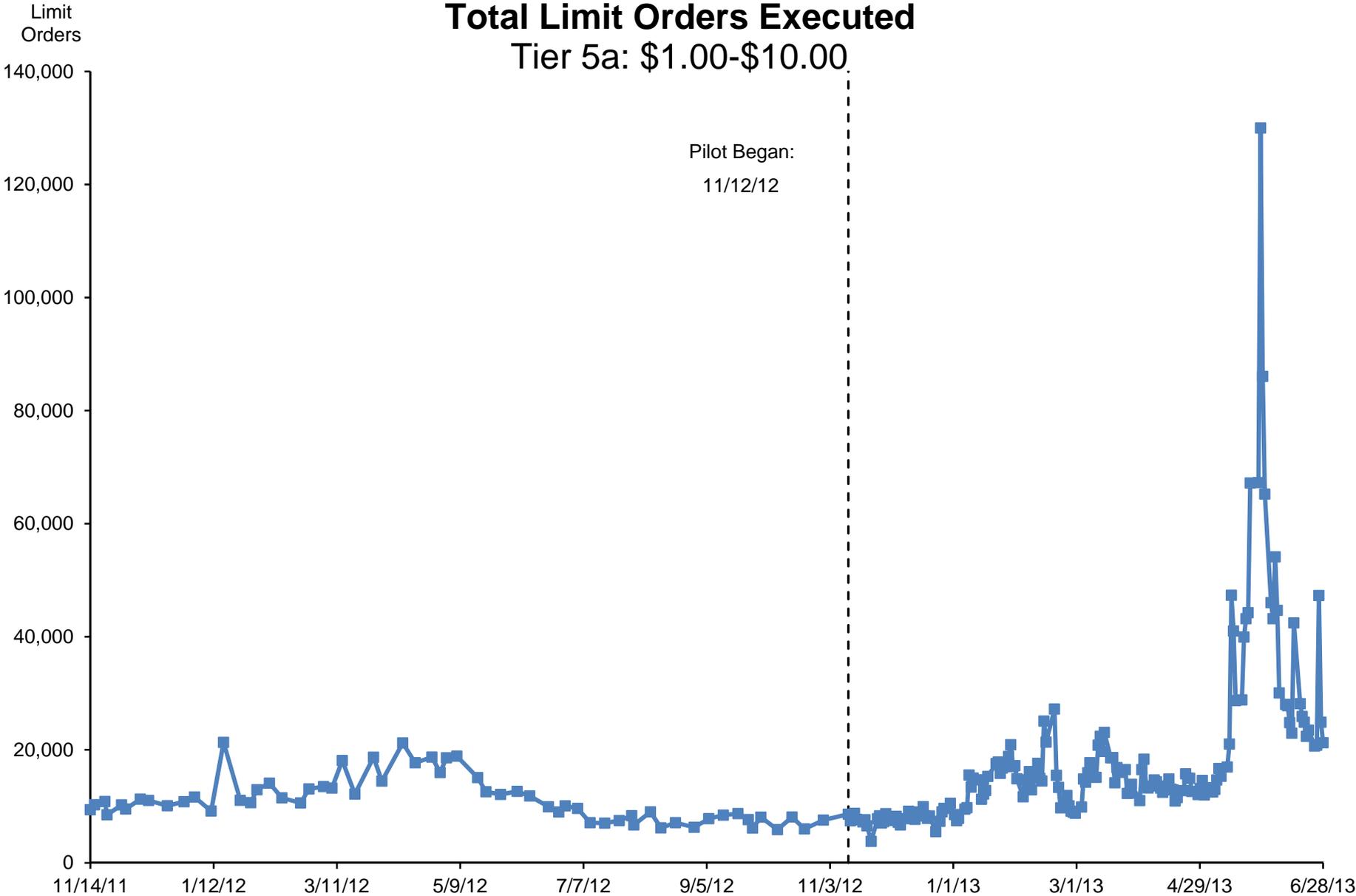
# Total Limit Orders Executed Tier 4: \$0.51-\$1.00



Source: OTC Link

Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

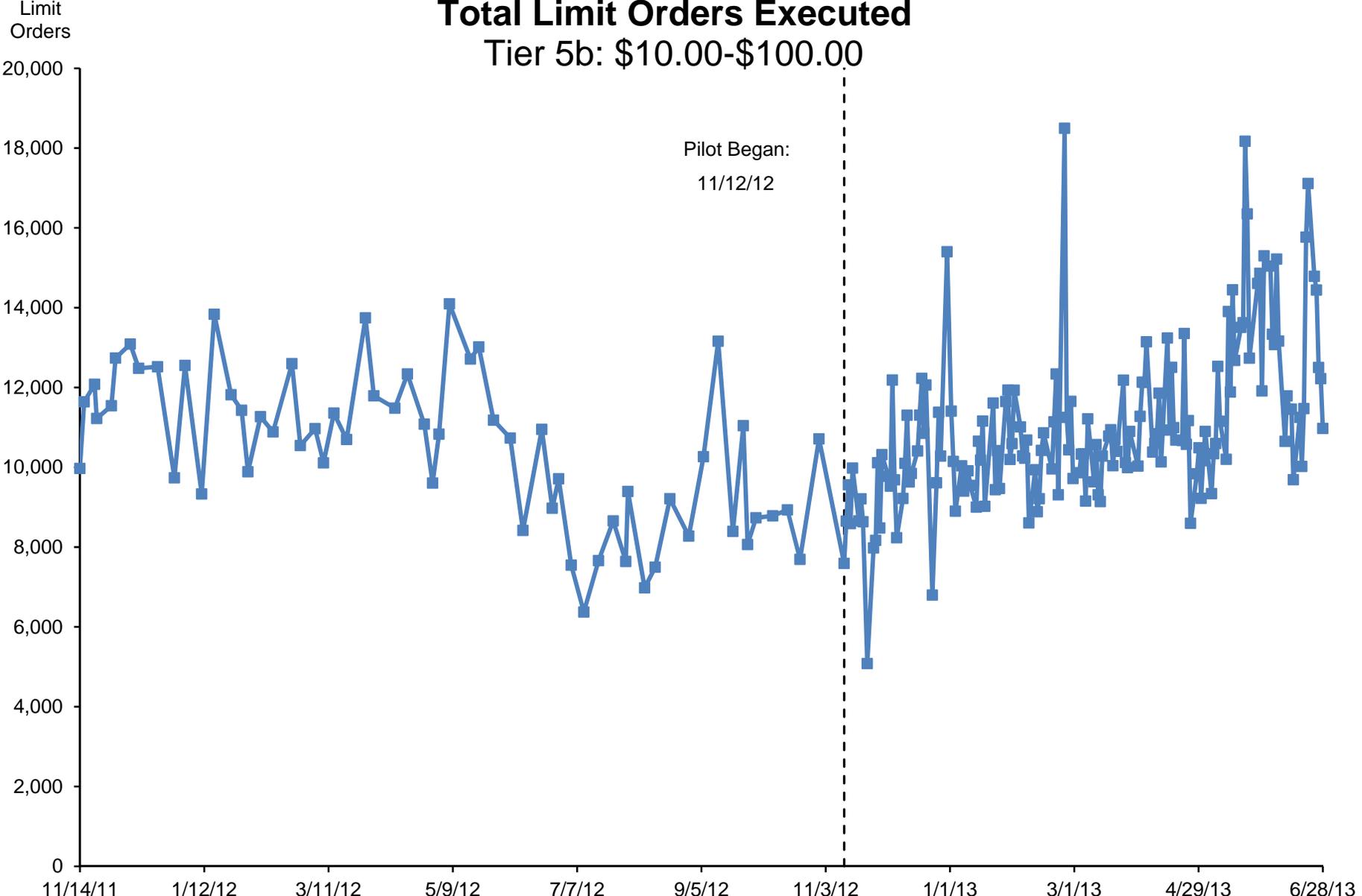
# Total Limit Orders Executed Tier 5a: \$1.00-\$10.00



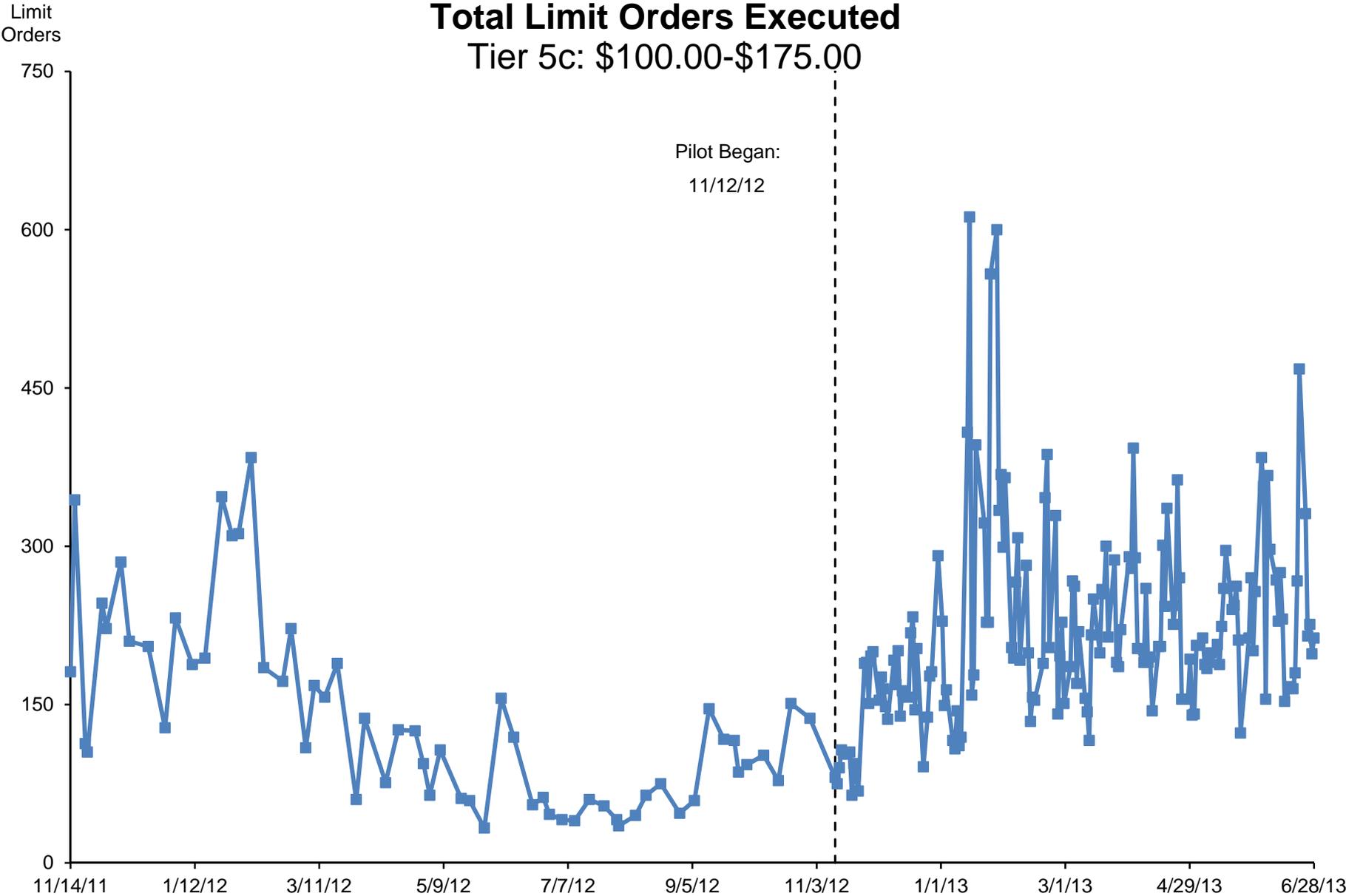
Source: OTC Link

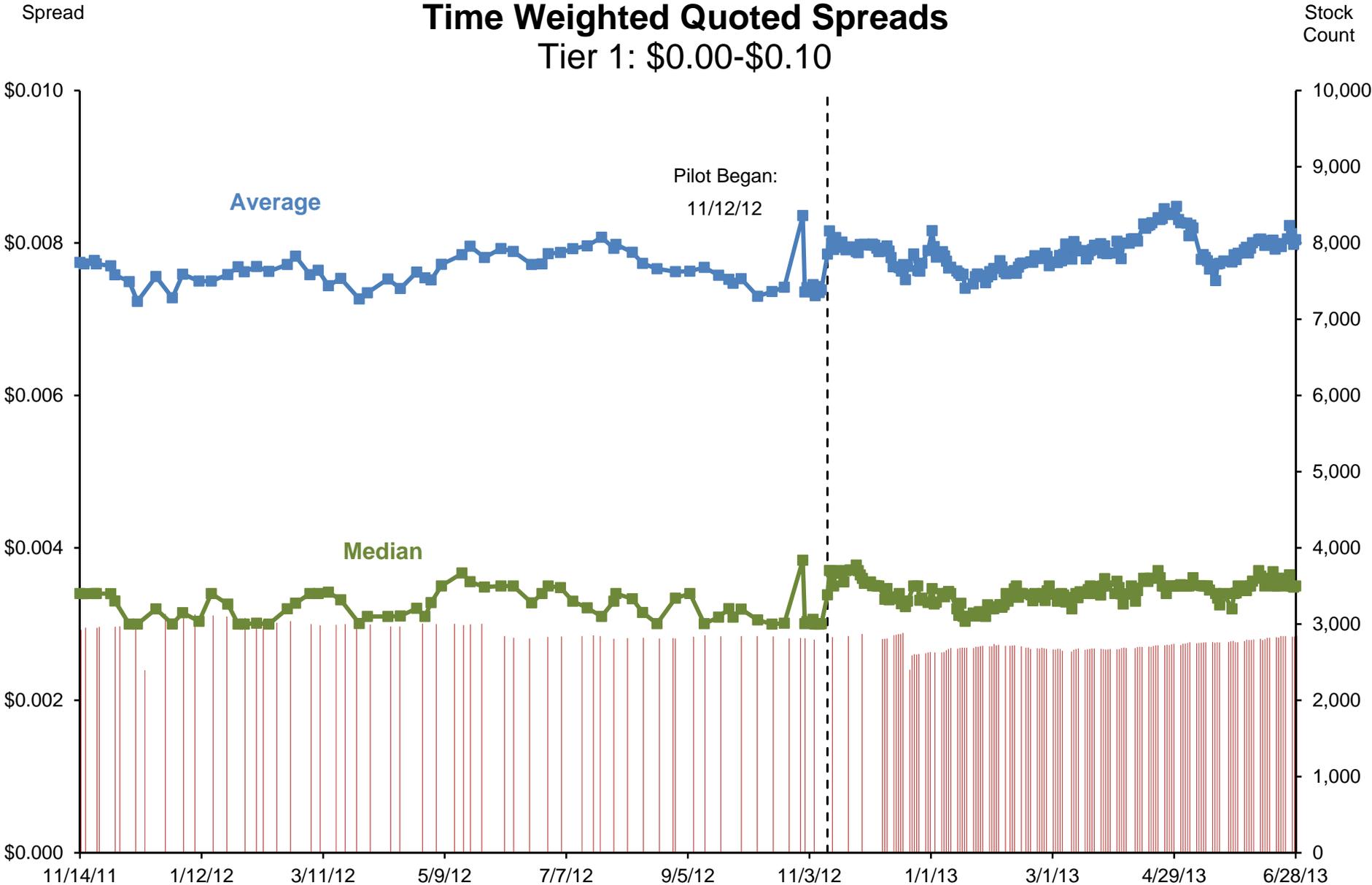
Note: Orders are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.

