

NASDAQ ACCESS FEE EXPERIMENT

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INTRODUCTION

This is the second of three reports on Nasdaq's access fee experiment that began on February 2, 2015. As with the initial report, the purpose of this report is twofold: first to, establish a common set of facts upon which the industry can agree when evaluating the experiment. And second, take the industry behind the publicly observable facts by providing insight into the firm-level dynamics which Nasdaq is uniquely positioned to observe. This report covers activity for both March and April since responses to the experiment achieved a steady state in March and there seems little value in issuing interim reports for both March and April.

The access fee experiment is just that, an experiment to observe whether there are changes in market participant liquidity taking behavior in response to a significant reduction in exchange access fees. There have been no significant changes in the nature of liquidity taking during the pilot. As stated in the first paragraph, the purpose of these reports is to provide a common set of facts to the industry. The reports are not intended to provide an interpretation of those facts. There will be time for that once the experiment is over.

Liquidity provider rebates are also reduced as a consequence of the reduction in access fees. Consequently, the experiment also allows us the opportunity to examine the importance of liquidity provider rebates to participant firms' posting behavior on Nasdaq. Liquidity providers are the primary responders to the fee changes during the experiment to date. Documenting these responses and the effects they create is the focus we have chosen for this report. While the results for Nasdaq would not necessarily be duplicated industry-wide if access fees and rebates were reduced across the board, we hope the industry will share our interest in the changes we observe in our order book.

Many of the metrics and statistical techniques used in our initial report are used again here. For the sake of brevity, we will not repeat the descriptions of these metrics and techniques and instead refer interested readers to the initial report. Metrics and techniques new to this report will be described in sufficient detail for the reader to understand our approach.

The report begins with an update on last month's observations on the characteristics of Nasdaq's quote, time at the inside, depth at the top of book, and quoted spread. Following the update we cover three topics. First, we document that the minimal changes in liquidity taking behavior observed during February persist. Second, we describe the changes in Nasdaq's quote that occur as firms respond to the liquidity provider rebates offered by Nasdaq. Finally, we look at whether these compositional changes affect Nasdaq's inside quote or the quality of the NBBO in a number of dimensions. The report will conclude with an update on trends in Nasdaq's market share in the experiment stocks. We now turn to a more detailed discussion of these issues.

Liquidity share provides a way to compare the level of displayed liquidity across lit exchanges, combining both the likelihood of quoting at the NBBO as well as the size of the quote. It is computed as follows. For a given stock/date combination, an exchange's duration-weighted average time at the NBBO is multiplied by its average quoted size when at the NBBO. (Both averaged over the bid and offer.) This amount may be termed the exchange's Average Liquidity. This quantity is then turned into a share amount by dividing by the sum of Average Liquidity over all exchanges quoting the stock. The liquidity share is therefore like a market share metric for displayed liquidity.

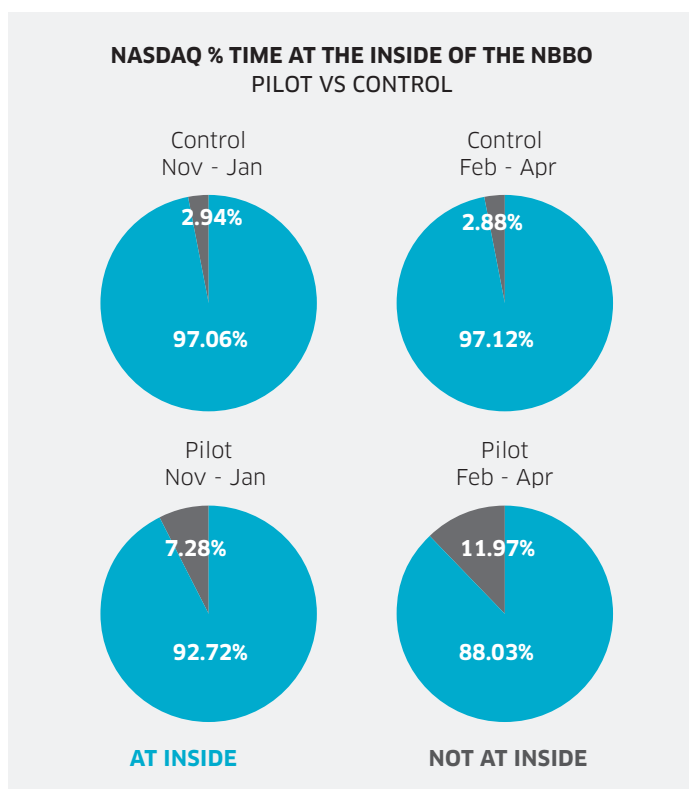
FINDINGS

Displayed Liquidity

The experiment's reduction in the liquidity provider rebate has the expected negative impact on the displayed liquidity available on Nasdaq but does not affect the aggregate displayed liquidity at the NBBO. We look at three measures of Nasdaq displayed liquidity, the percentage of time when Nasdaq is displaying prices equal to the National Best Bid and Offer (NBBO), the time weighted number of shares displayed by Nasdaq at the NBBO, and Nasdaq's Liquidity Share which is the time weighted average of Nasdaq's displayed liquidity as a percentage of all displayed liquidity. We also examine the aggregate depth at the NBBO available from all markets quoting through the consolidated tape plans.