### Total Limit Orders Executed Tier 5b: \$10.00-\$100.00



### Total Limit Orders Executed Tier 5c: \$100.00-\$175.00

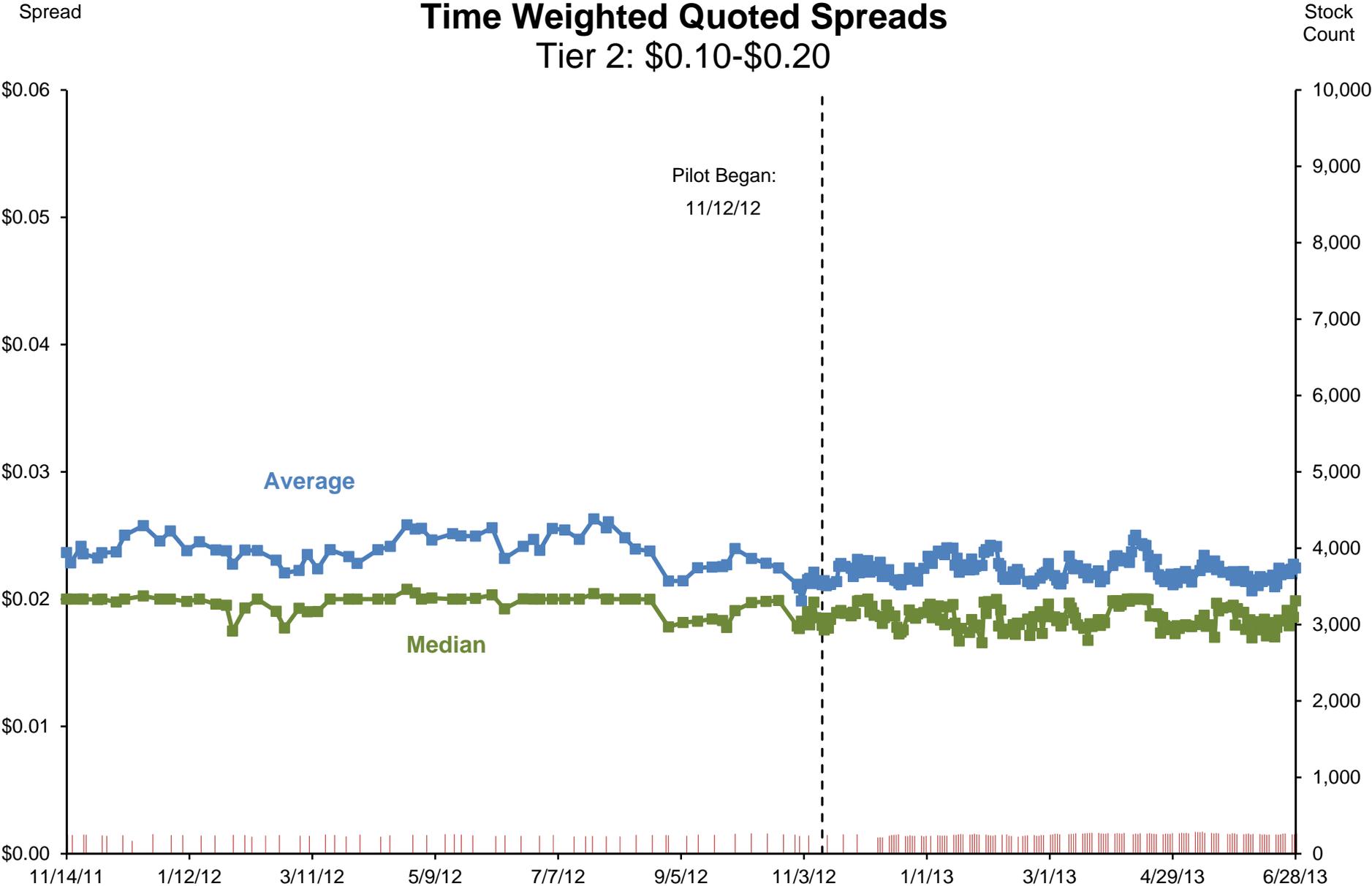




Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

# Time Weighted Quoted Spreads Tier 2: \$0.10-\$0.20

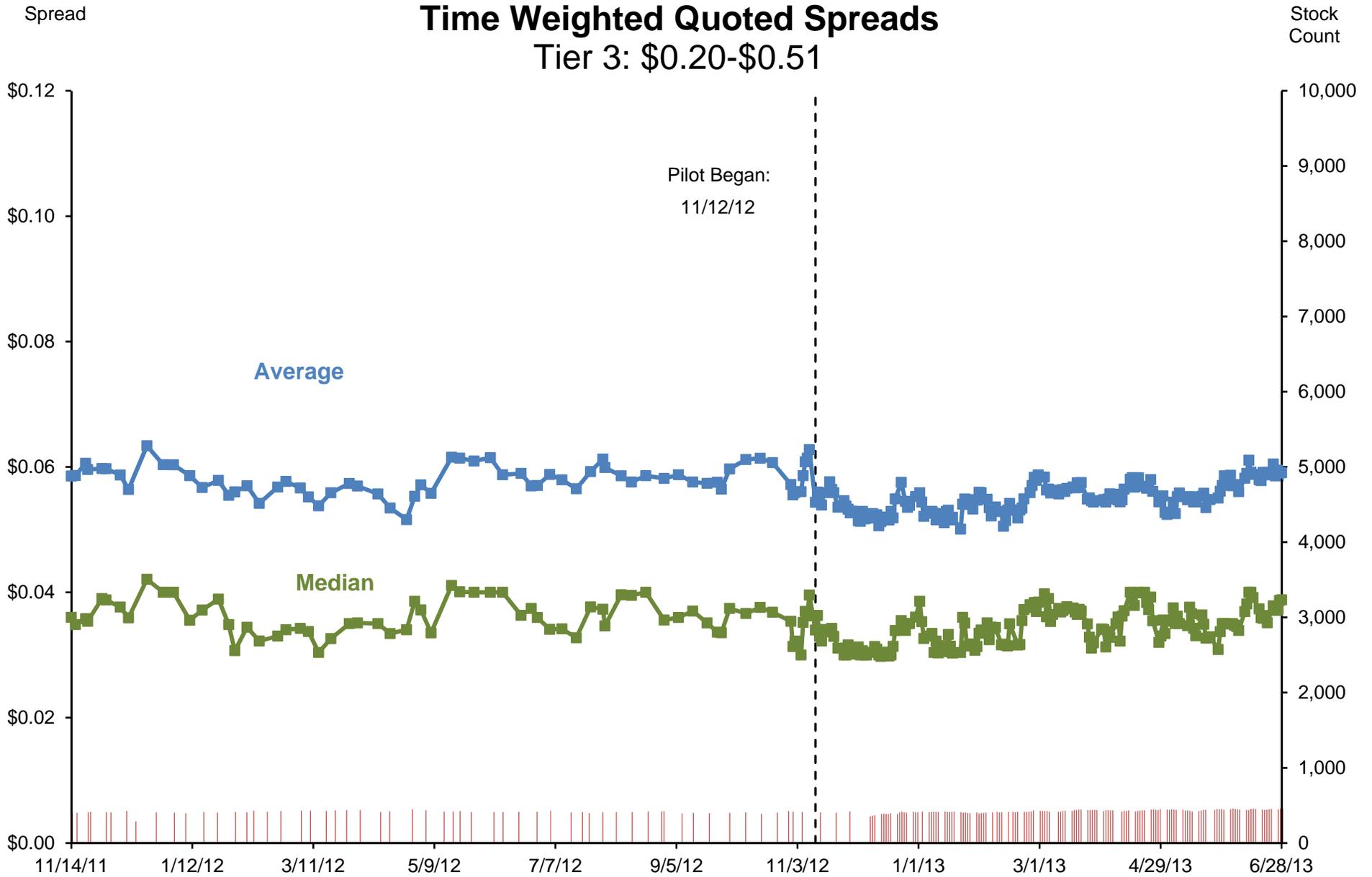


Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

# Time Weighted Quoted Spreads

## Tier 3: \$0.20-\$0.51



Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

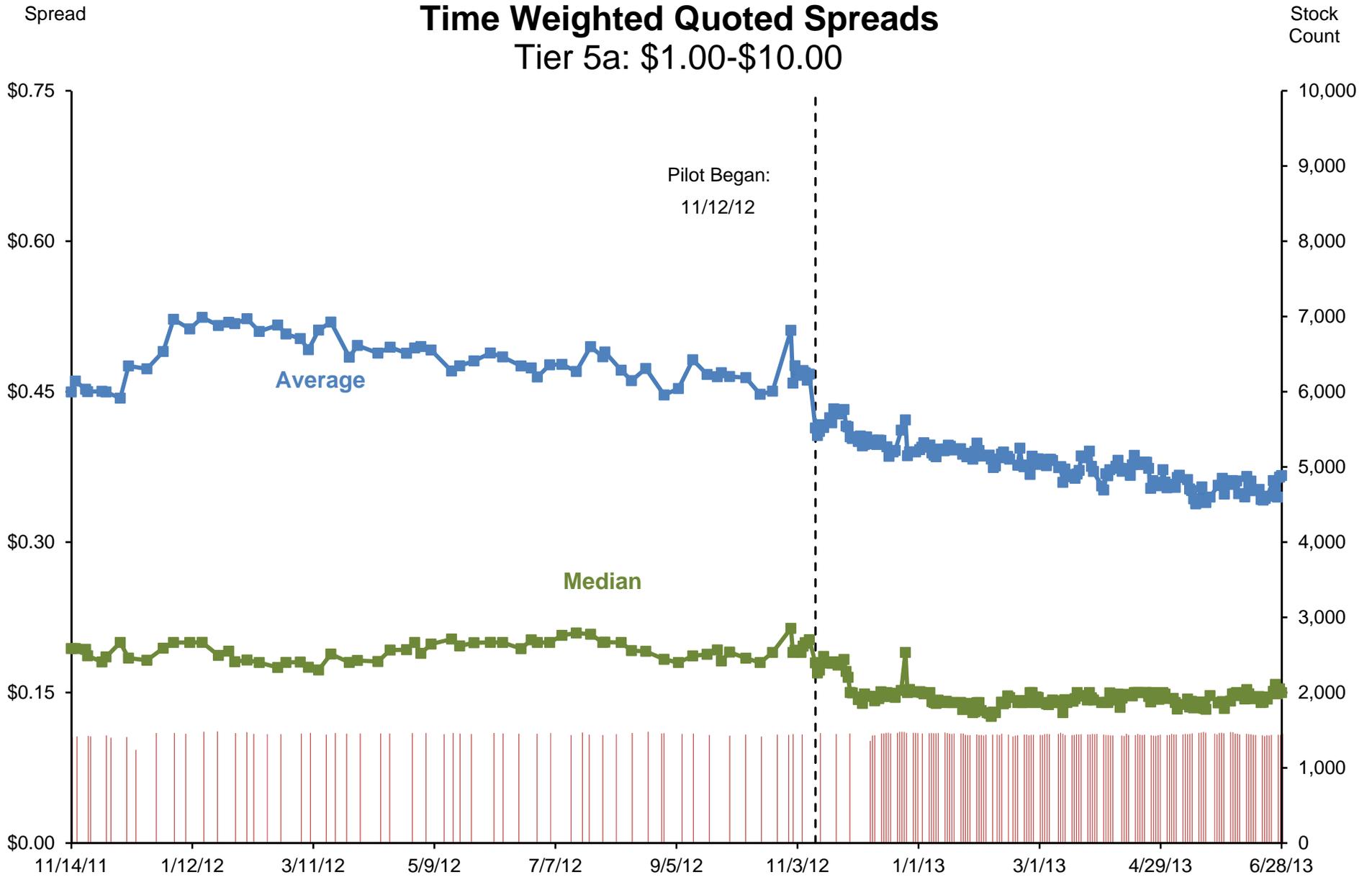


Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

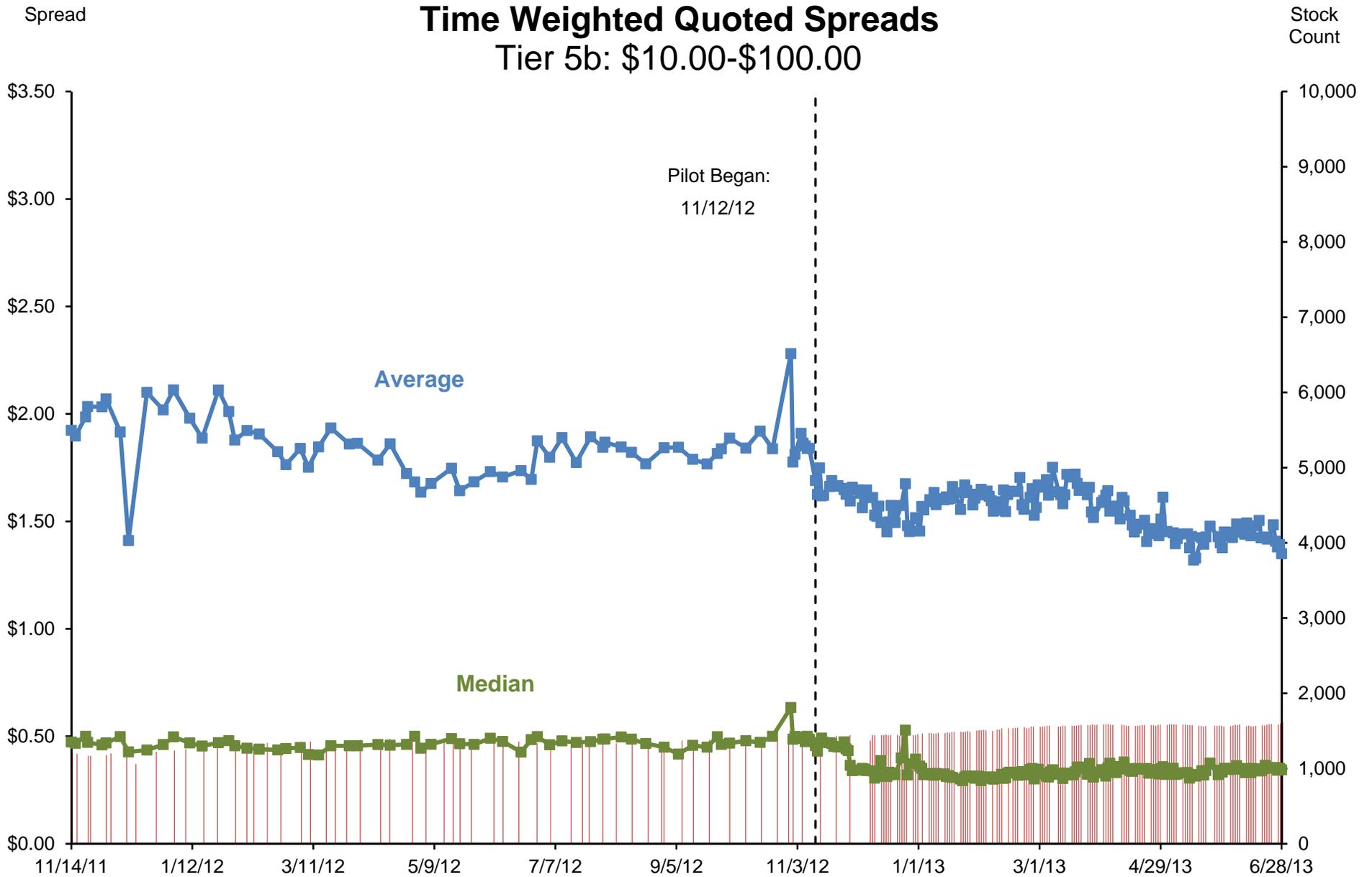
# Time Weighted Quoted Spreads

## Tier 5a: \$1.00-\$10.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.



Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.

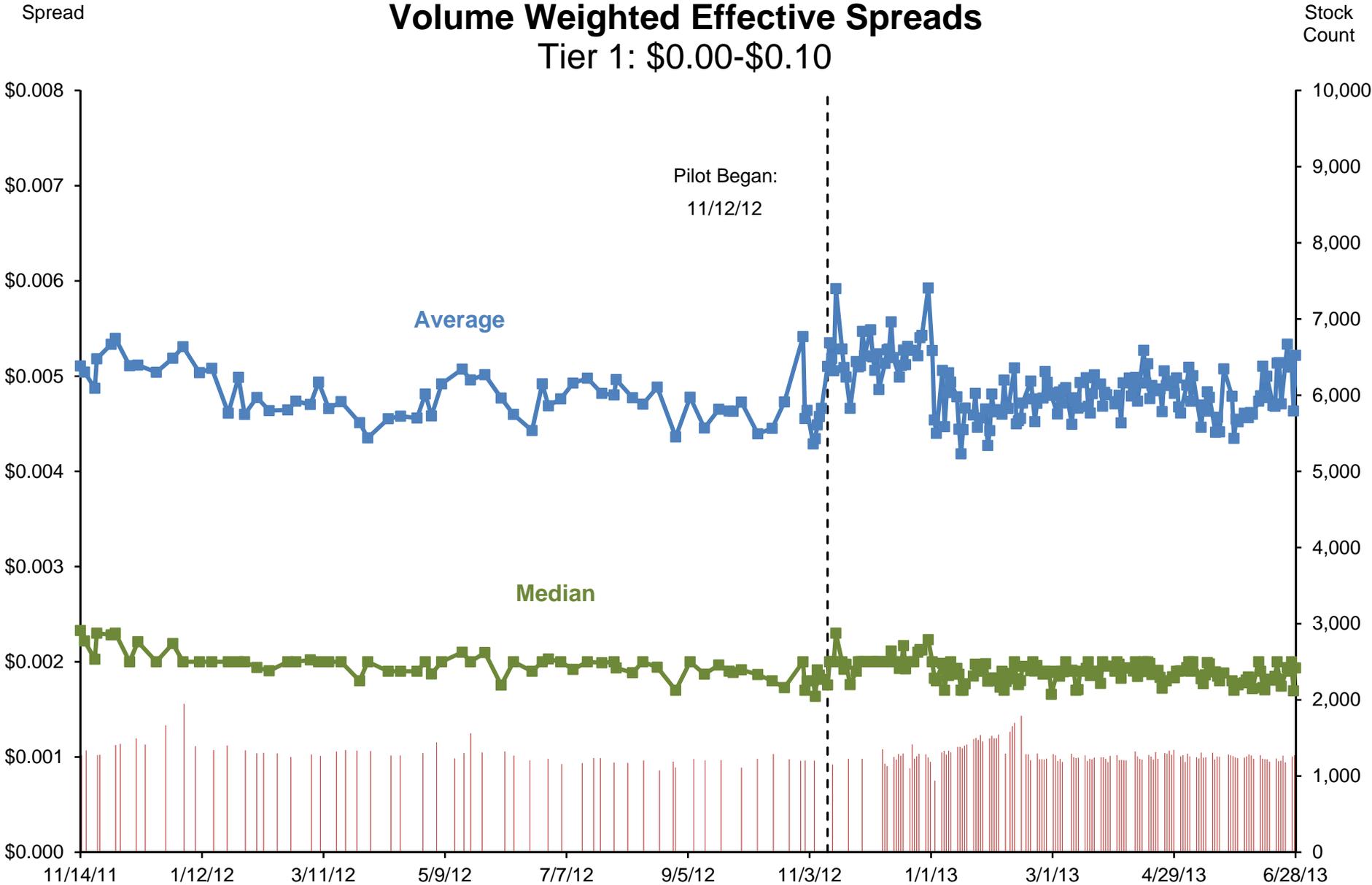
# Time Weighted Quoted Spreads

## Tier 5c: \$100.00-\$175.00



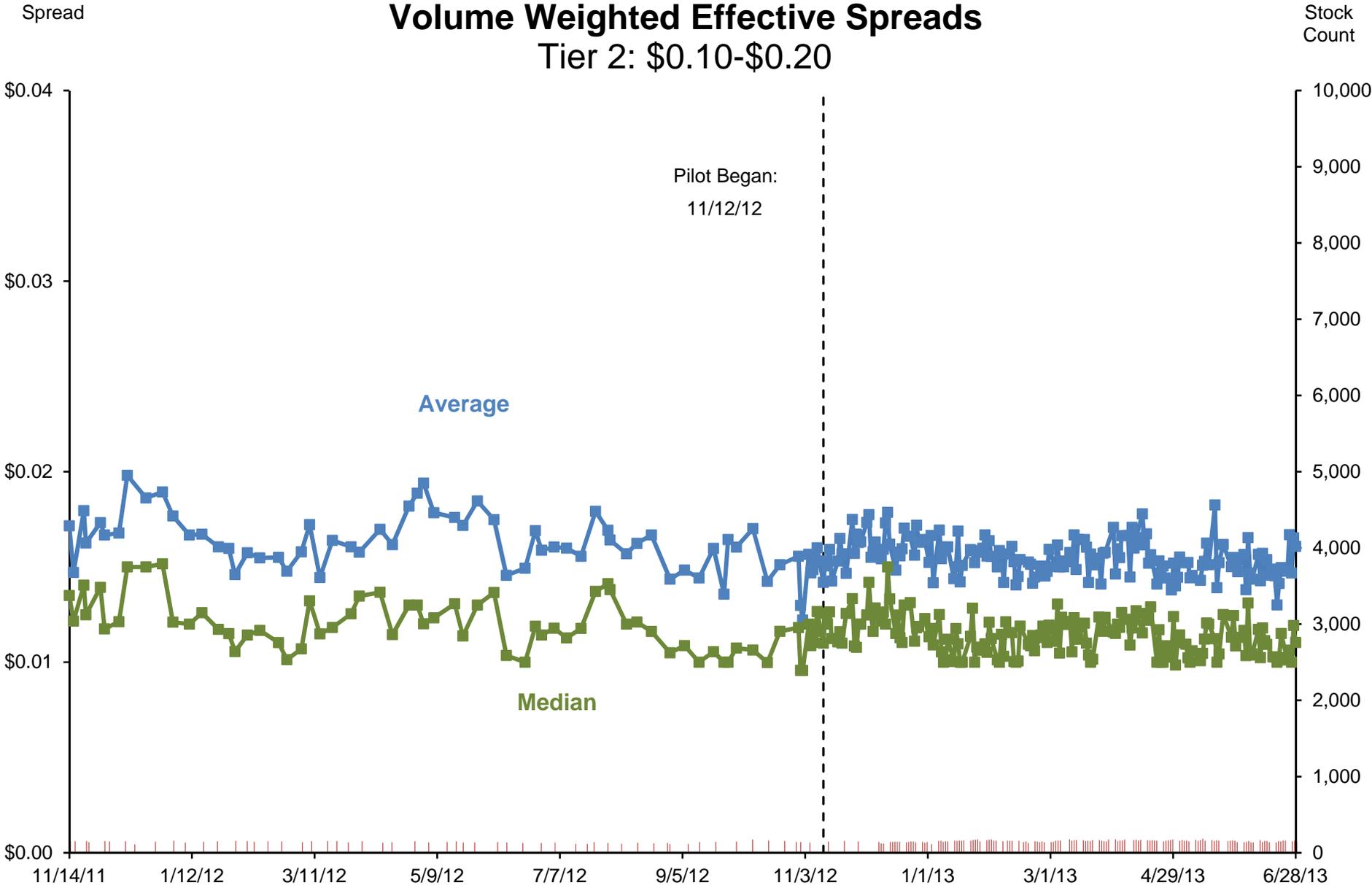
Source: OTC Link

Note: Quotes are removed from calculation 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. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.



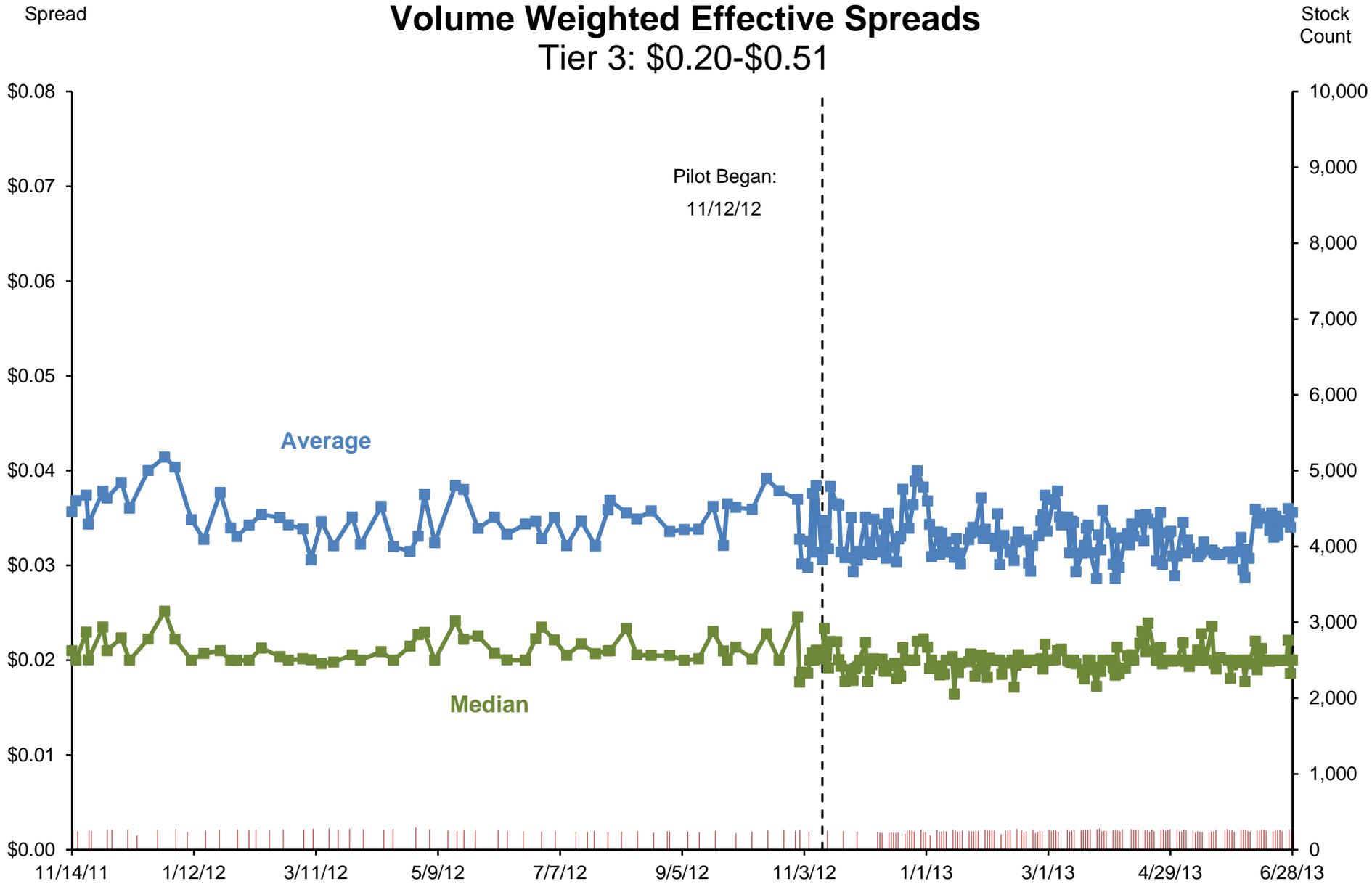
Source: OTC Link

Note: Prevailing 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. If offer is less than or equal to \$0.20, the trade is removed from calculation if the trade price is more than \$0.10 over the offer or \$0.10 less than the bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.



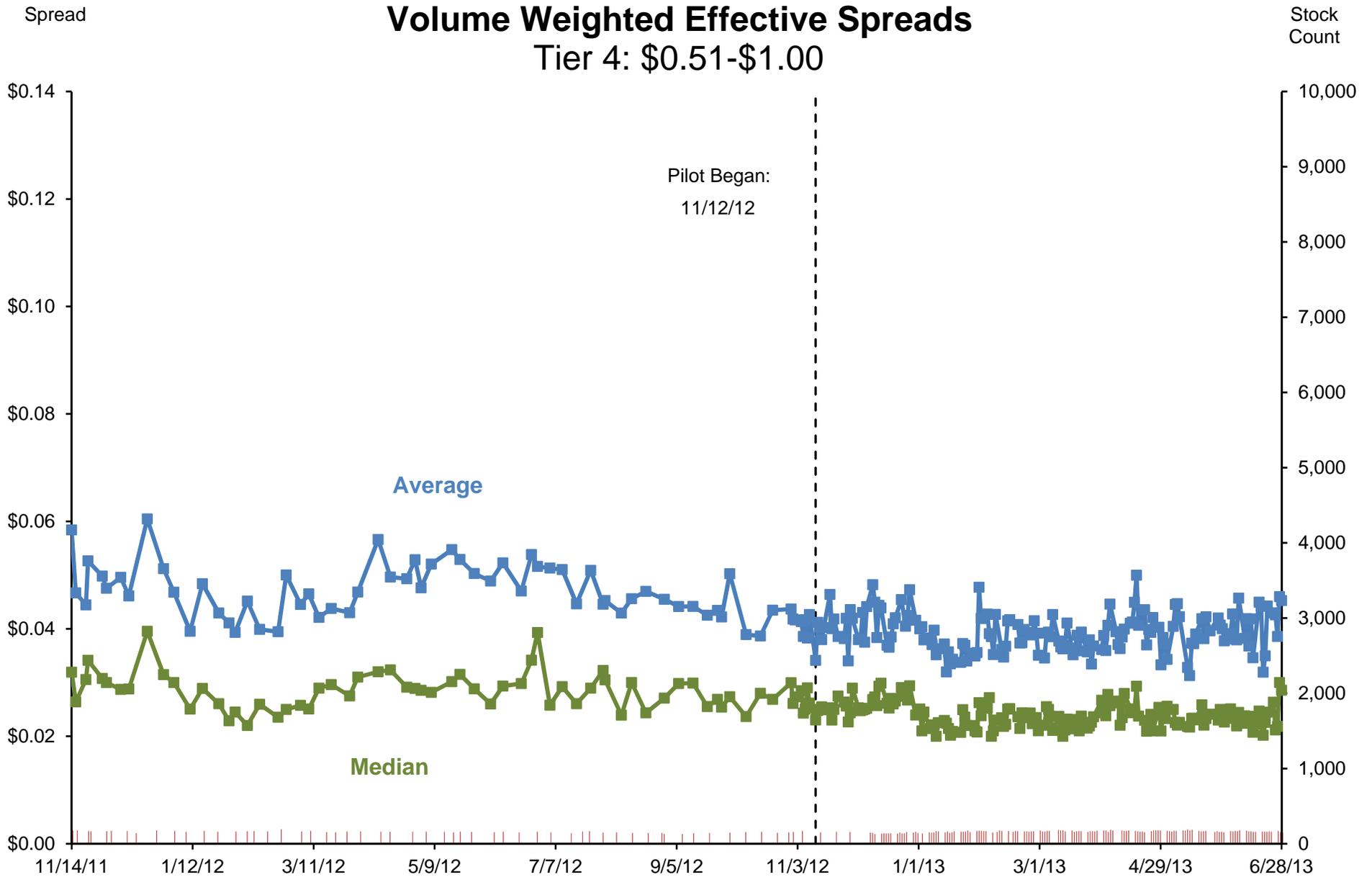
Source: OTC Link

Note: Prevailing 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. If offer is less than or equal to \$0.20, the trade is removed from calculation if the trade price is more than \$0.10 over the offer or \$0.10 less than the bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.



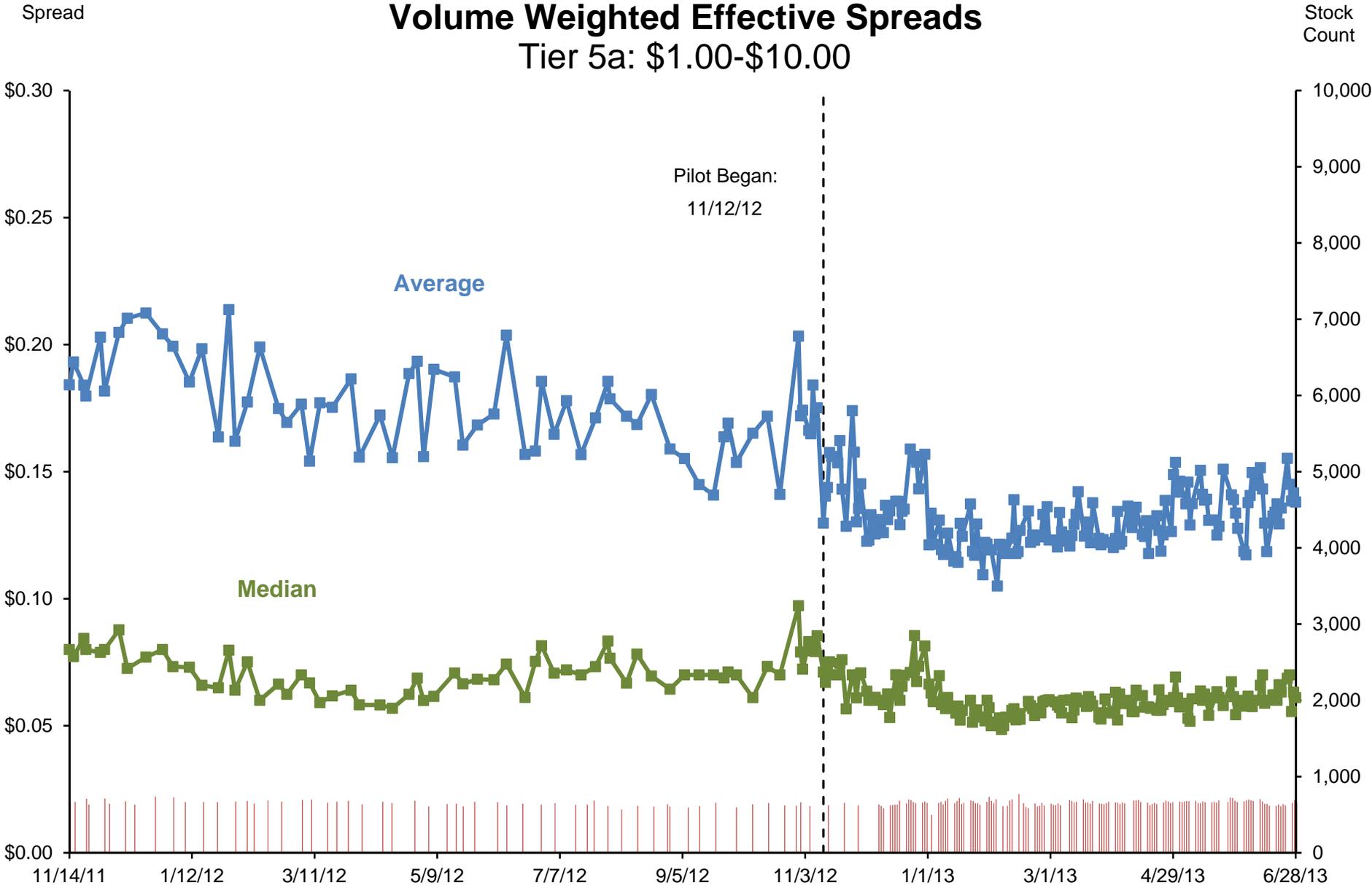
Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.



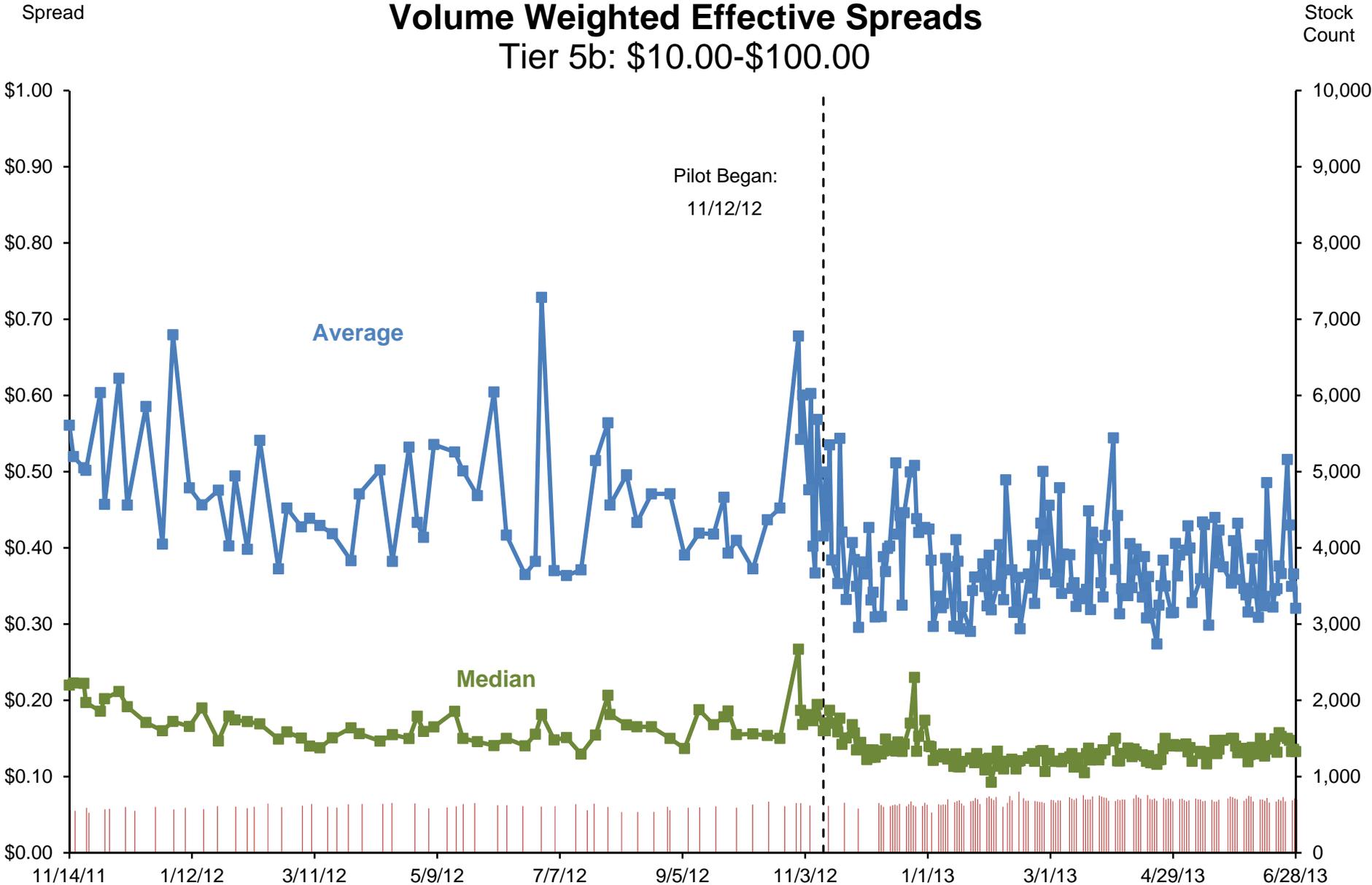
Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.



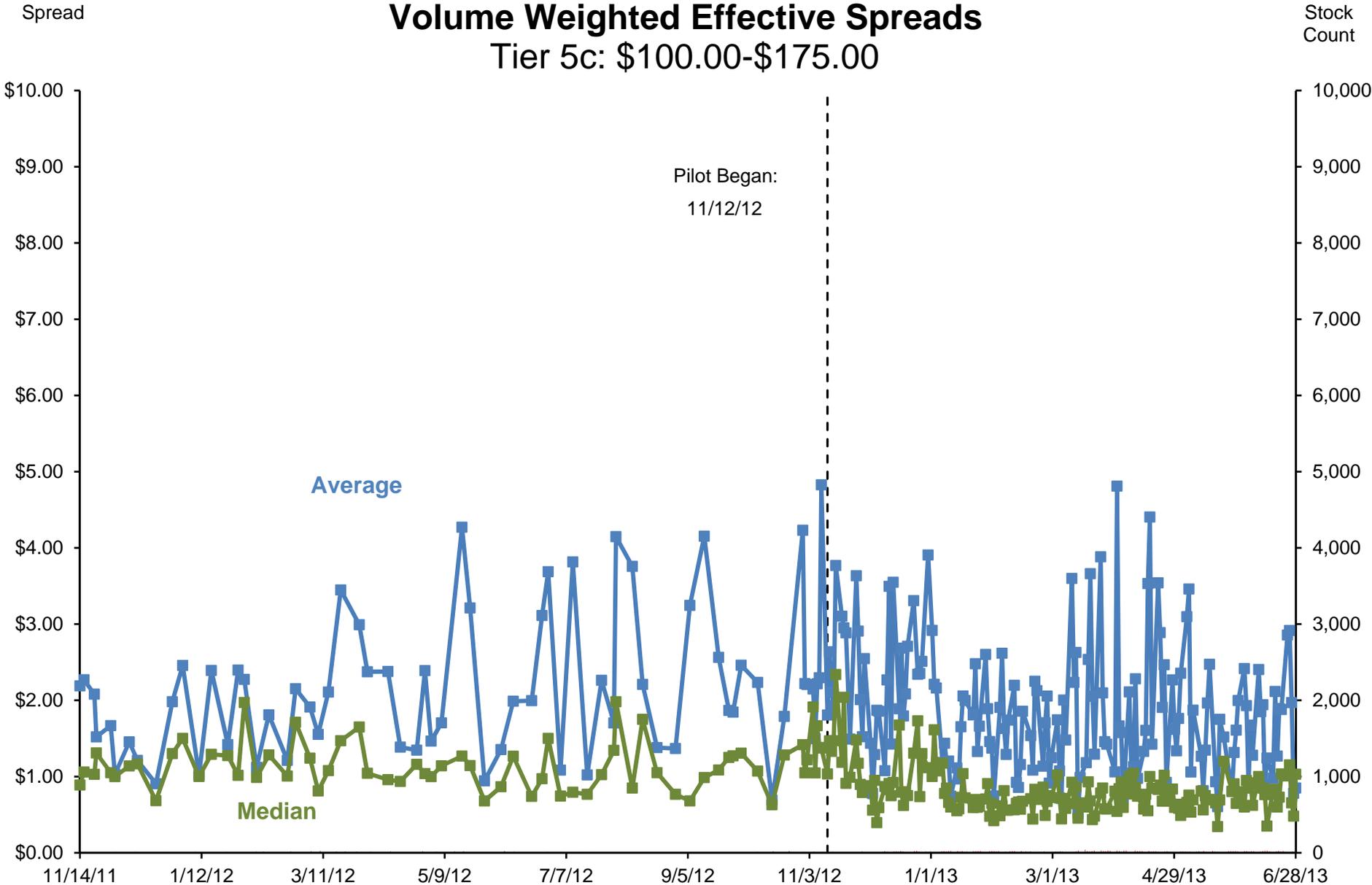
Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100.



Source: OTC Link

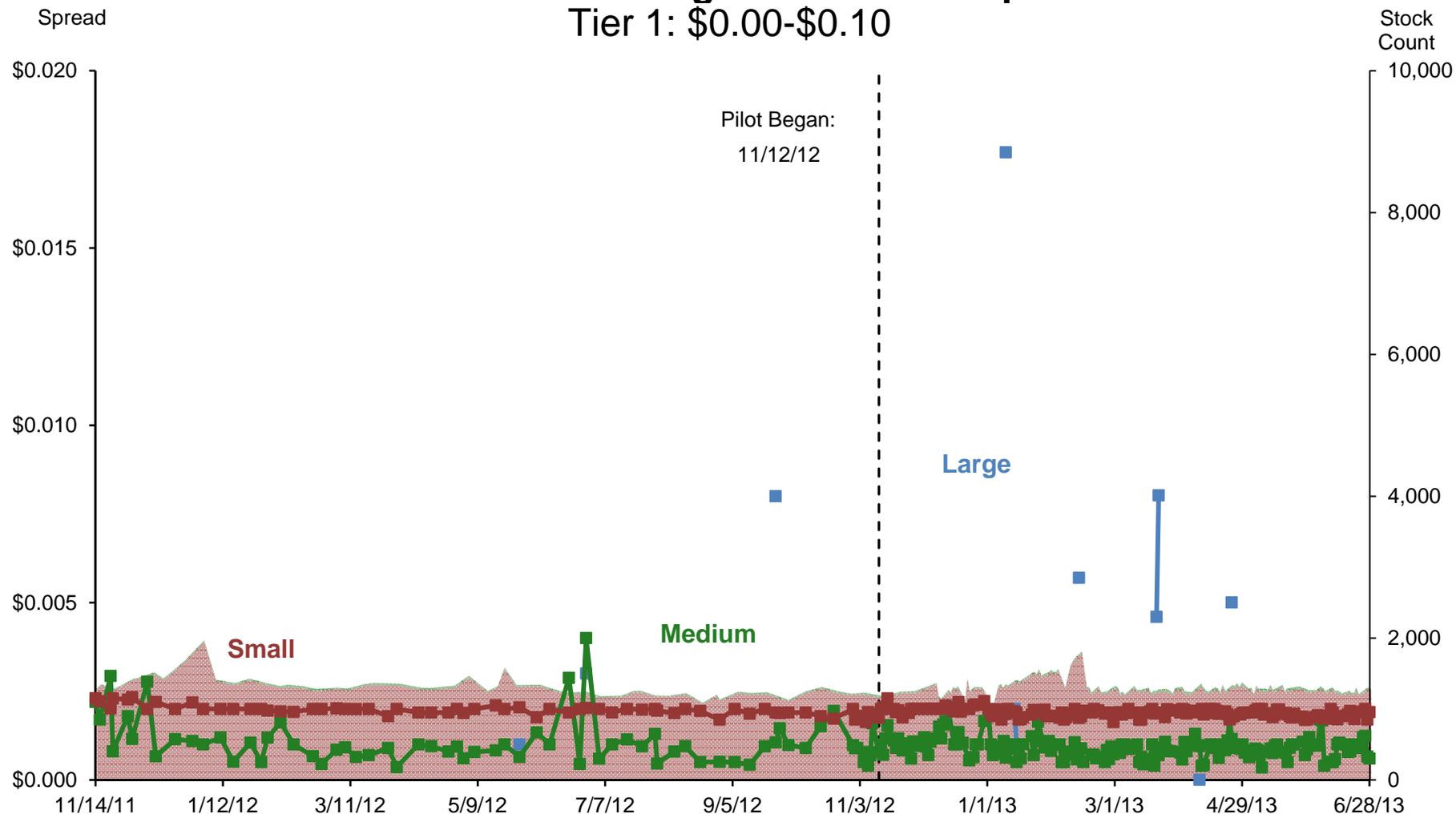
Note: Prevailing quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100.



Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements.

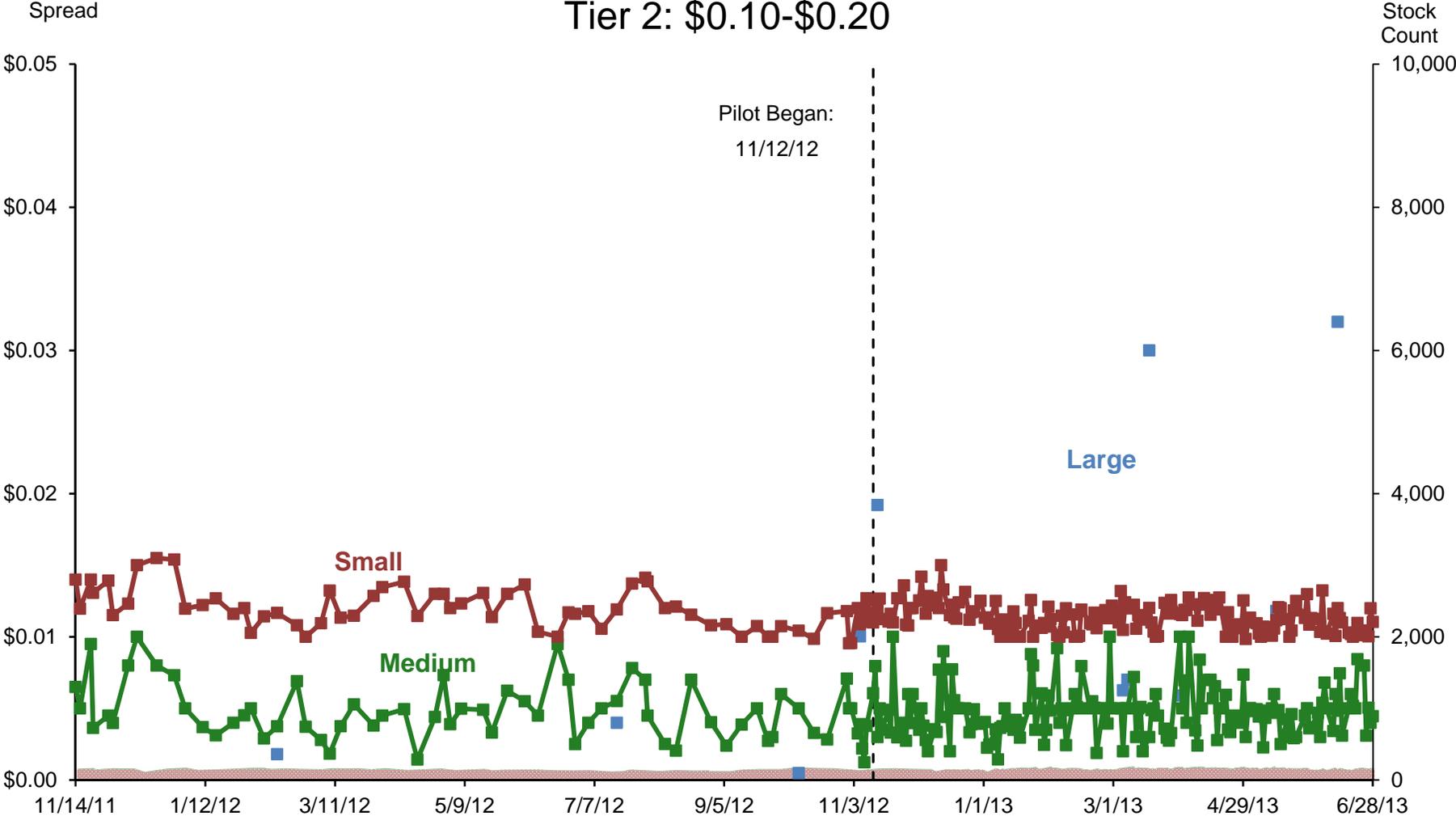
## Median Volume Weighted Effective Spreads Tier 1: \$0.00-\$0.10



Source: OTC Link

Note: Prevailing 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. If offer is less than or equal to \$0.20, the trade is removed from calculation if the trade price is more than \$0.10 over the offer or \$0.10 less than the bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000. Shaded values represent the number of equities for which a valid effective spread was calculated.

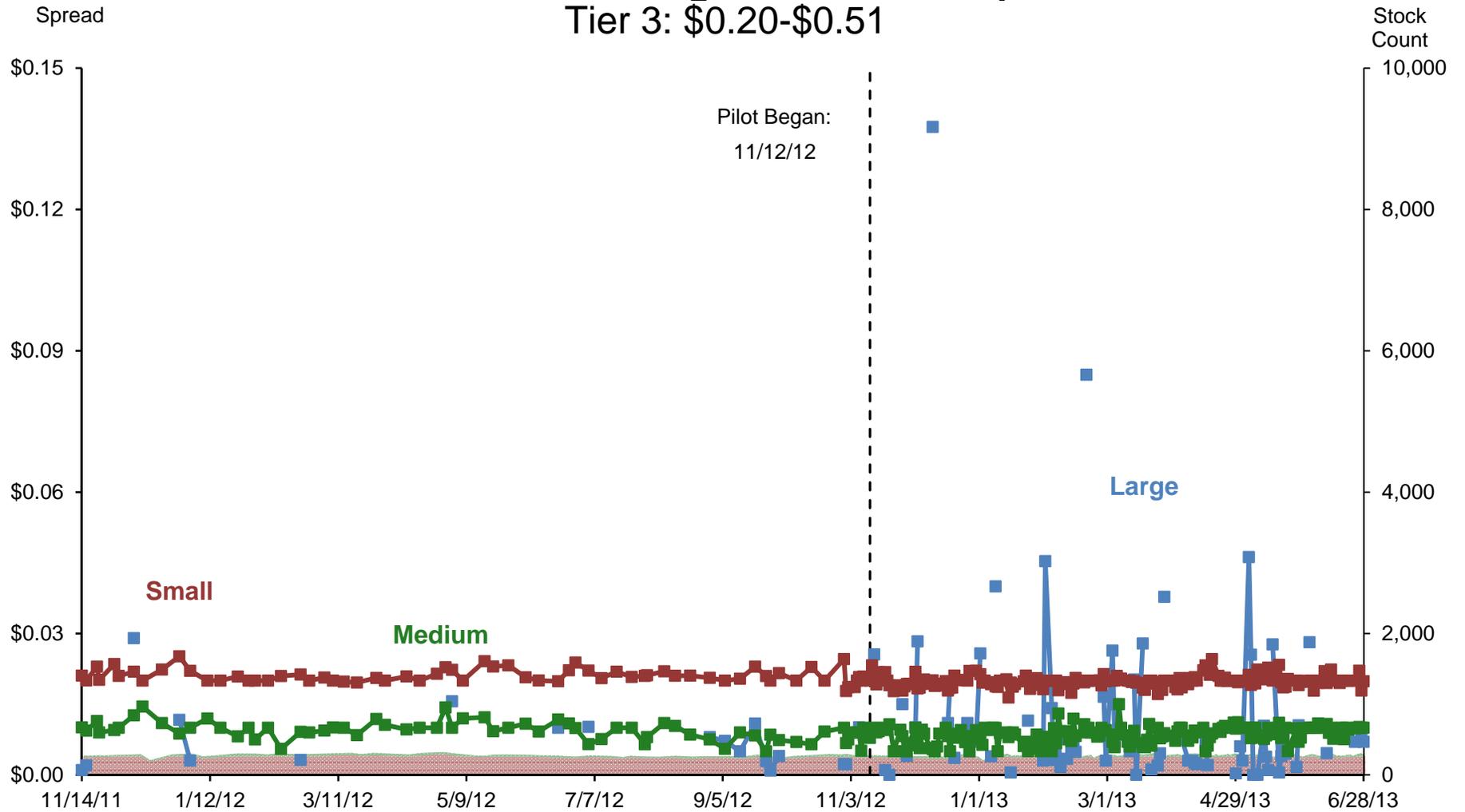
# Median Volume Weighted Effective Spreads Tier 2: \$0.10-\$0.20



Source: OTC Link

Note: Prevailing 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. If offer is less than or equal to \$0.20, the trade is removed from calculation if the trade price is more than \$0.10 over the offer or \$0.10 less than the bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Shaded values represent the number of equities for which a valid effective spread was calculated.

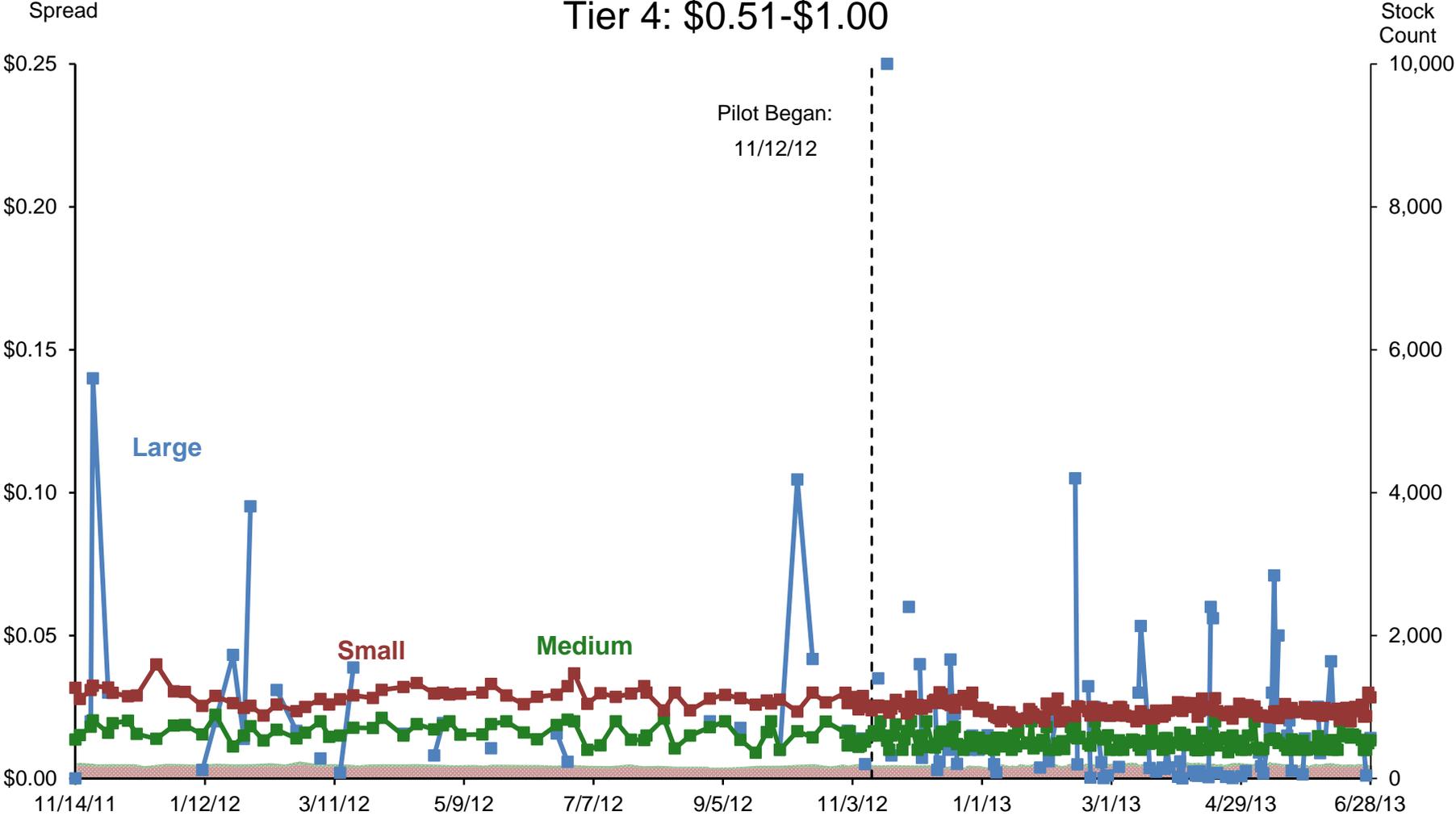
## Median Volume Weighted Effective Spreads Tier 3: \$0.20-\$0.51



Source: OTC Link

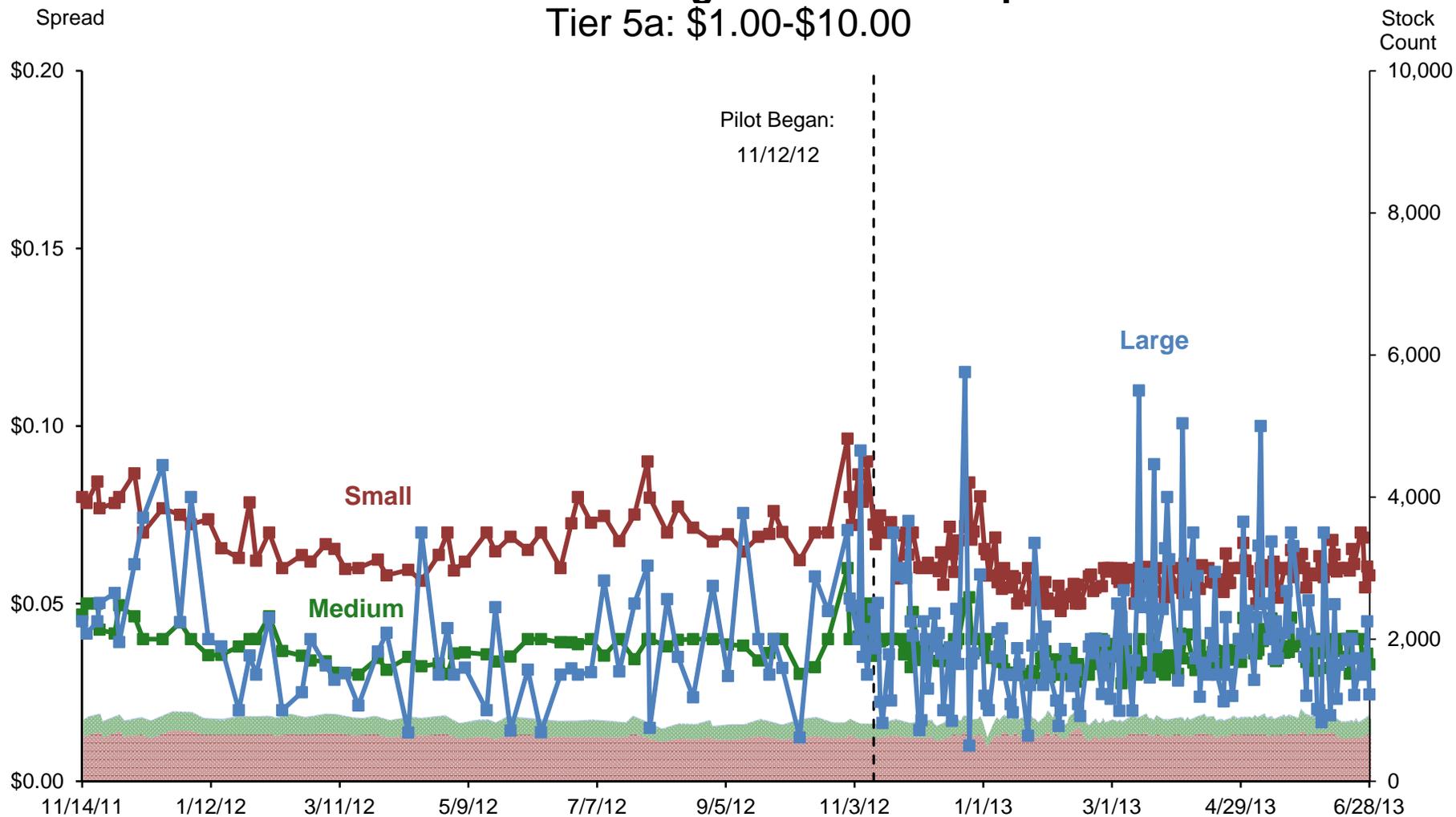
Note: Prevailing quotes are removed if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500. Shaded values represent the number of equities for which a valid effective spread was calculated.

# Median Volume Weighted Effective Spreads Tier 4: \$0.51-\$1.00



Source: OTC Link  
Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000. Shaded values represent the number of equities for which a valid effective spread was calculated.

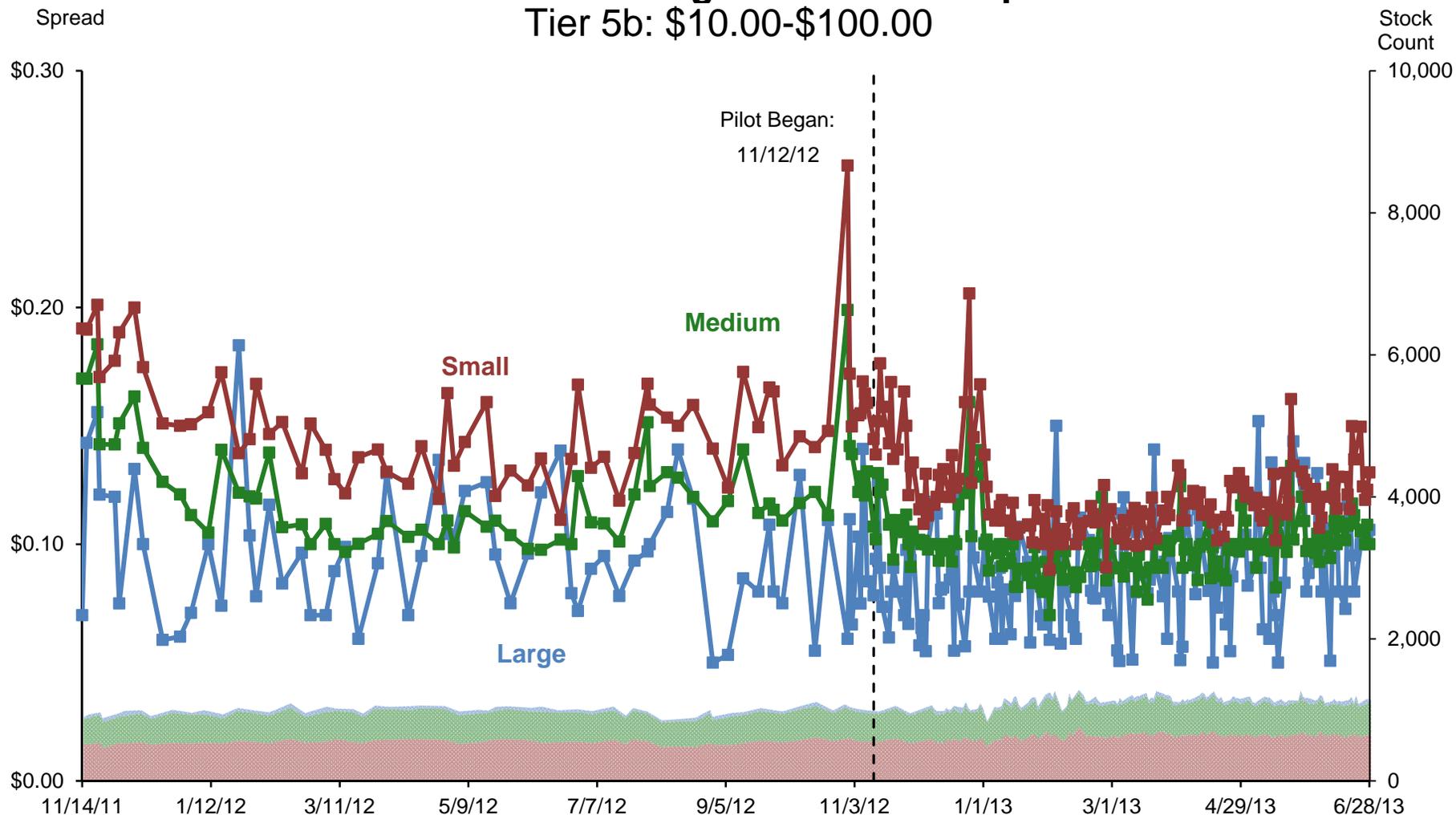
## Median Volume Weighted Effective Spreads Tier 5a: \$1.00-\$10.00



Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100. Shaded values represent the number of equities for which a valid effective spread was calculated.

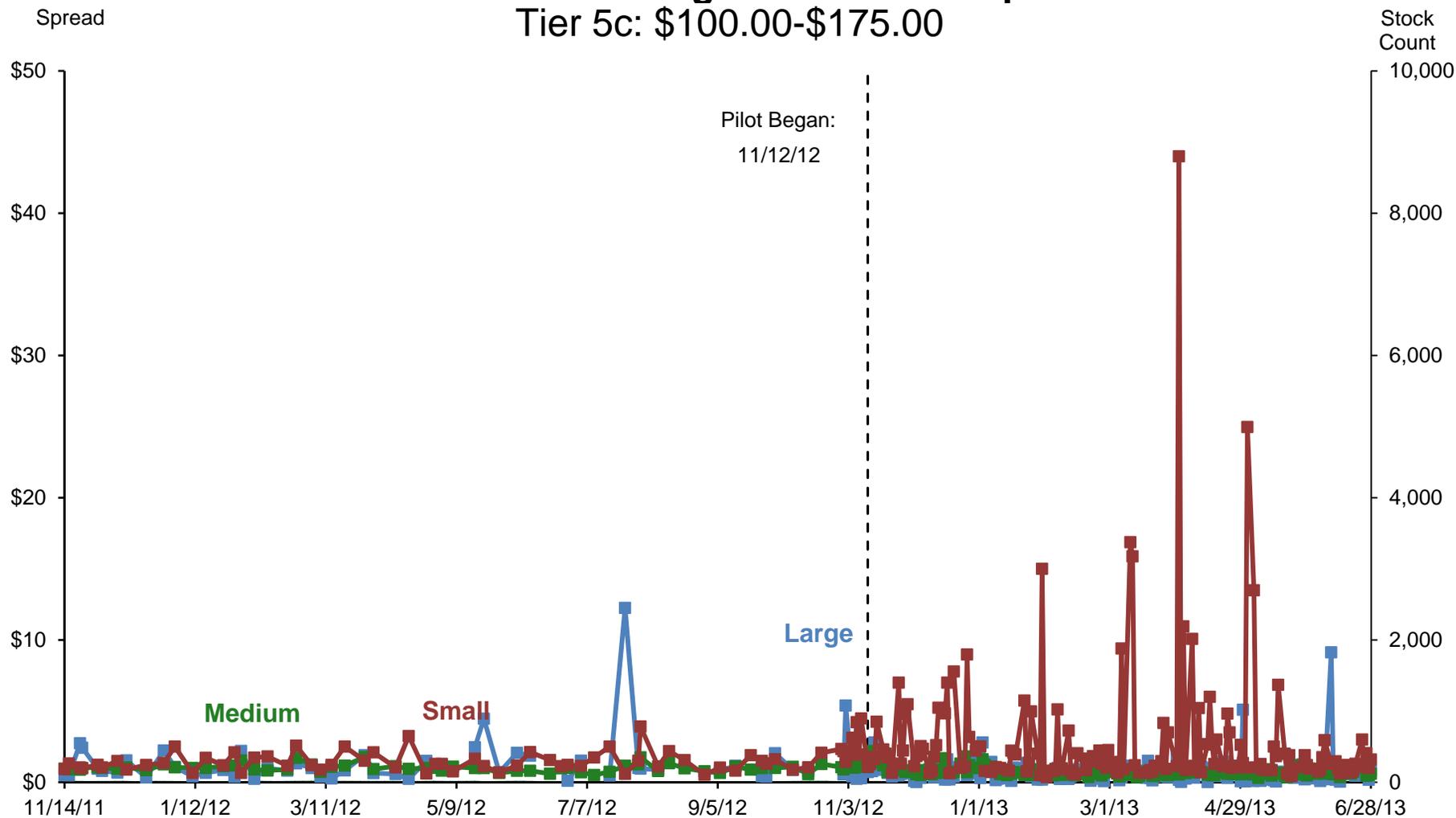
## Median Volume Weighted Effective Spreads Tier 5b: \$10.00-\$100.00



Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100. Shaded values represent the number of equities for which a valid effective spread was calculated.

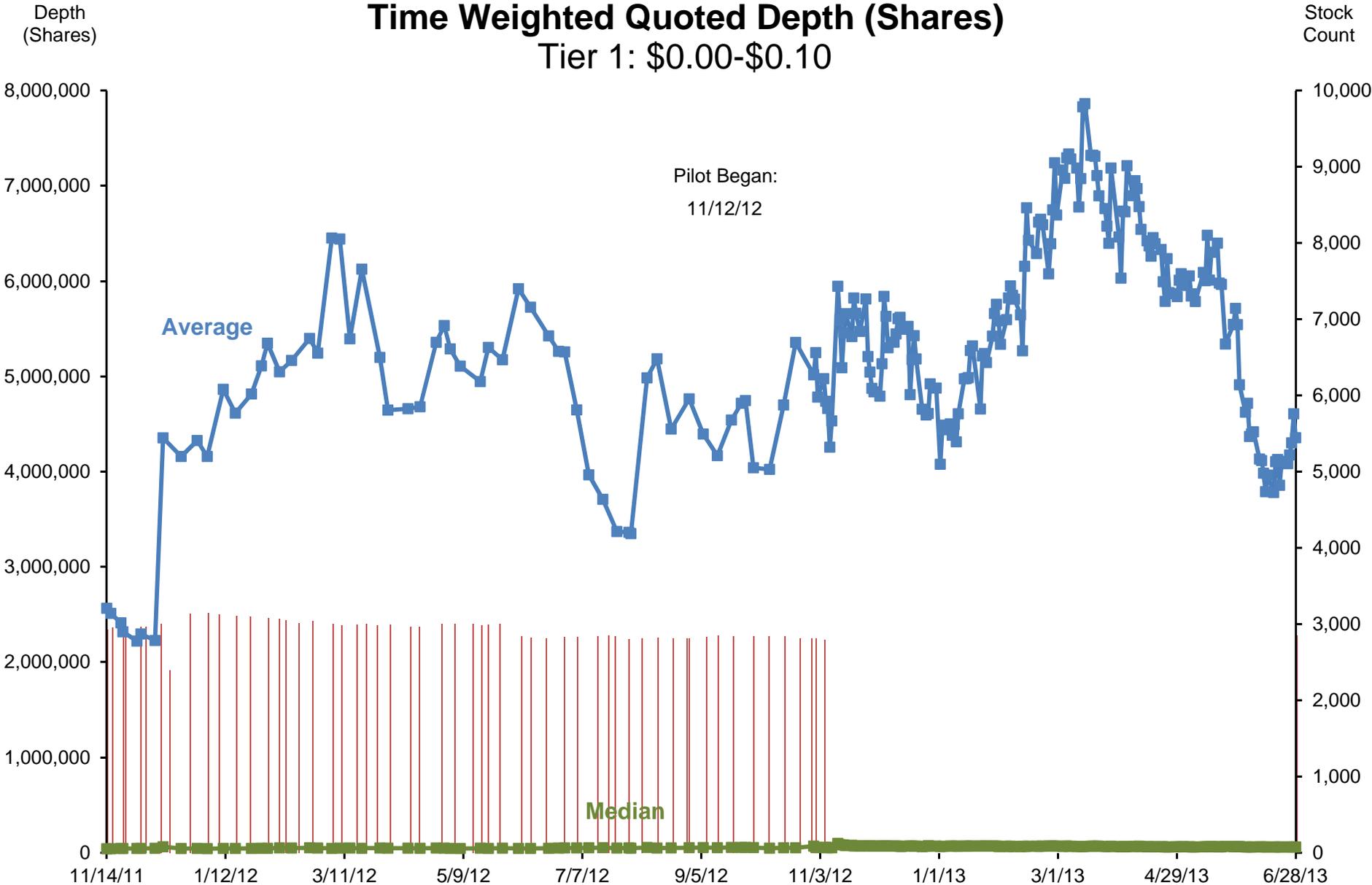
## Median Volume Weighted Effective Spreads Tier 5c: \$100.00-\$175.00



Source: OTC Link

Note: Prevailing 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. Trades are removed if they are priced over 150 percent of the prevailing offer or less than 50 percent of the prevailing bid. Spreads are excluded if valid quotes during the day span more than one tier. Small, Medium, and Large indicate dollar volume of trades on each day of less than \$10,000, \$10,000 - 200,000, and over \$200,000, respectively. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Shaded values represent the number of equities for which a valid effective spread was calculated.

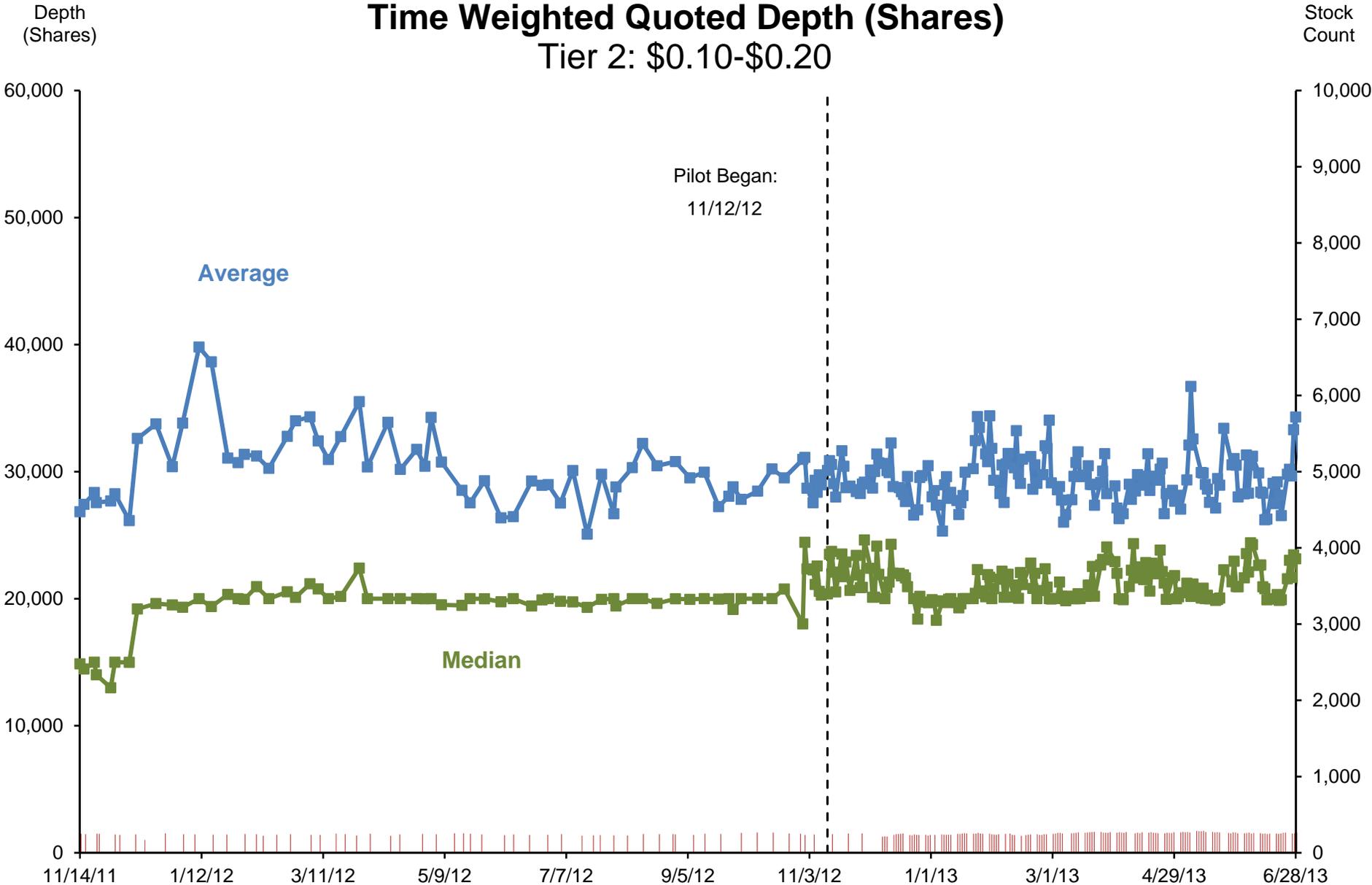
# Time Weighted Quoted Depth (Shares) Tier 1: \$0.00-\$0.10



Source: OTC Link

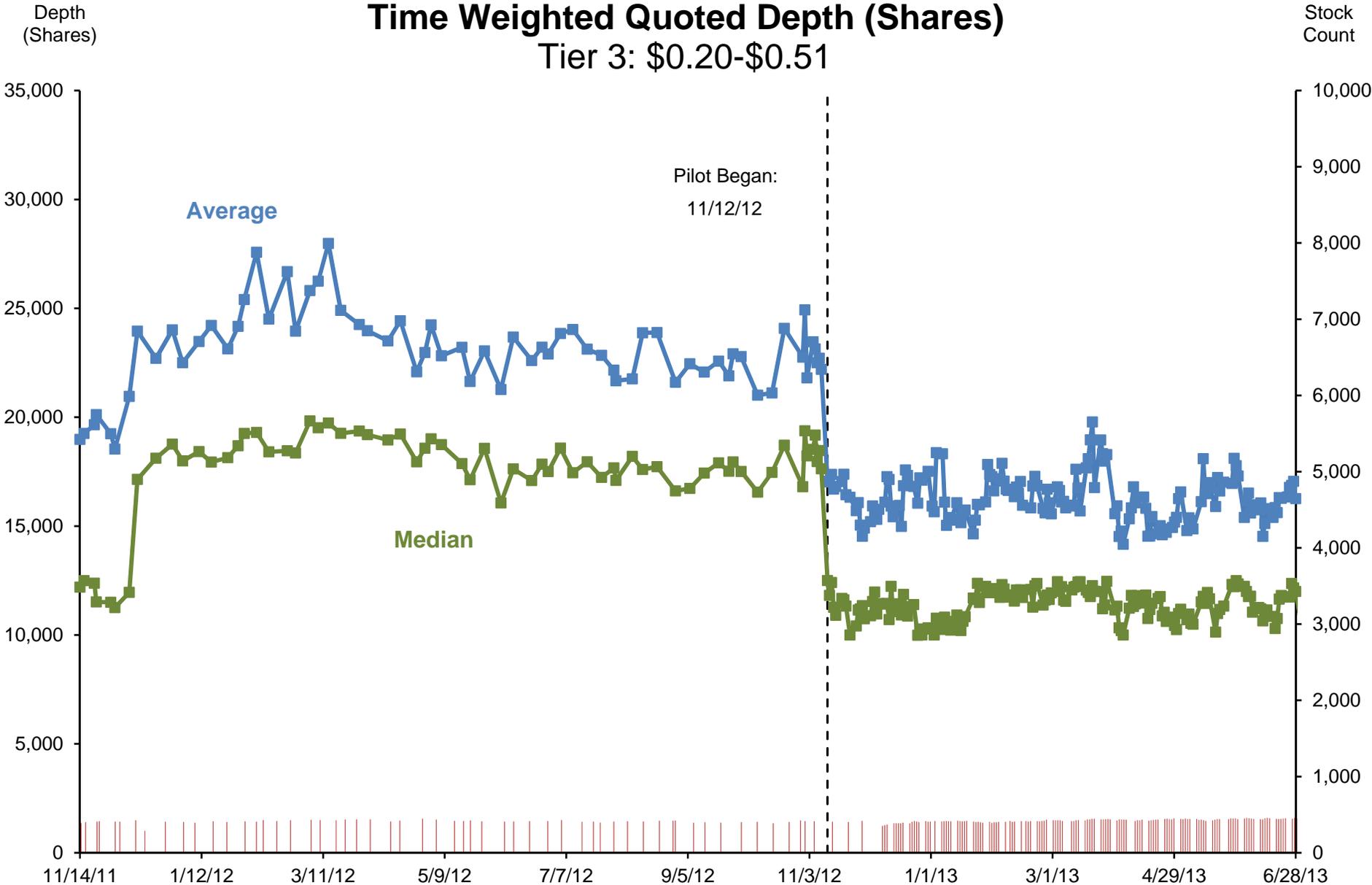
Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000. Quoted depth is calculated as the sum of bid and offer depths.

# Time Weighted Quoted Depth (Shares) Tier 2: \$0.10-\$0.20



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Quoted depth is calculated as the sum of bid and offer depths.

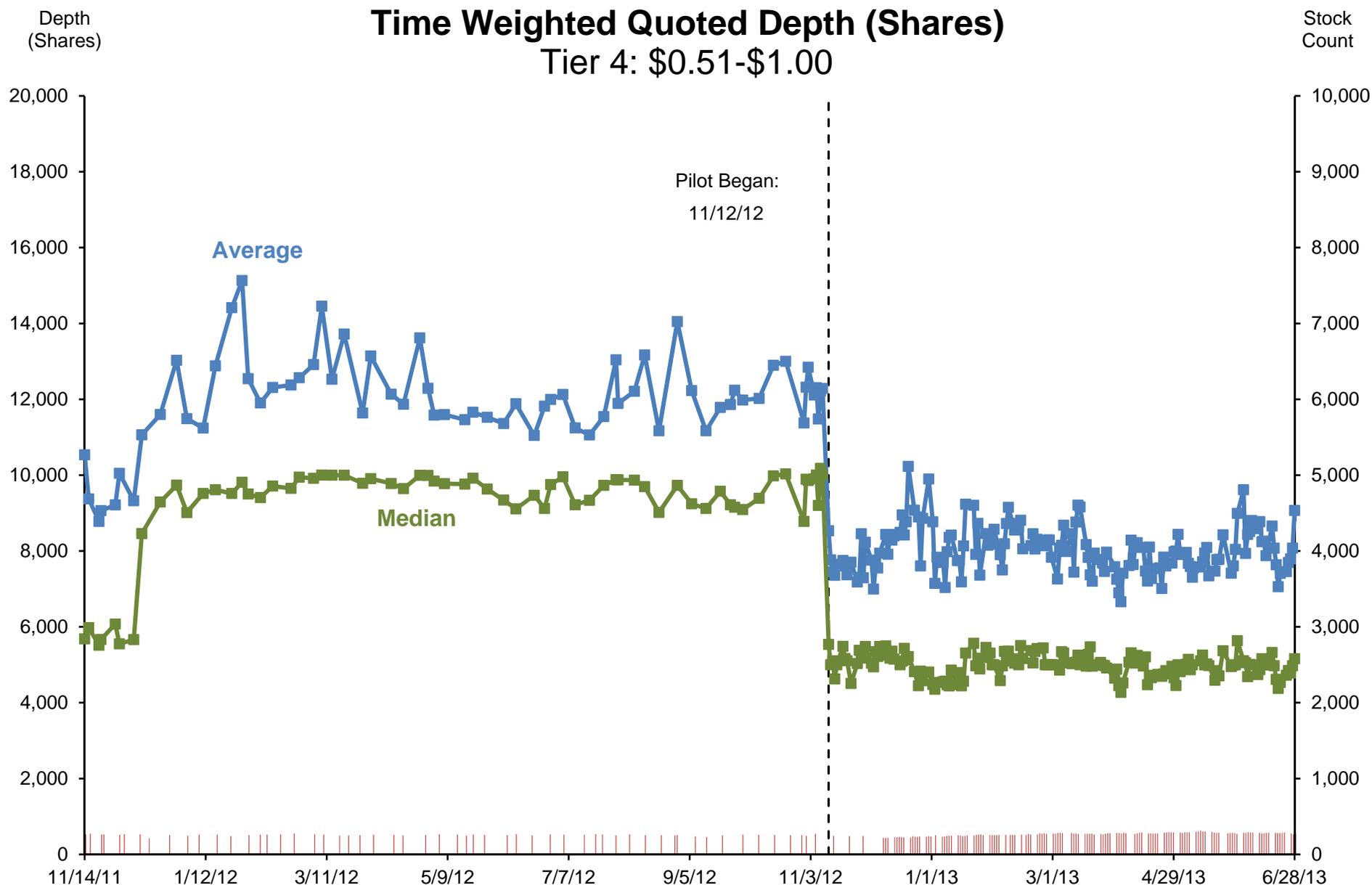


Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500. Quoted depth is calculated as the sum of bid and offer depths.

# Time Weighted Quoted Depth (Shares)

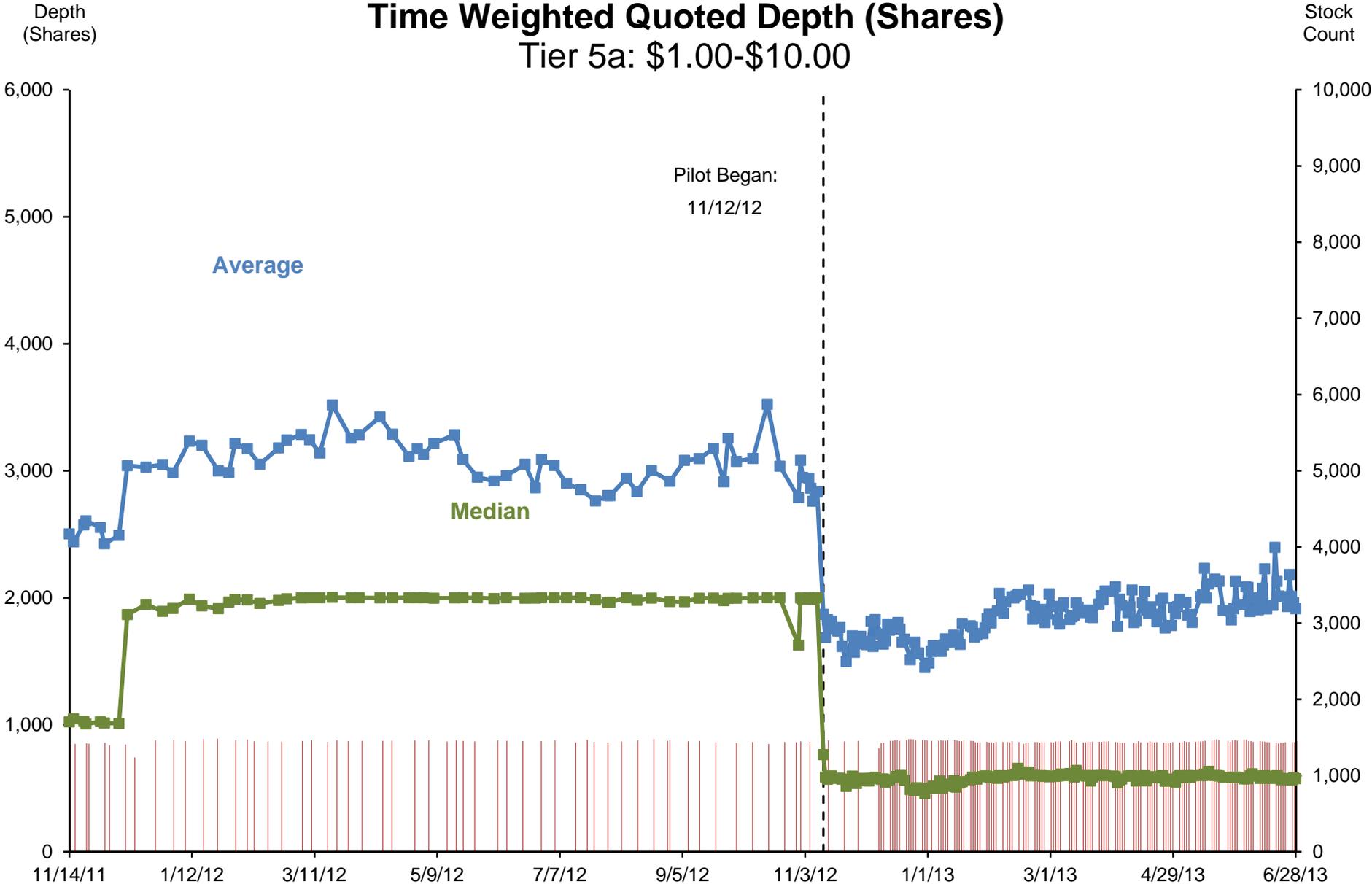
## Tier 4: \$0.51-\$1.00



Source: OTC Link

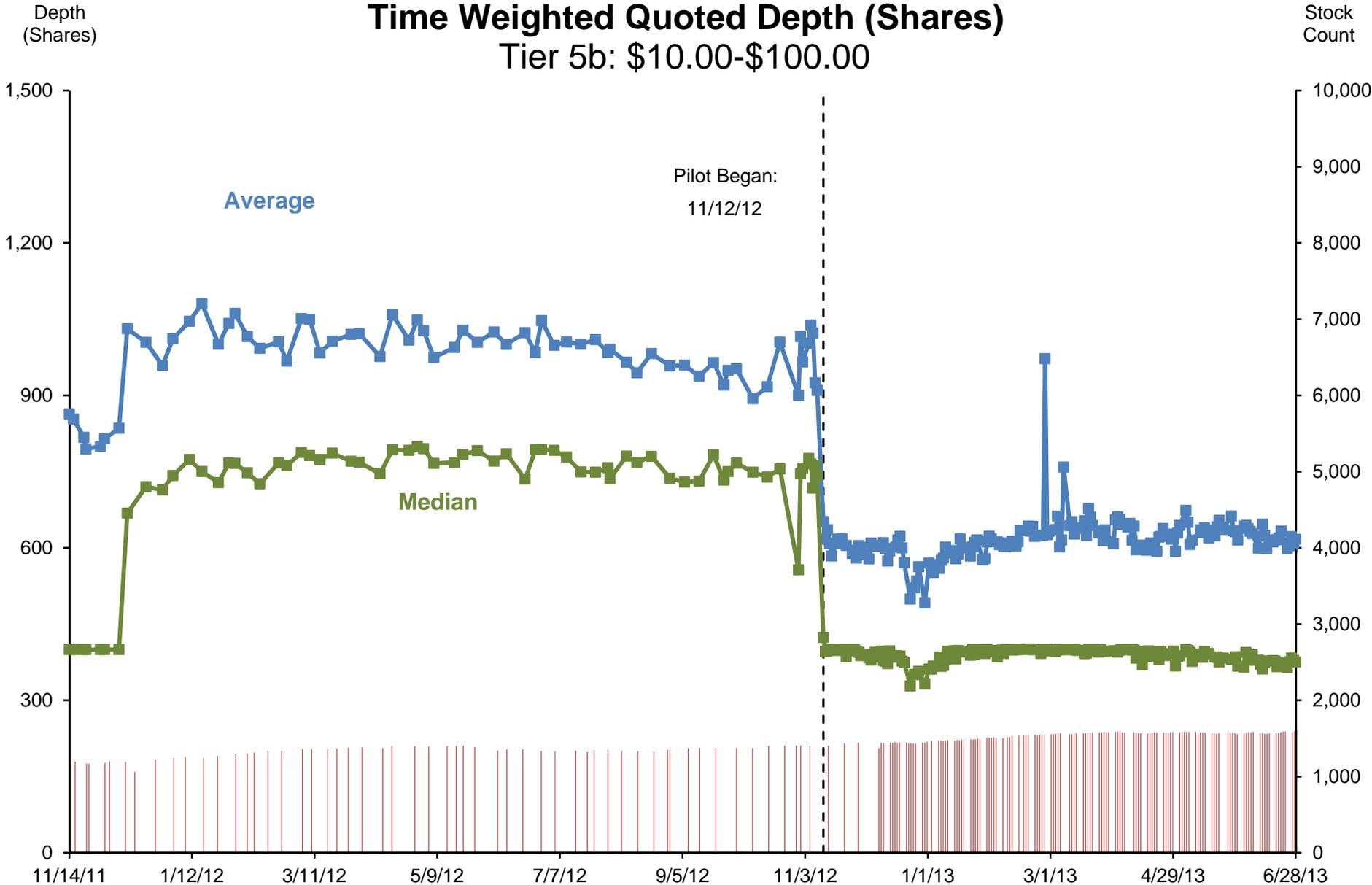
Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000. Quoted depth is calculated as the sum of bid and offer depths.

# Time Weighted Quoted Depth (Shares) Tier 5a: \$1.00-\$10.00



Source: OTC Link

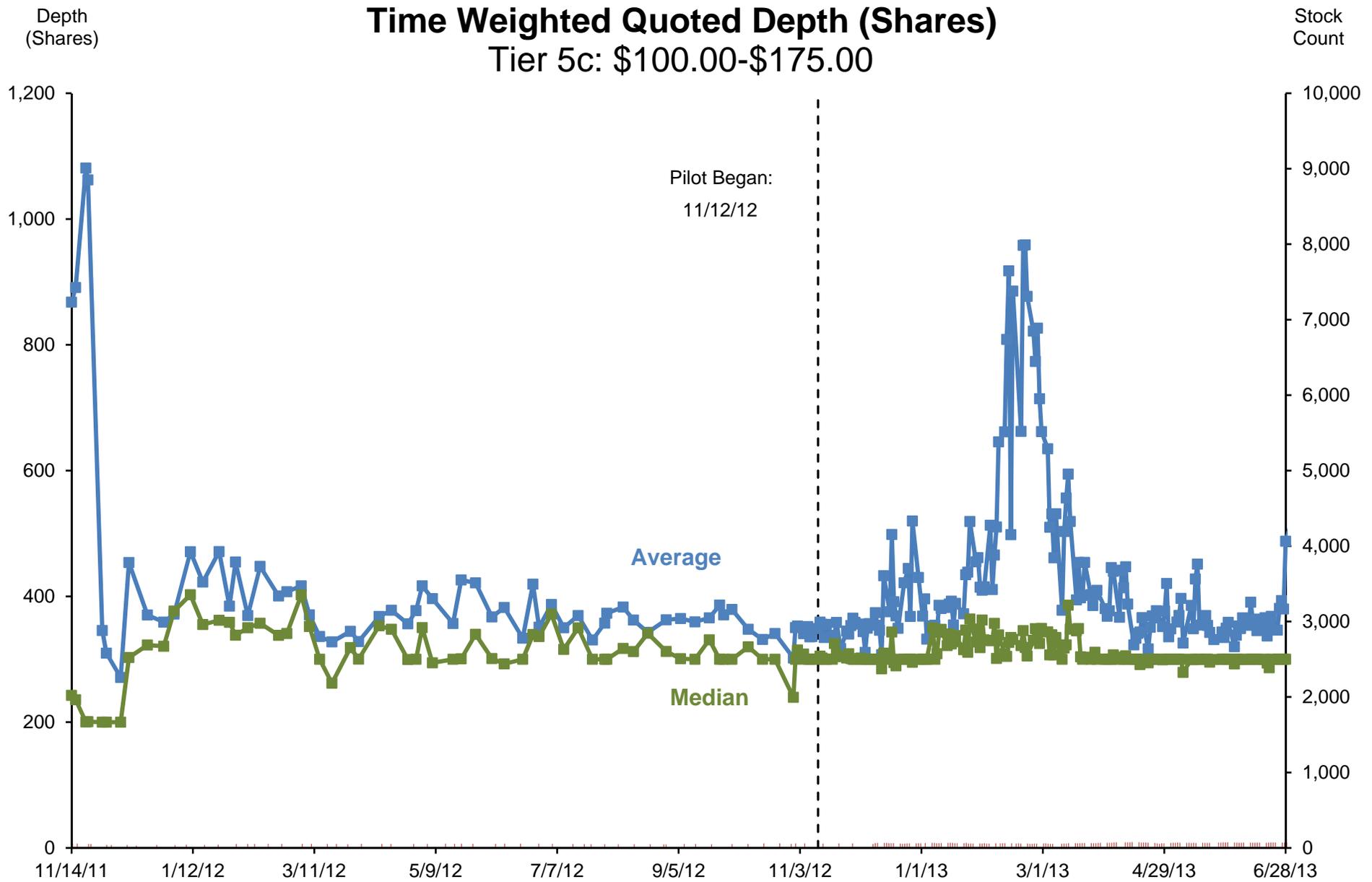
Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, or if the quoted spread divided by the offer price is over 90 percent. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100. Quoted depth is calculated as the sum of bid and offer depths.



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100. Quoted depth is calculated as the sum of bid and offer depths.

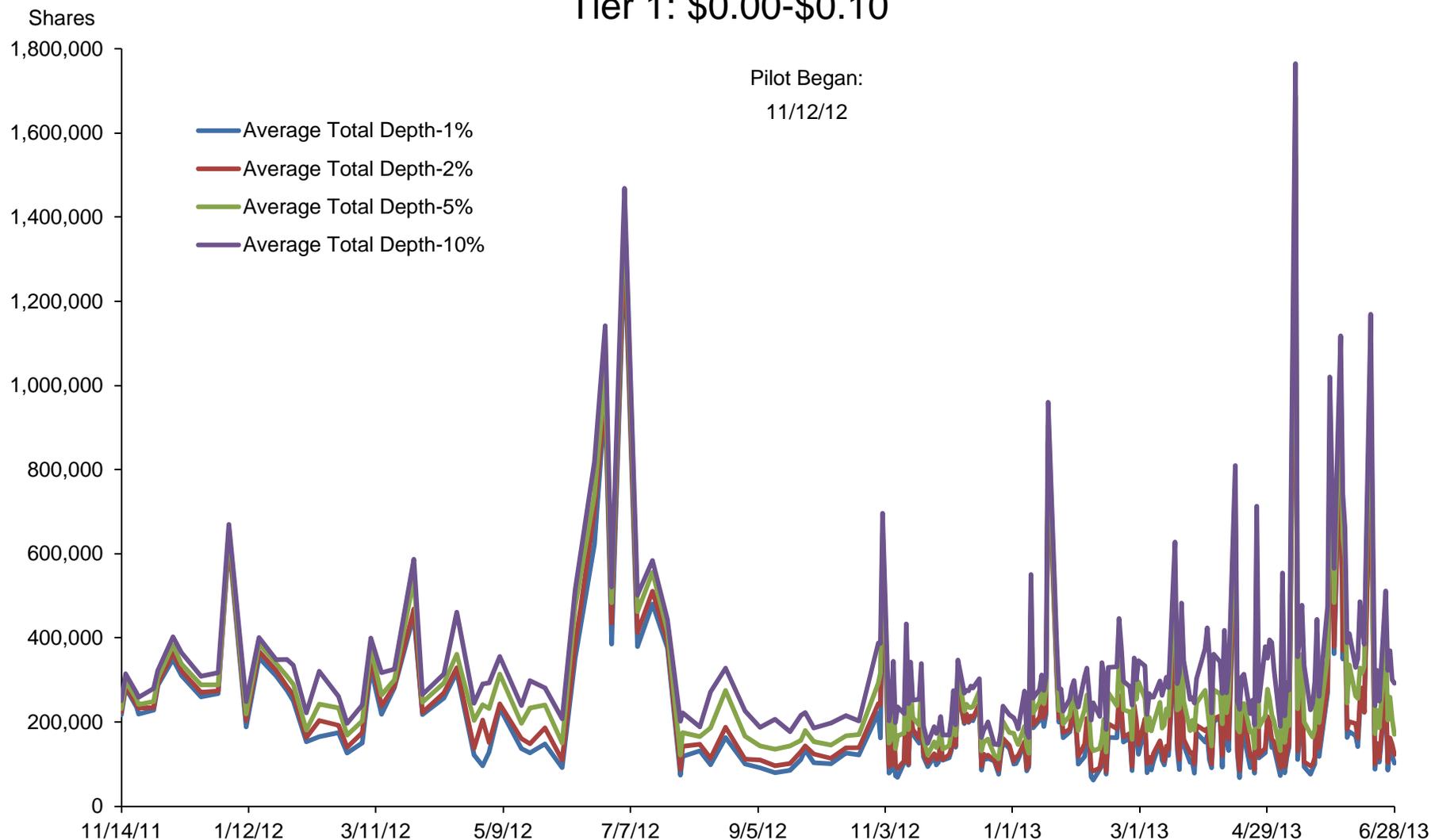
## Time Weighted Quoted Depth (Shares) Tier 5c: \$100.00-\$175.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Quoted depth is calculated as the sum of bid and offer depths.

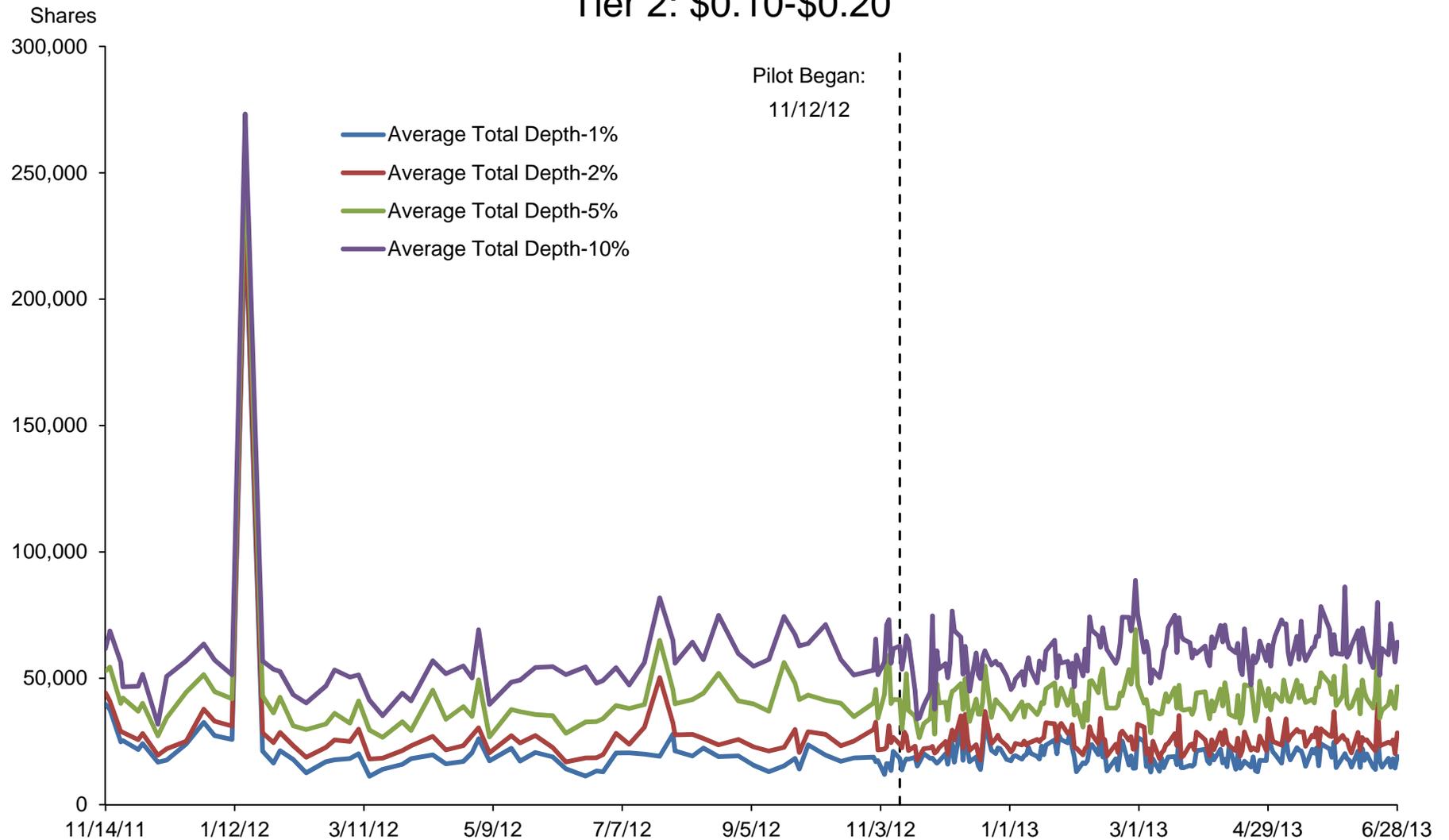
## Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 1: \$0.00-\$0.10



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500. Quoted depth is calculated as the sum of bid and offer depths.

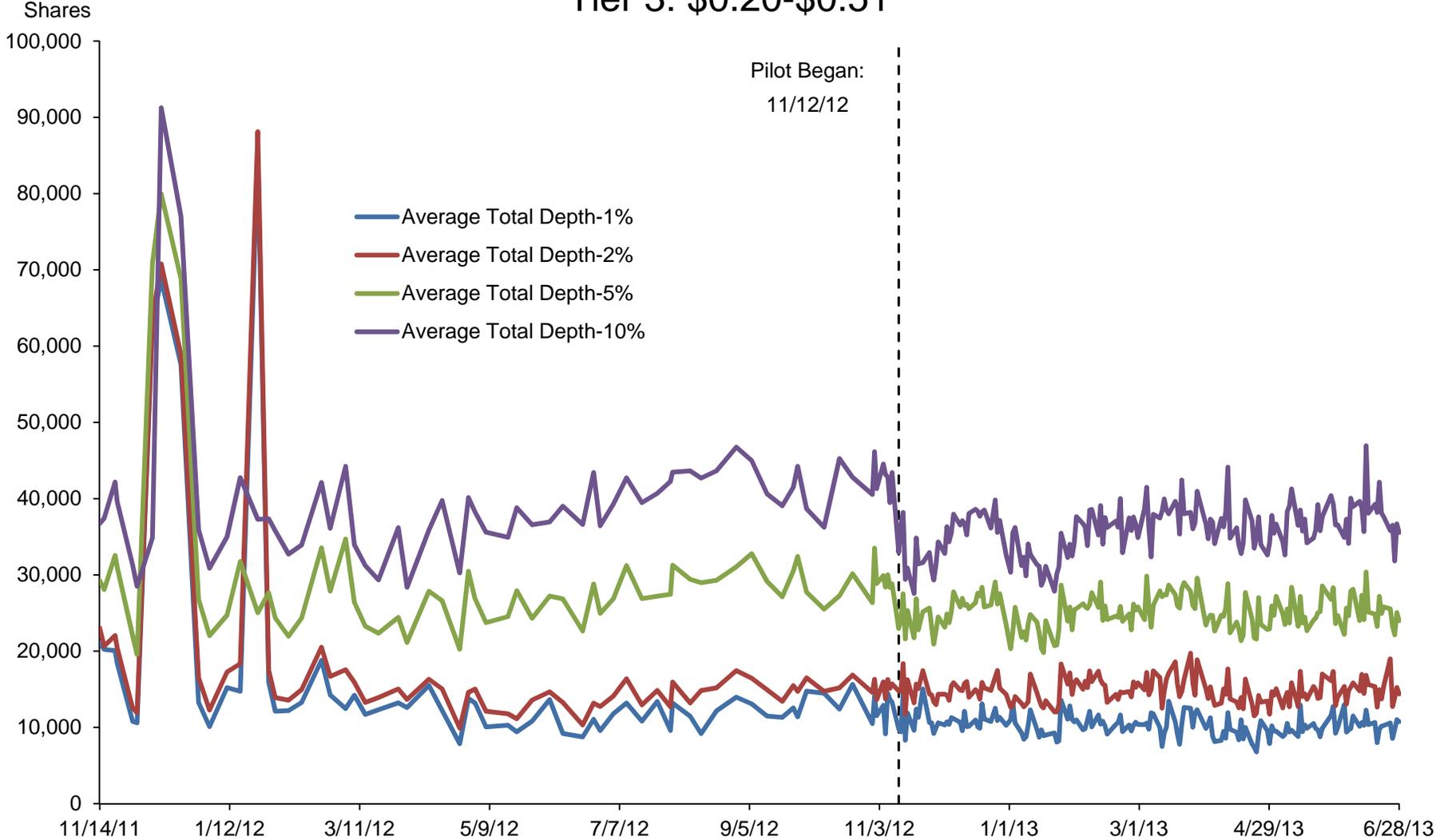
## Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 2: \$0.10-\$0.20



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Quoted depth is calculated as the sum of bid and offer depths.

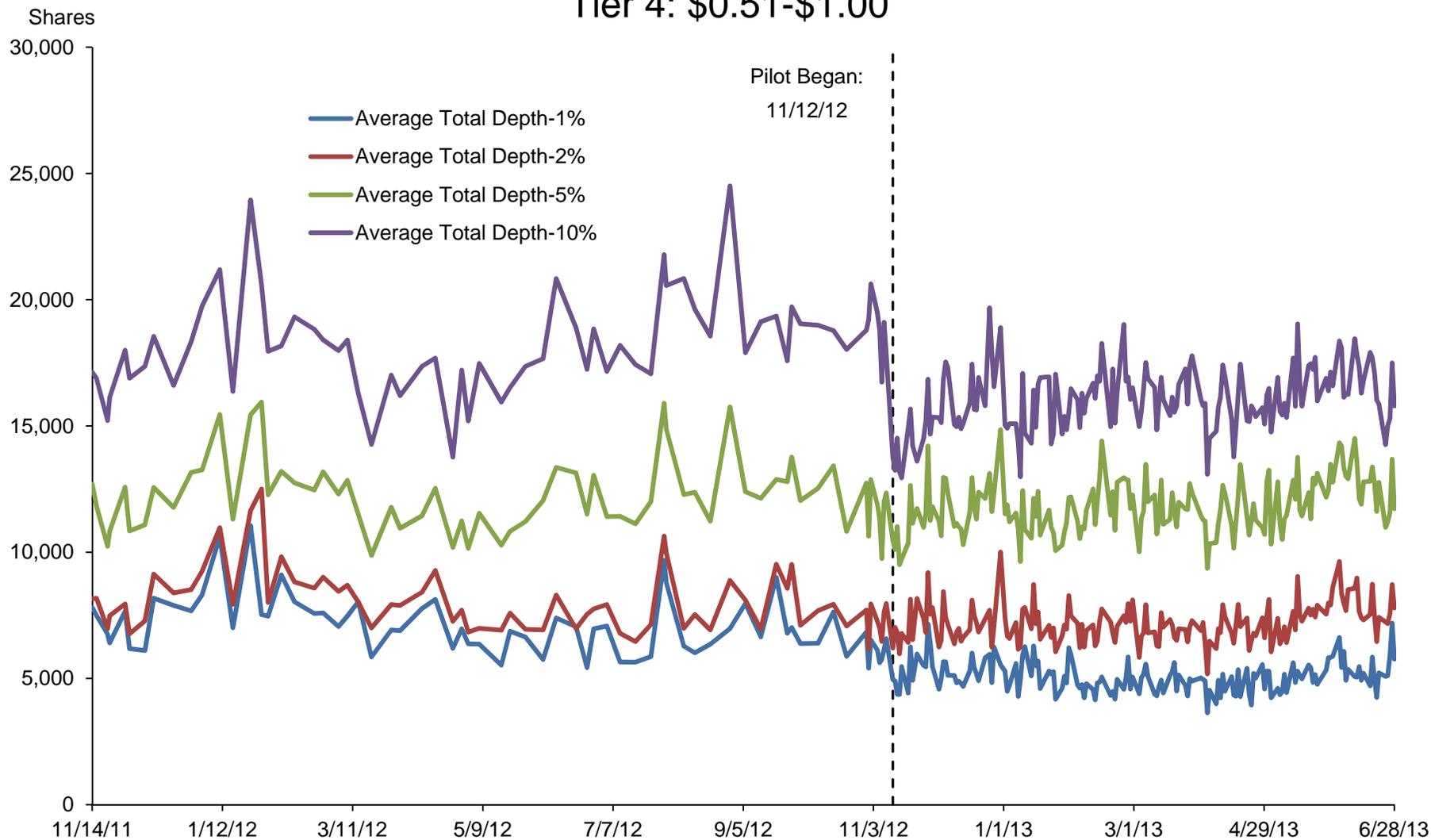
### Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 3: \$0.20-\$0.51



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500. Quoted depth is calculated as the sum of bid and offer depths.

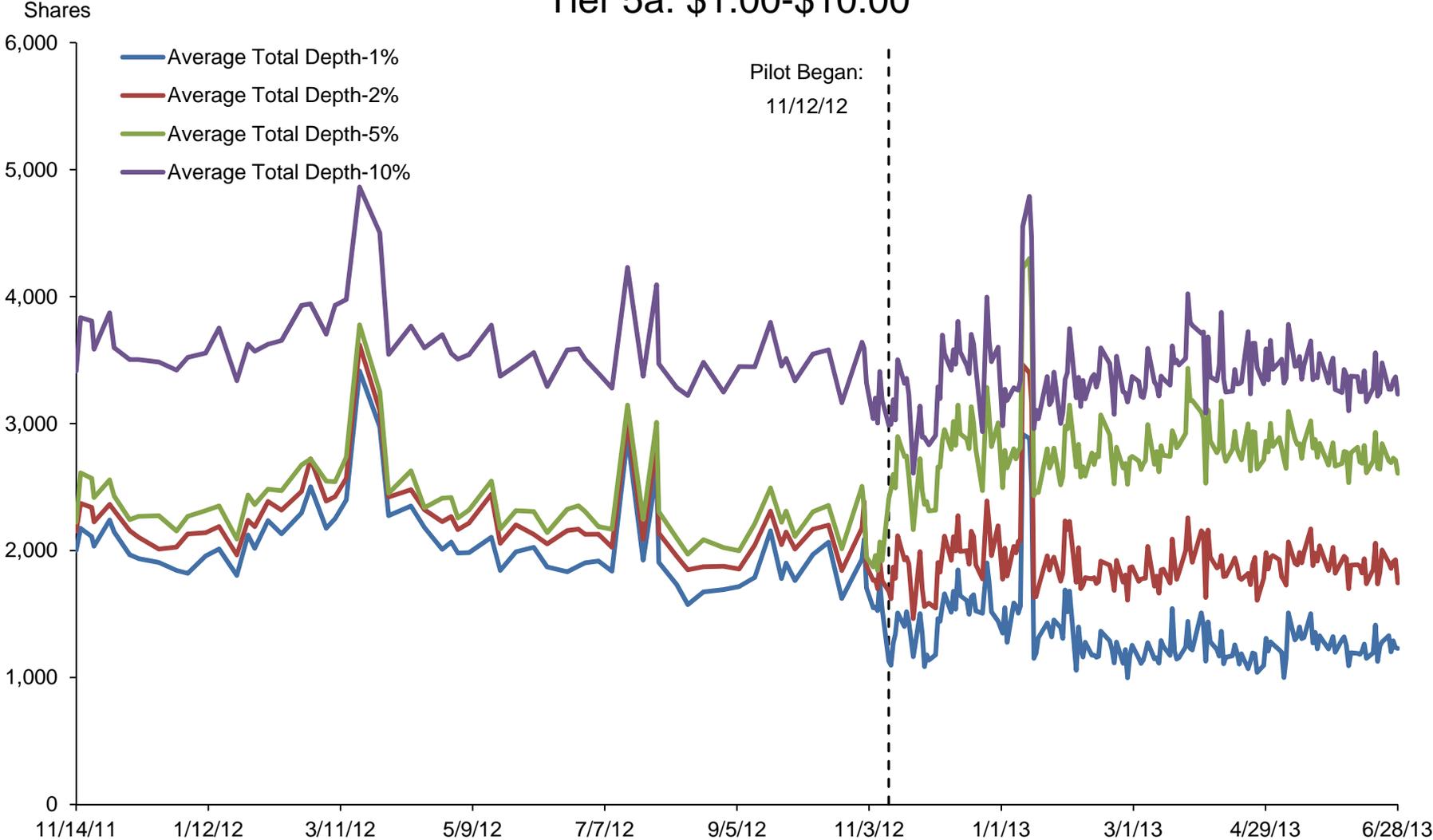
## Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 4: \$0.51-\$1.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000. Quoted depth is calculated as the sum of bid and offer depths.

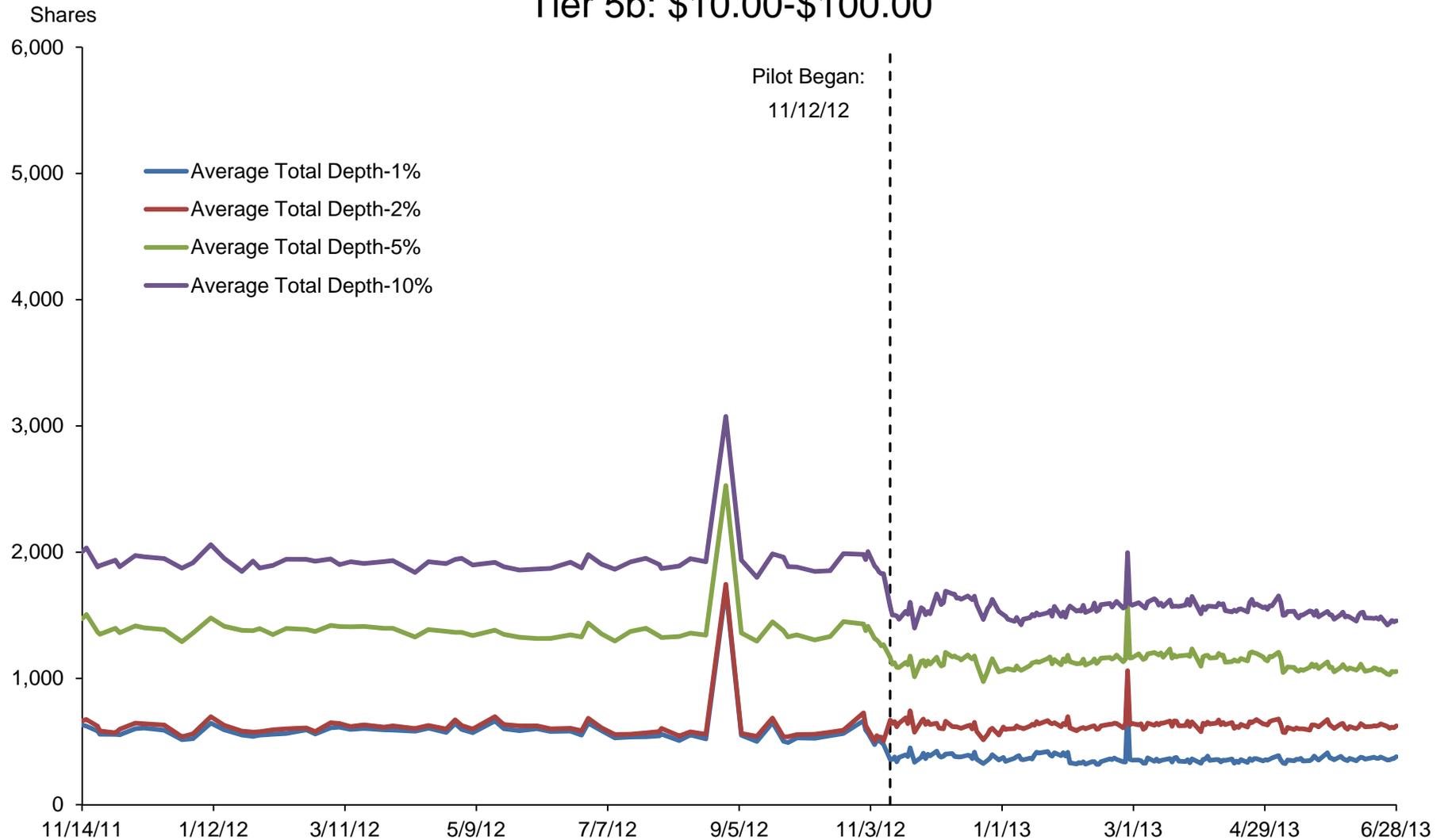
### Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 5a: \$1.00-\$10.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 500 to 100. Quoted depth is calculated as the sum of bid and offer depths.

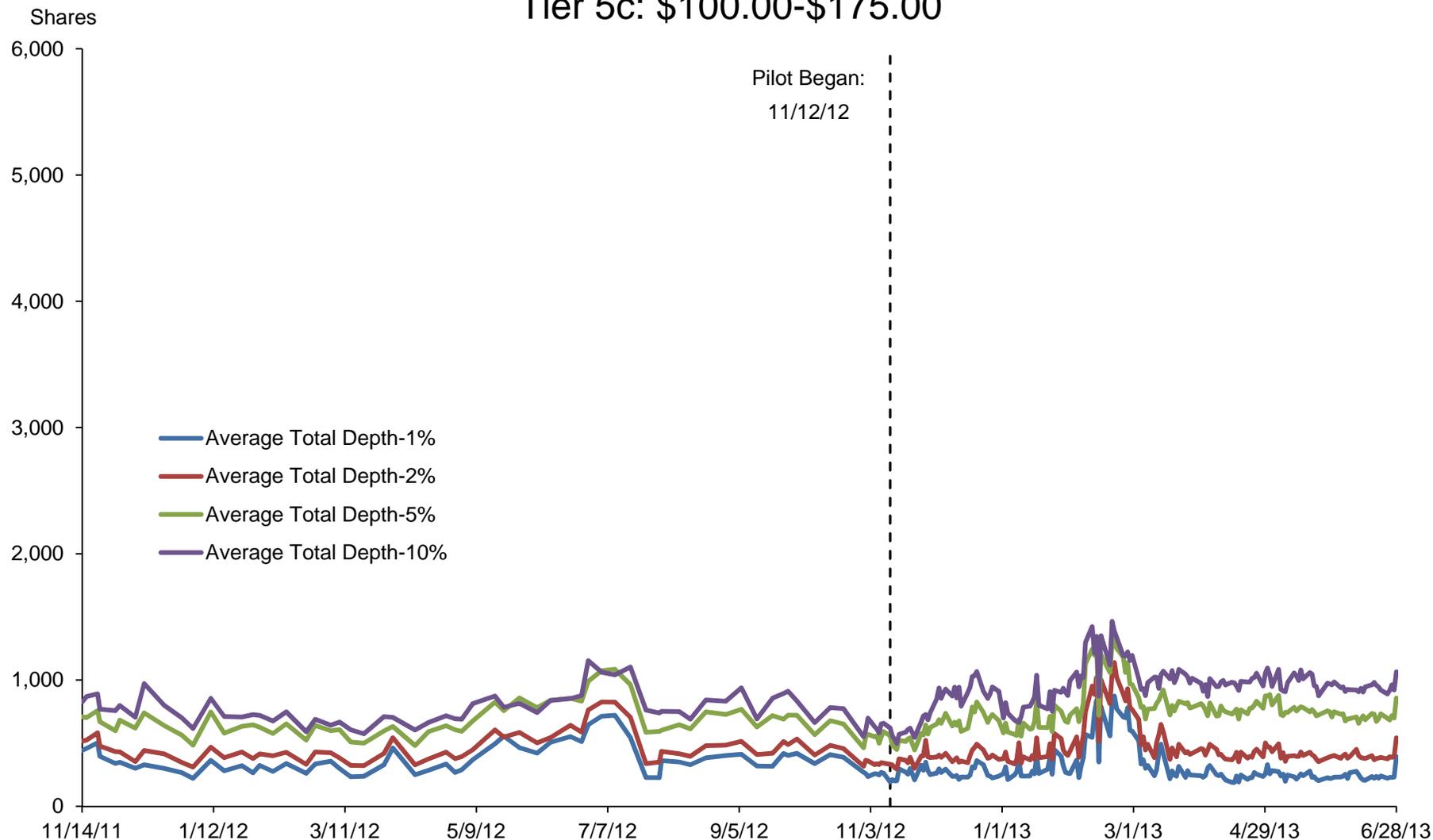
## Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 5b: \$10.00-\$100.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 decreased the minimum depth from 200 to 100. Quoted depth is calculated as the sum of bid and offer depths.

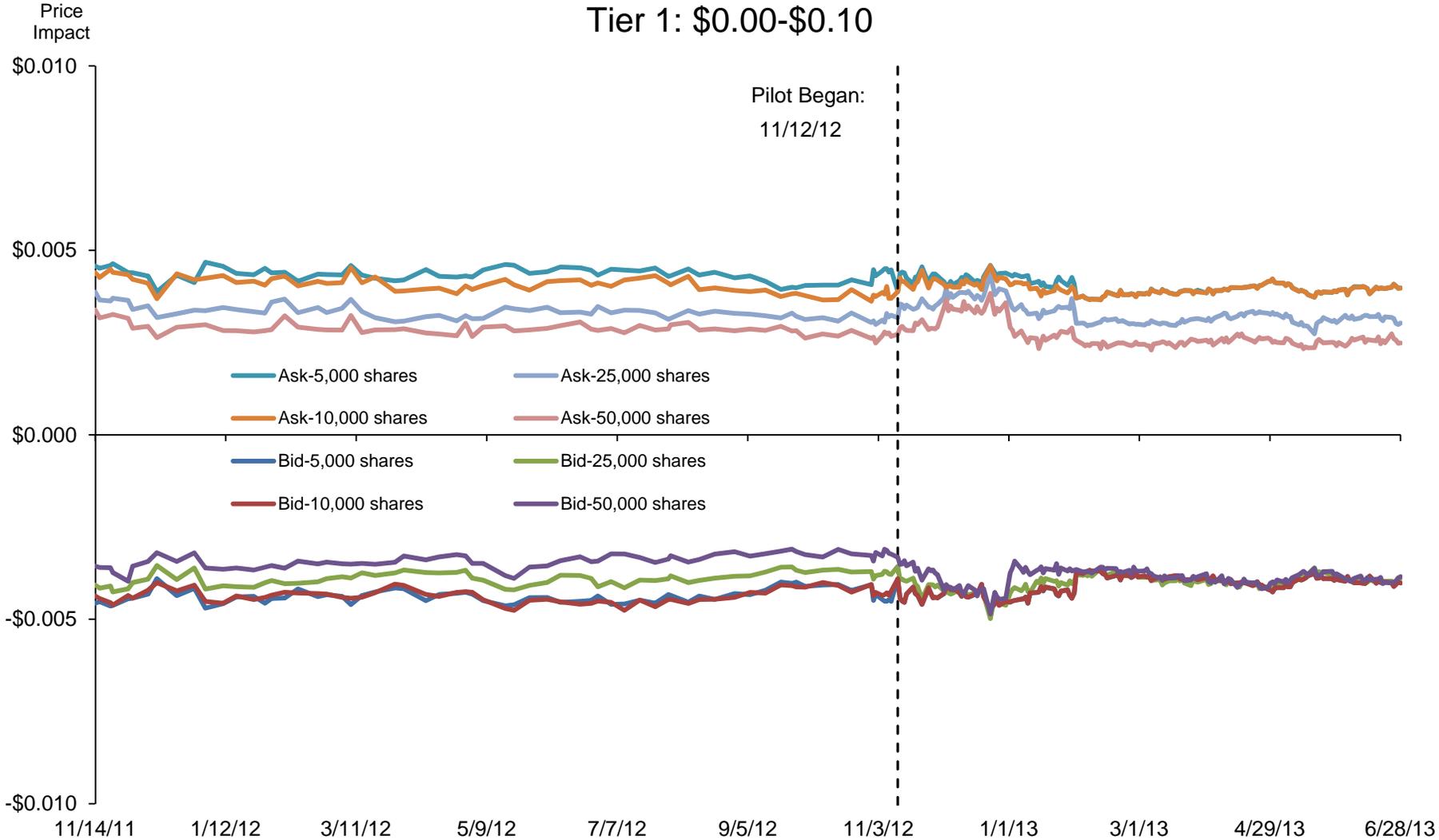
## Time-Weighted Quoted Depth around the BBO Midpoint (Shares) Tier 5c: \$100.00-\$175.00



Source: OTC Link

Note: Quotes are removed from calculation 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. Depths are excluded if valid quotes during the day span more than one tier. All depth within a given percentage, for which the corresponding quote is within 45% of the midpoint, are included. For stocks in this tier, FINRA Rule 6433 maintained the previous minimum depth requirements. Quoted depth is calculated as the sum of bid and offer depths.

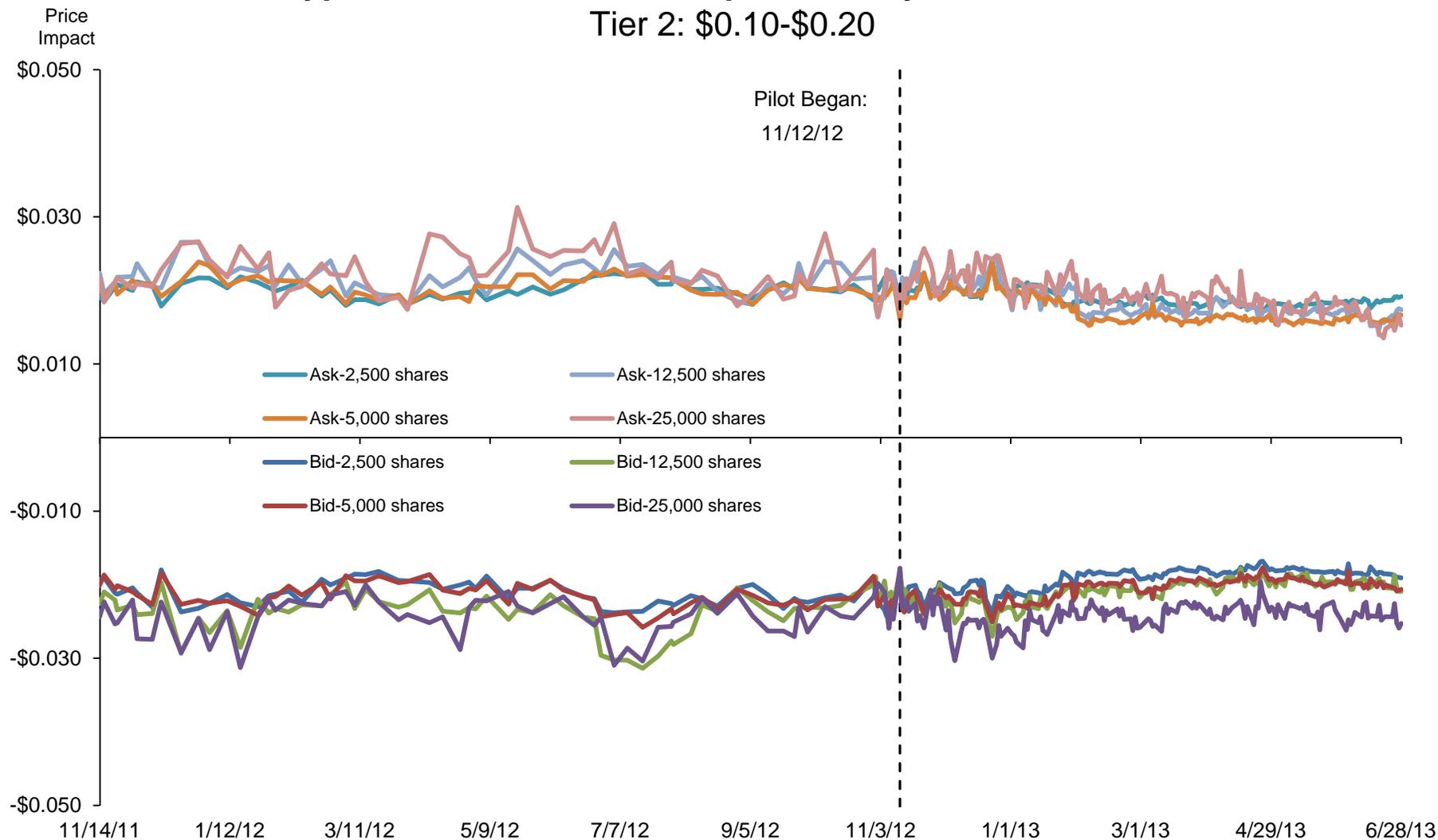
### Hypothetical Trade Price Impact for Buy and Sell Orders Tier 1: \$0.00-\$0.10



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

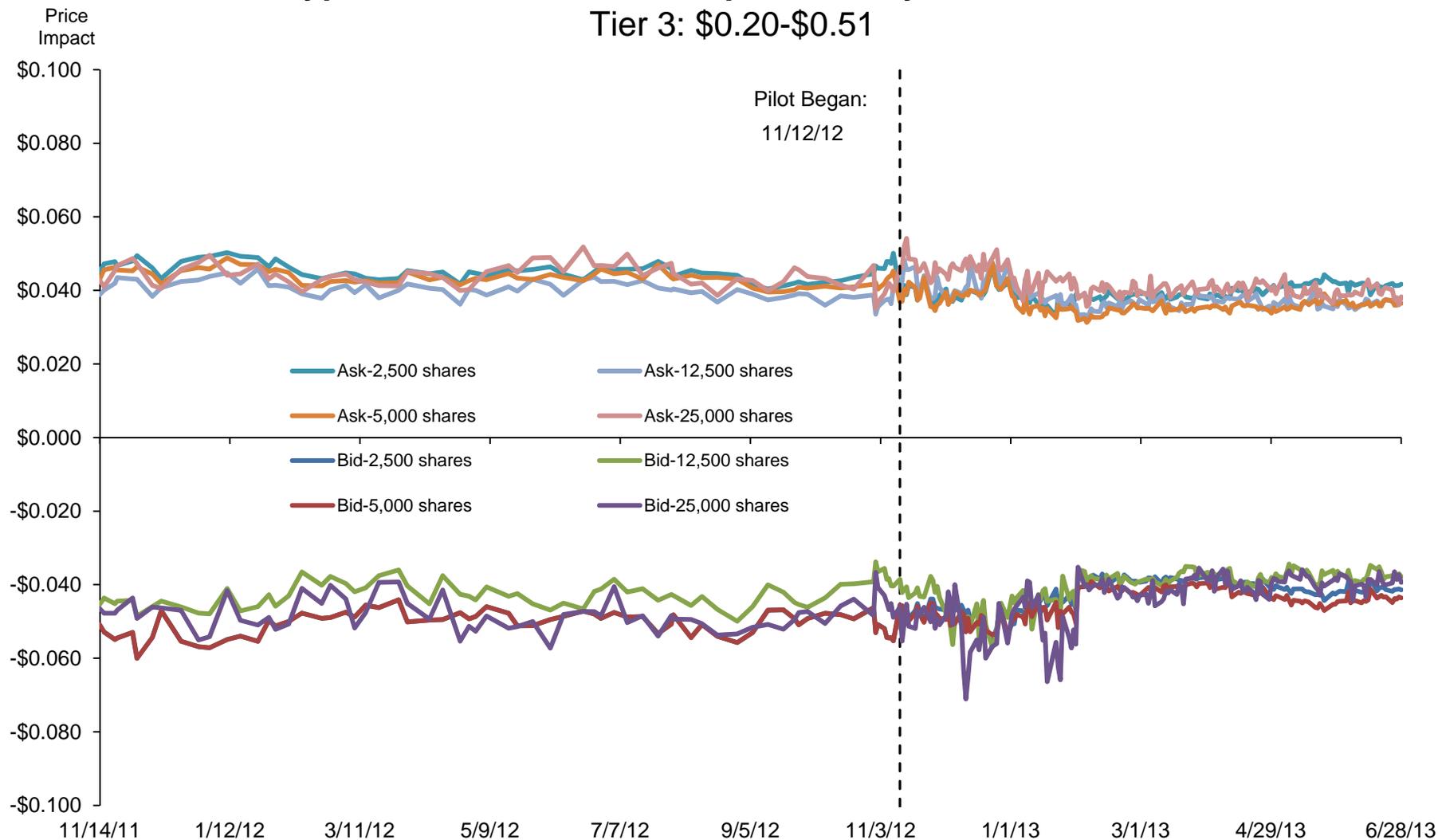
## Hypothetical Trade Price Impact for Buy and Sell Orders Tier 2: \$0.10-\$0.20



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 maintained the previous minimum depth requirements.

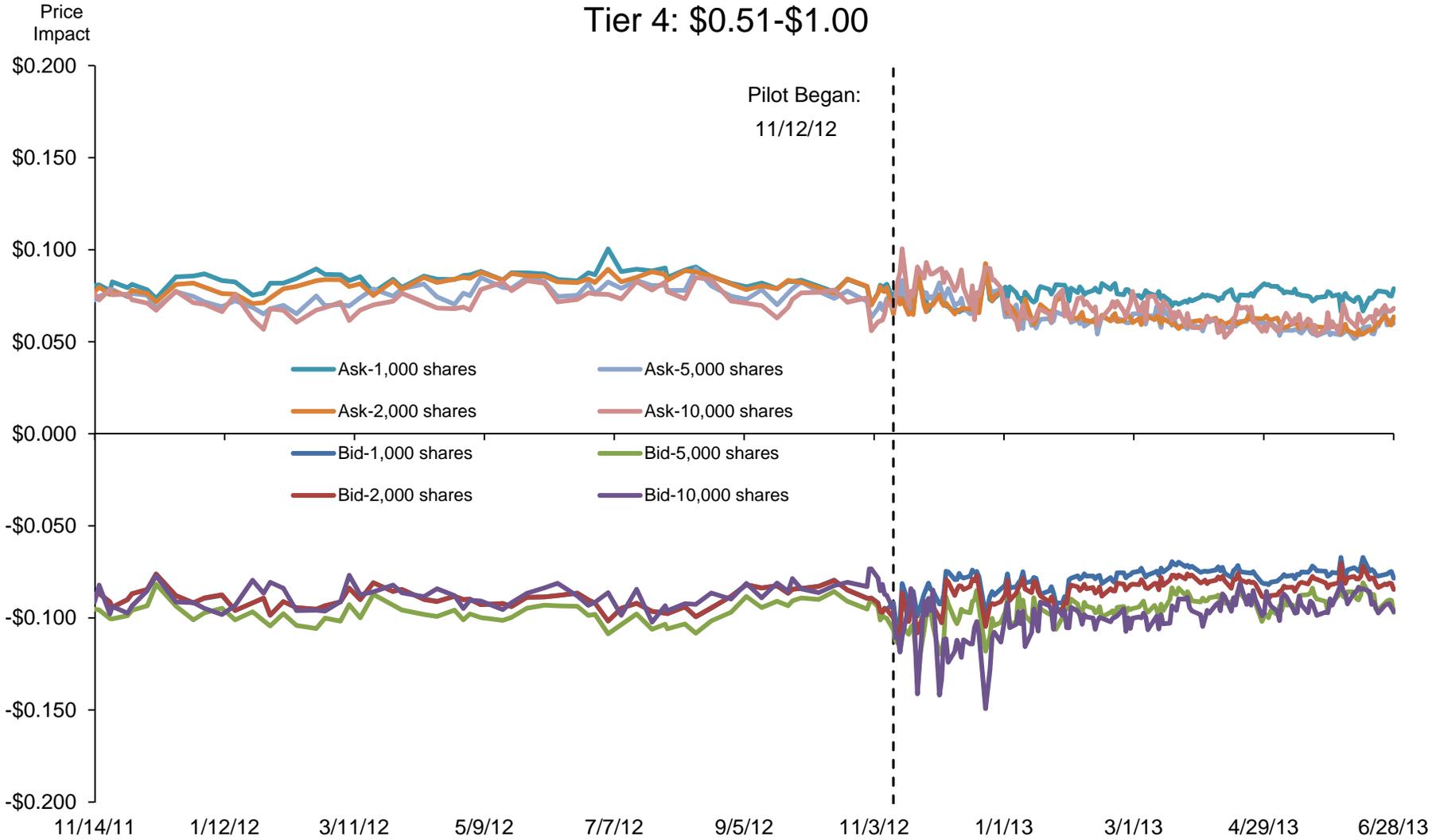
## Hypothetical Trade Price Impact for Buy and Sell Orders Tier 3: \$0.20-\$0.51



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

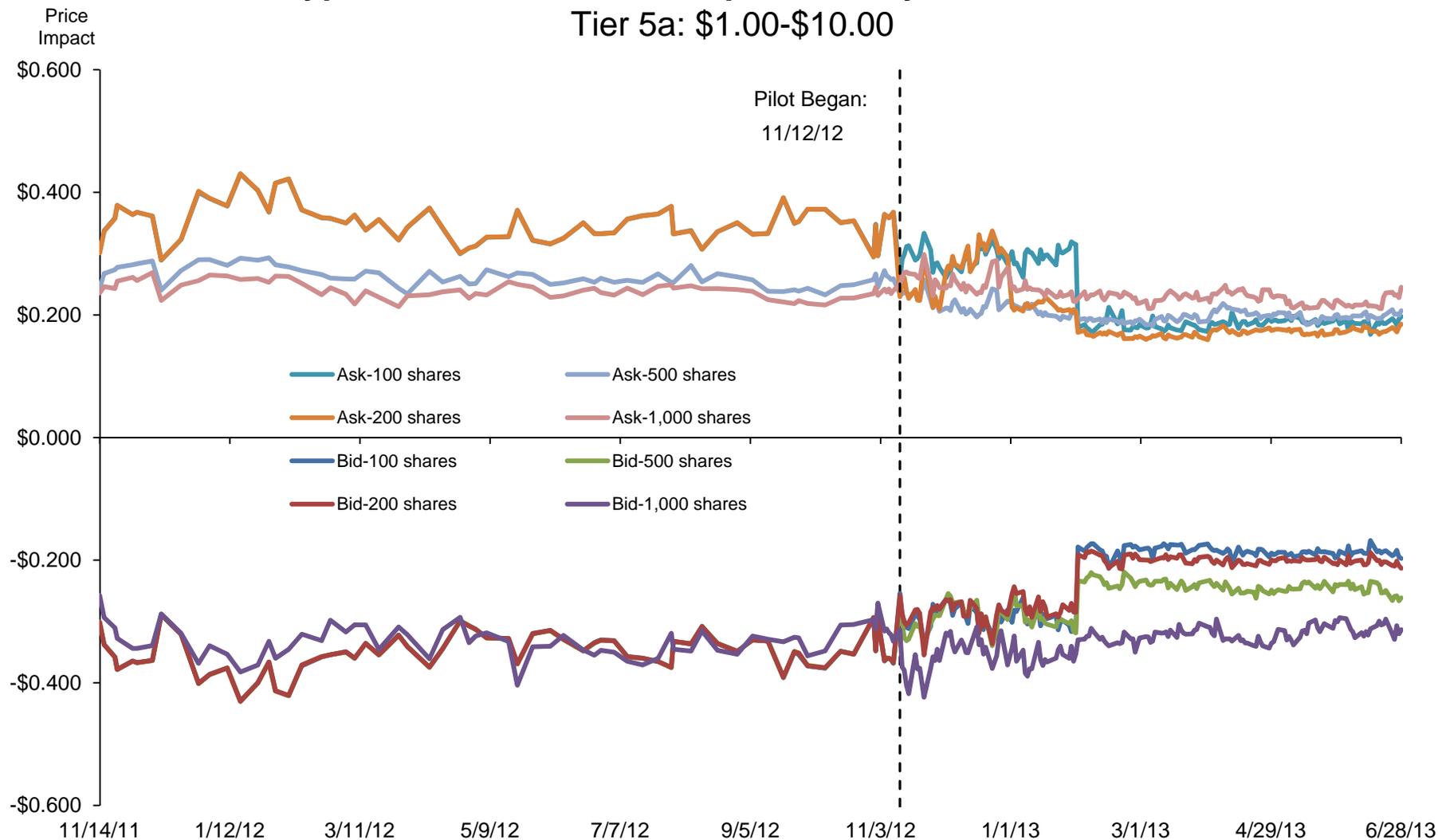
### Hypothetical Trade Price Impact for Buy and Sell Orders Tier 4: \$0.51-\$1.00



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

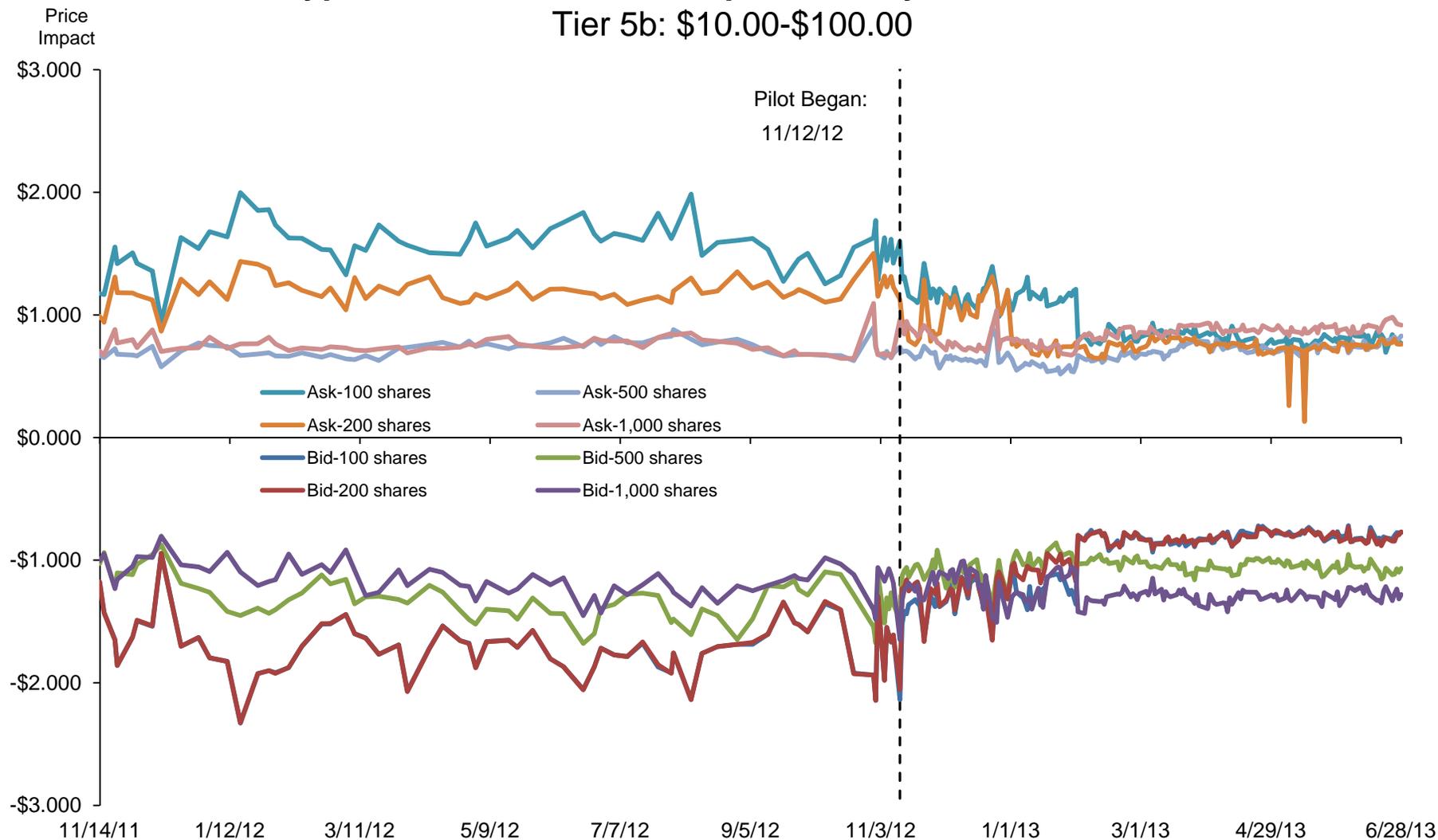
## Hypothetical Trade Price Impact for Buy and Sell Orders Tier 5a: \$1.00-\$10.00



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 500 to 100.

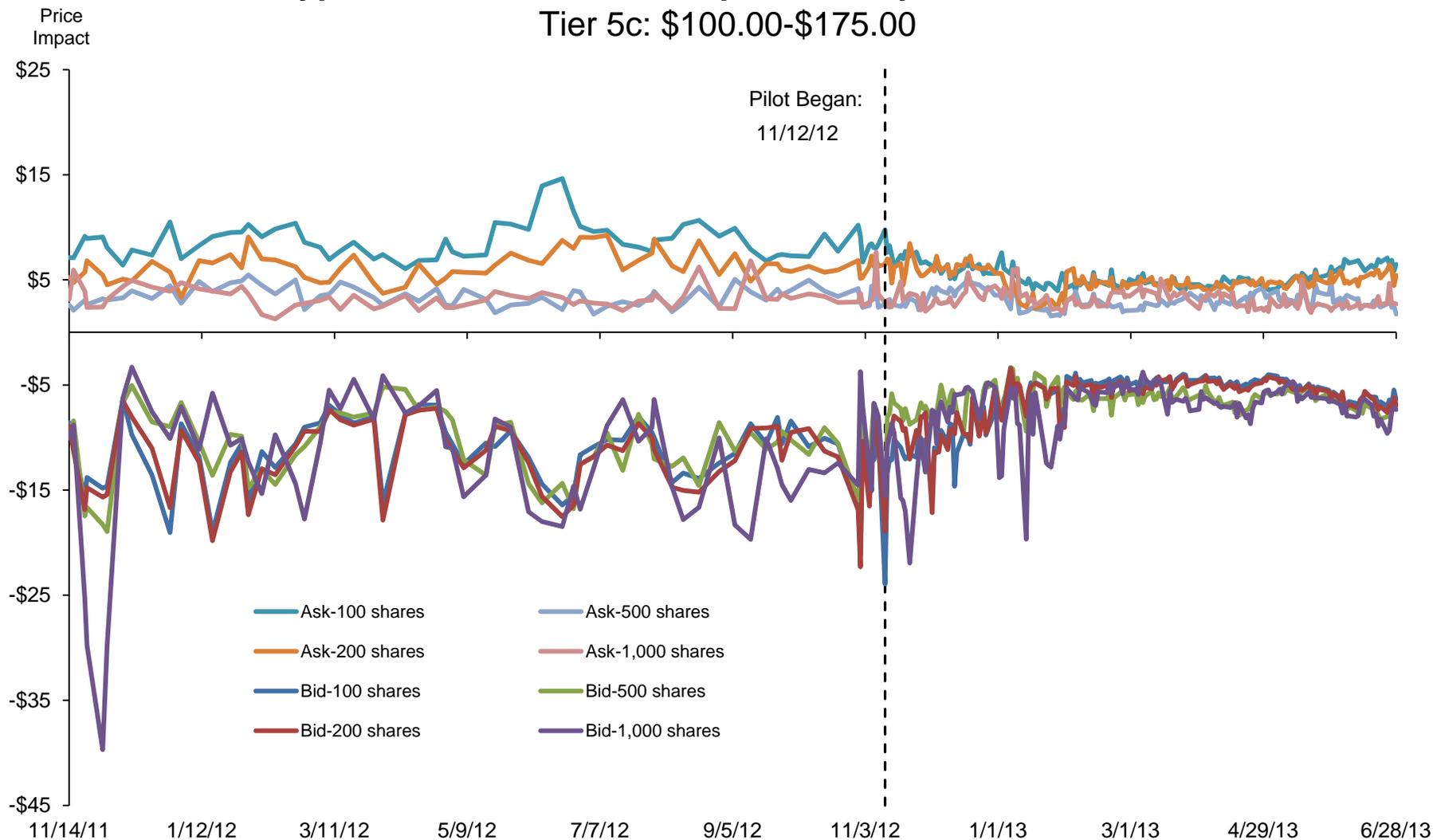
## Hypothetical Trade Price Impact for Buy and Sell Orders Tier 5b: \$10.00-\$100.00



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 200 to 100.

## Hypothetical Trade Price Impact for Buy and Sell Orders Tier 5c: \$100.00-\$175.00

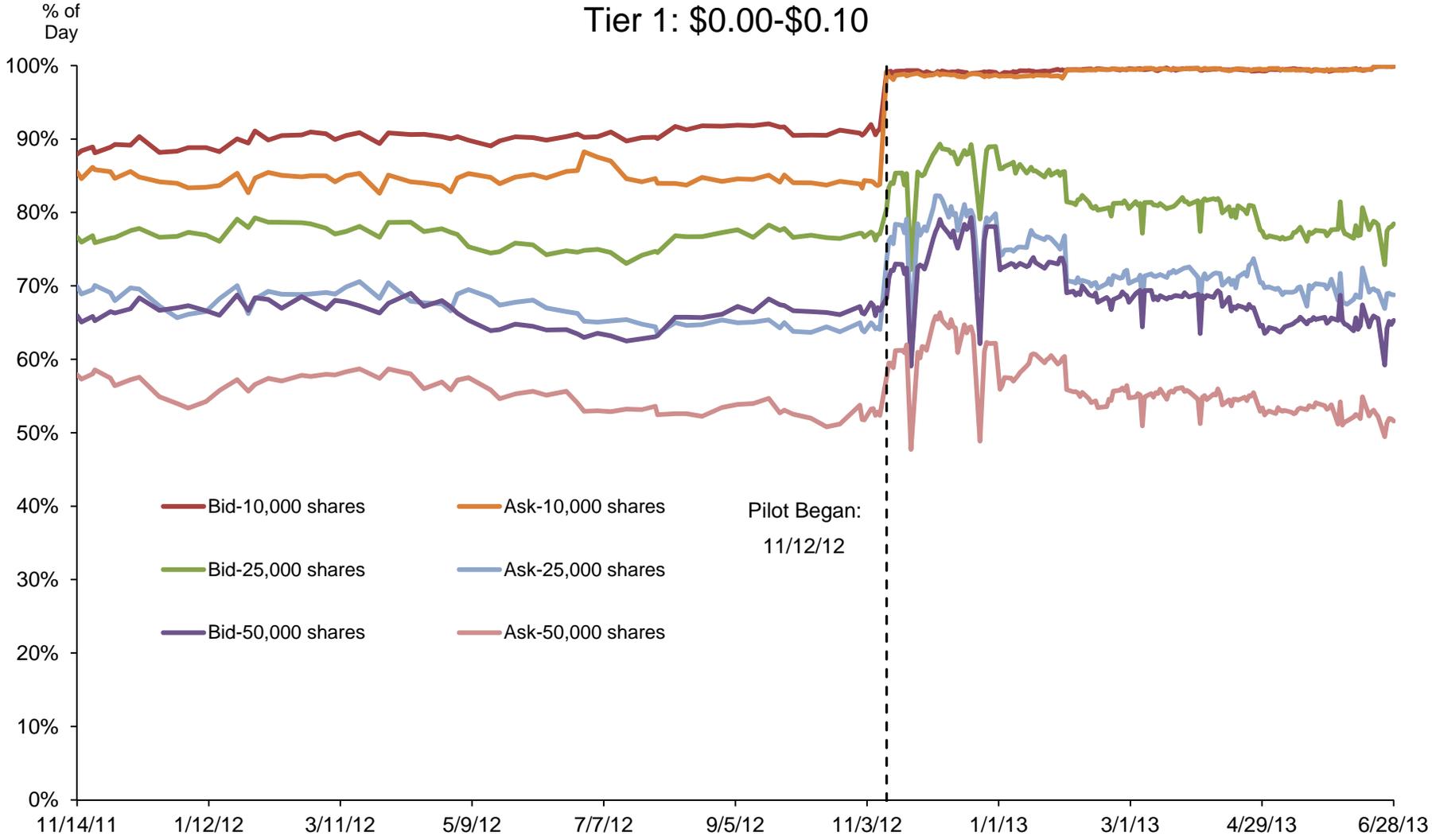


Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Impact calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 maintained the previous minimum depth requirements.

# Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders

Tier 1: \$0.00-\$0.10

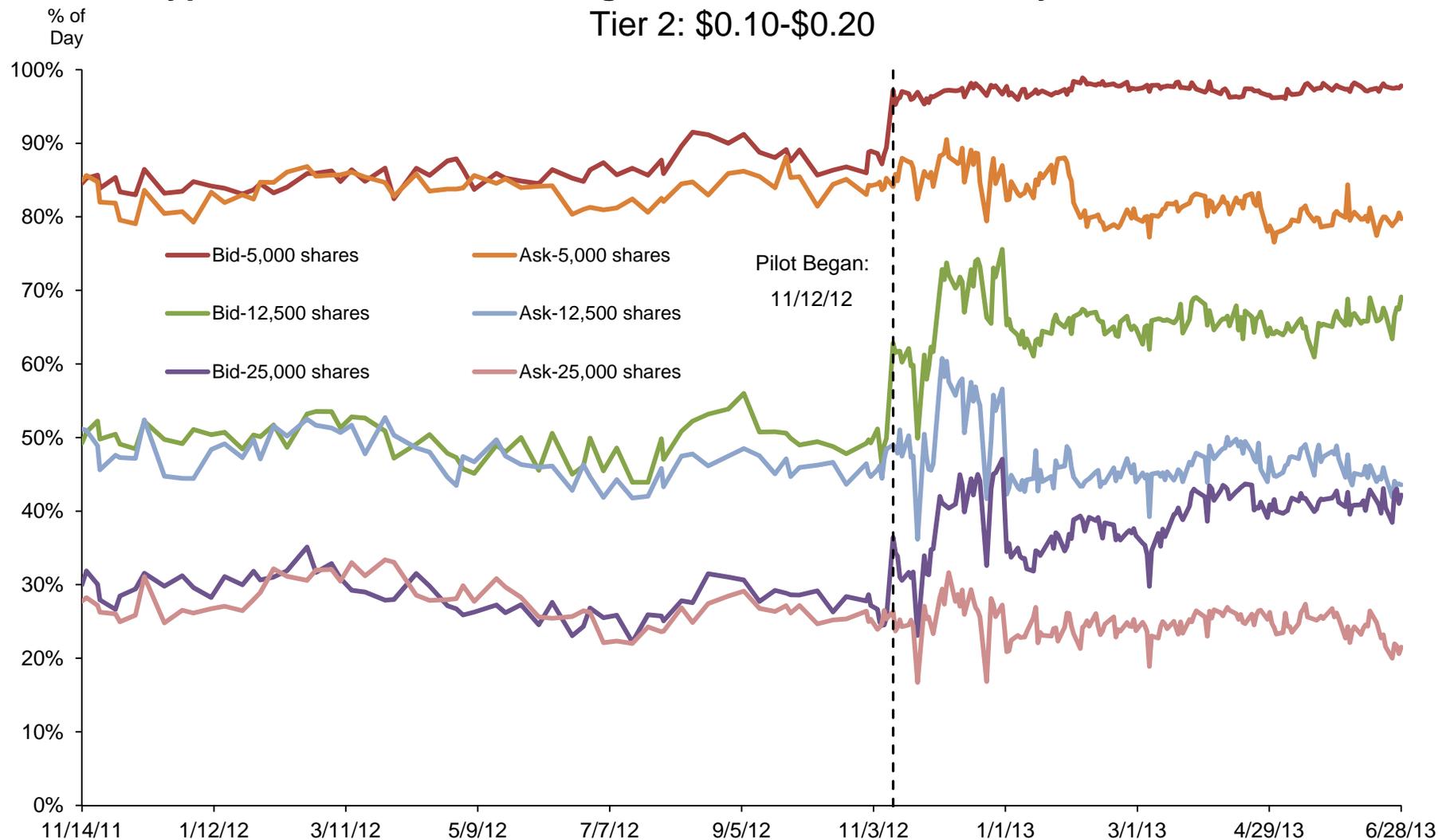


Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. For stocks in this tier, FINRA Rule 6433 increased the minimum depth from 5,000 to 10,000.

## Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders

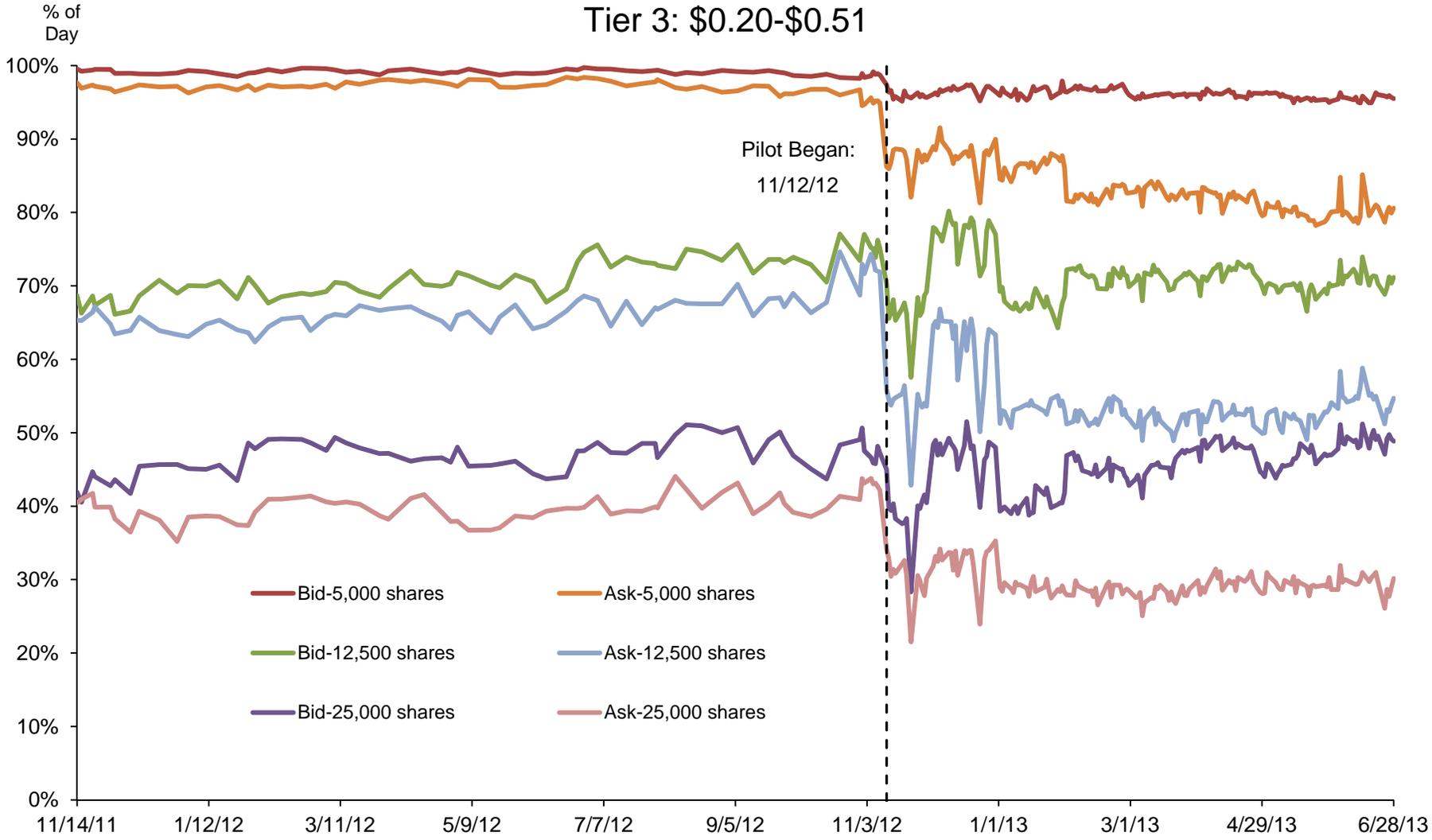
Tier 2: \$0.10-\$0.20



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 maintained the previous minimum depth requirements.

### Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders Tier 3: \$0.20-\$0.51

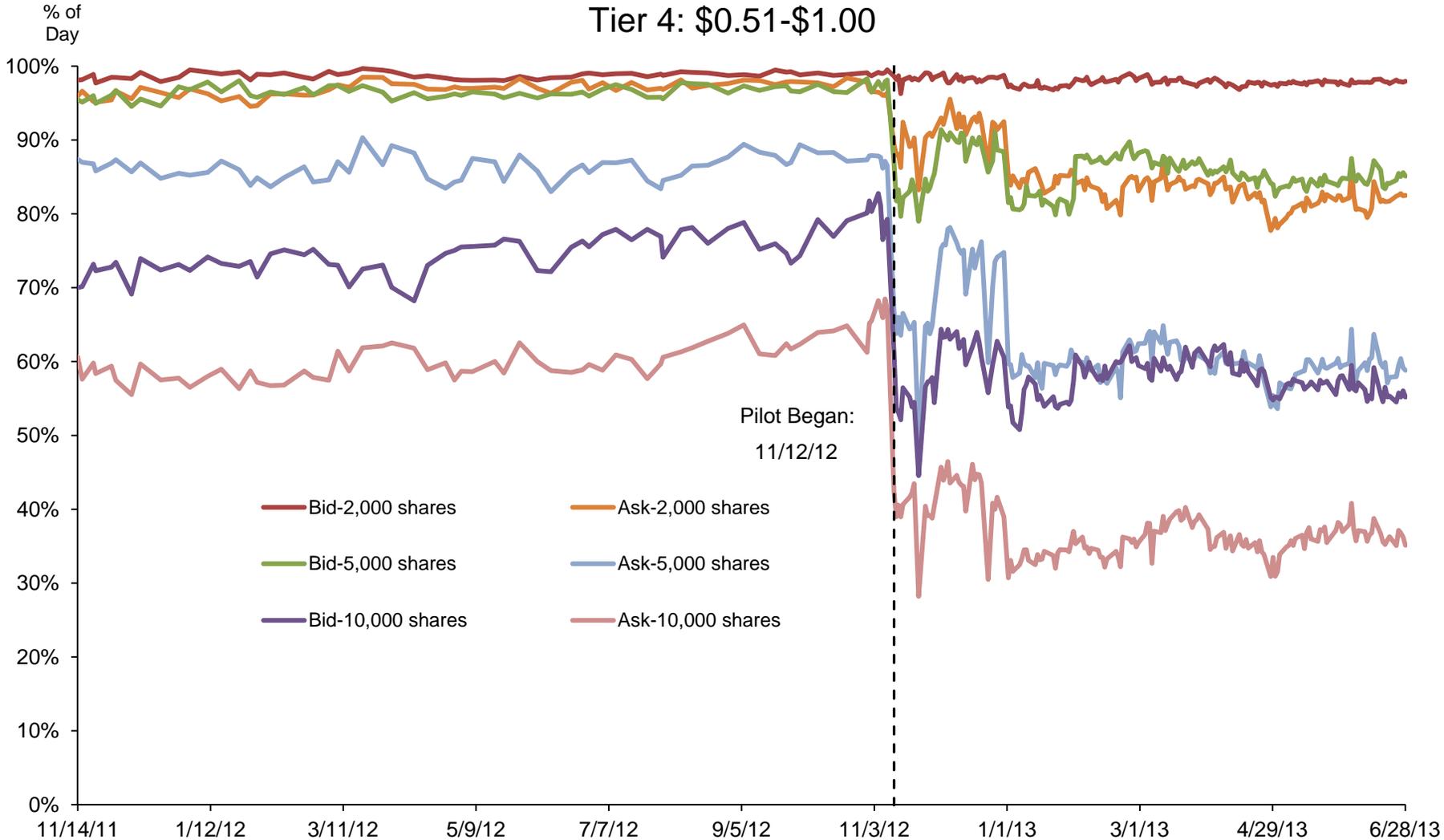


Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 5,000 to 2,500.

### Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders

Tier 4: \$0.51-\$1.00

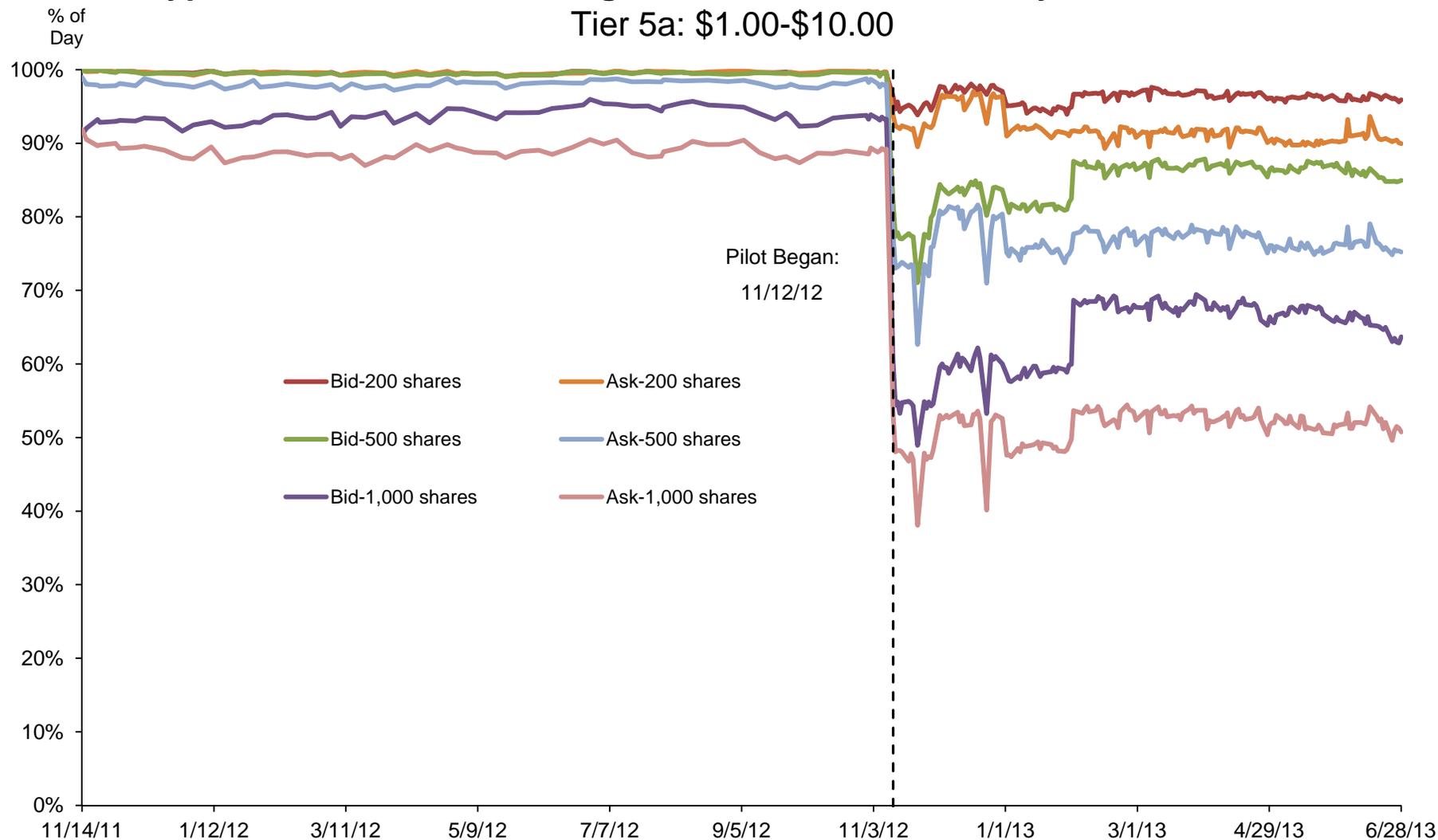


Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 2,500 to 1,000.

# Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders

Tier 5a: \$1.00-\$10.00

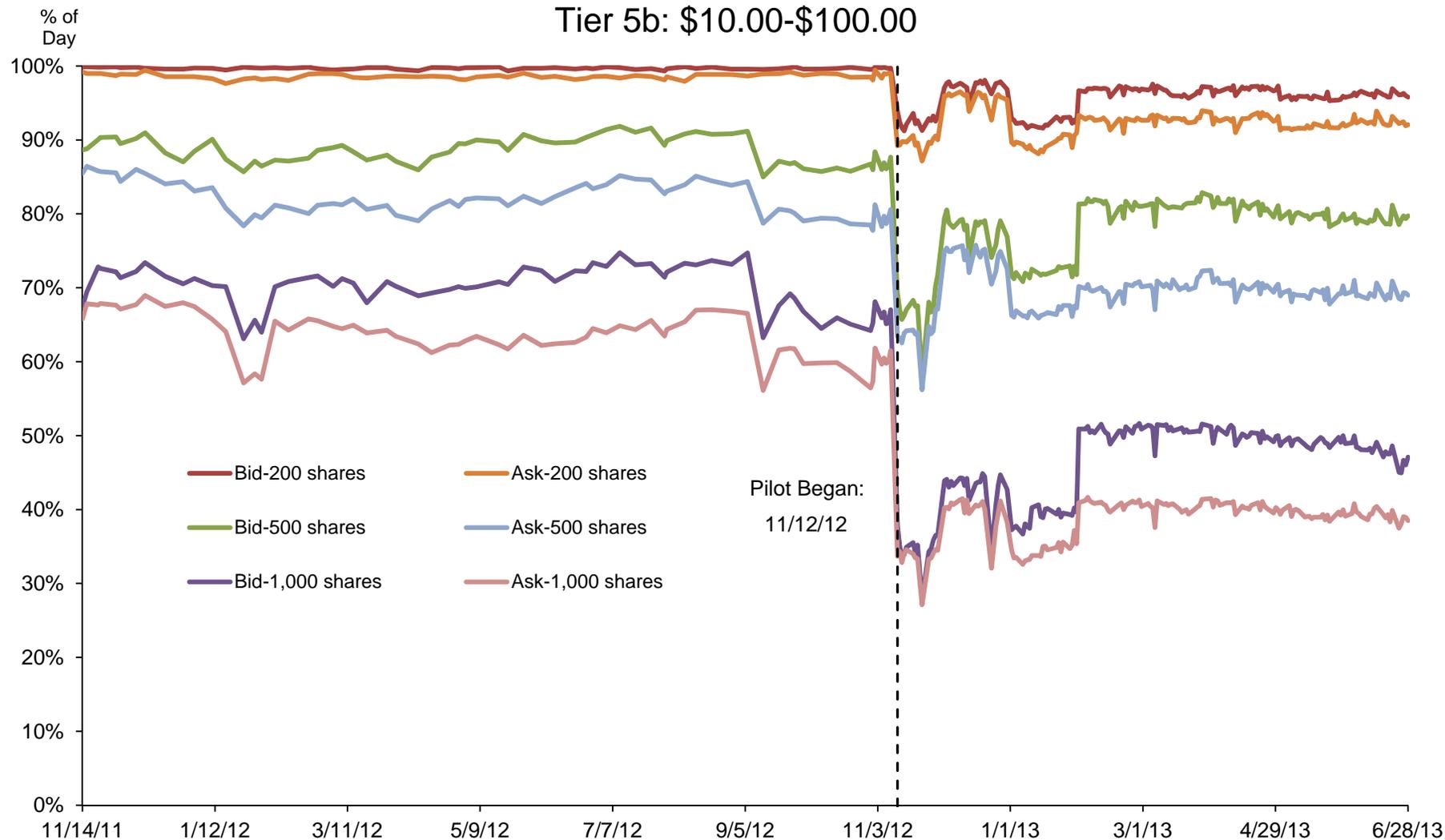


Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 500 to 100.

## Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders

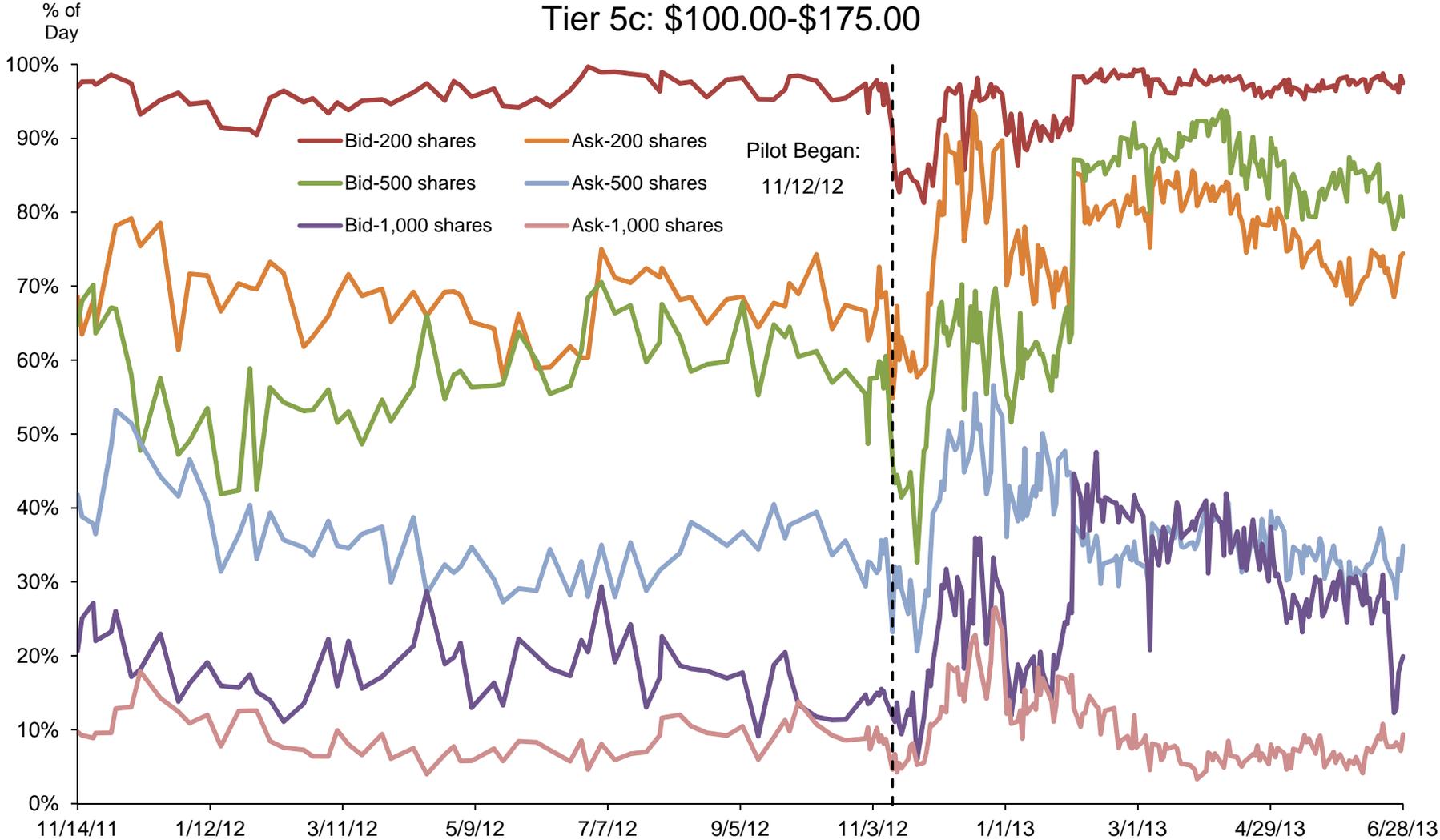
Tier 5b: \$10.00-\$100.00



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 decreased the minimum depth from 200 to 100.

### Hypothetical Trade Percentage of Time Executed for Buy and Sell Orders Tier 5c: \$100.00-\$175.00



Source: OTC Link

Note: Quotes are removed from calculation if the market is crossed, if the quoted bid or offer is zero, if the quoted spread divided by the offer price is over 90 percent, or if the market maker quote is more than 45% away from the midpoint. Percentage calculated for various set sizes of hypothetical buy and sell orders, constituting fixed multiples of the minimum required depth size for the corresponding tier. FINRA Rule 6433 maintained the previous minimum depth requirements.