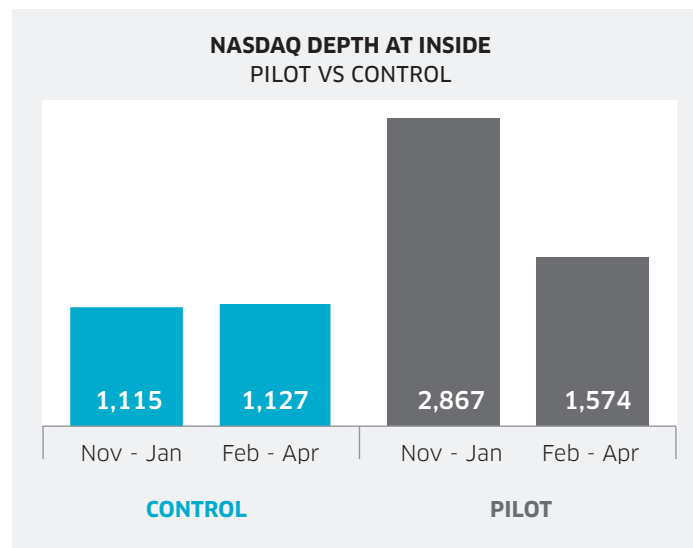
Across the experiment stocks, Nasdaq's average time at the NBBO declined 4.7 percentage points from 92.7% in the November 2014 to January 2015 pre-period to 88.0% in the February to April 2015 post-period (Figure 1). This compares to no change in time at the inside in the control stocks. The difference between the experiment and control stocks is statistically significant. As was the case in the initial report, there is considerable variation across individual stocks. Nasdaq's average time at the NBBO decreased the most in TWTR by 24.2 percentage points and increased the most in GPRO by 0.2 percentage points.

Figure 1



Also in aggregate, the average number of shares displayed by Nasdaq at the NBBO in the experiment stocks declined by 45.0% between the pre-period and the post period (Figure 2). In the control stocks, the average number of shares displayed by Nasdaq at the NBBO increased 0.1% over the same interval. As reported in the initial report, the number of shares displayed at the NBBO is highly variable but with additional trading days of data from March and April we can now conclude that the decline in displayed shares in the experiment stocks is statistically significant.

Figure 2

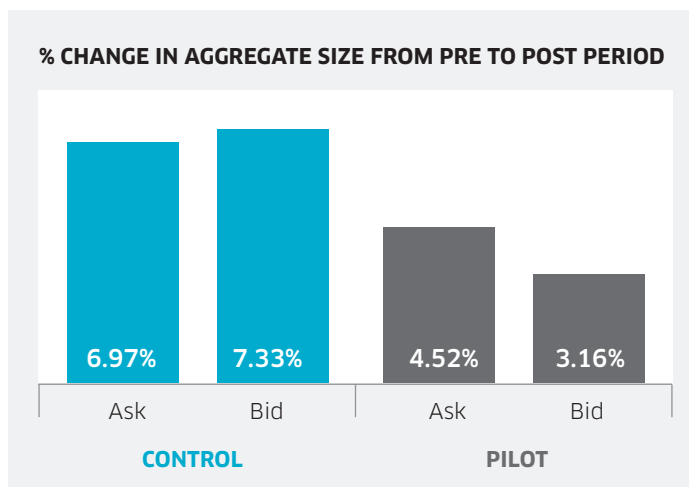


The report introduces the concept of liquidity share, which is described on the previous page. In aggregate, Nasdaq's liquidity share declined 10.0 percentage points from 29.0% to 19.0% in the pre- and post-periods, respectively. In the control stocks, Nasdaq's liquidity share declined 1.9 percentage points in the control stocks during the same interval. There is again significant variation across individual stocks. The largest decrease in Nasdaq's liquidity share was 16.4 percentage points in GRPN. The smallest decrease in liquidity share was 2.8 percentage points in BAC. The decline in Nasdaq's liquidity share in the experiment stocks is statistically significant.

Combining liquidity share with market share provides a useful indicator of the attractiveness of an exchange's quote. An exchange with high liquidity share and low market share is relatively unattractive to liquidity takers. Conversely, an exchange with low liquidity share and high market share is relatively attractive. The fact that Nasdaq's liquidity share fell substantially and Nasdaq's market share fell only slightly (Figure 8) indicates that one result of the access fee experiment is that Nasdaq's quote became relatively more attractive to those firms that were liquidity takers.

The final statistics on the displayed quote cover the aggregate displayed liquidity across all quotes at the NBBO in the market. This contrasts to the three previous figures which focus only on Nasdaq's displayed liquidity. The aggregate statistics address whether Nasdaq's experiment may cause a decrease in the total level of liquidity at the NBBO in the experiment stocks or whether liquidity moved from Nasdaq's quote to other exchanges displaying quotes in the market. Figure 3 shows that aggregate displayed liquidity increased 7.0% on the ask and 7.3% on the bid for the control stocks and 4.5% on the ask and 3.2% on the bid for the experiment stocks. As with other quote data, there is a great deal of noise at the individual stock level but the differences between the control and experiment stocks are statistically significant. The result is consistent with a partial shift in displayed liquidity from Nasdaq to other market displayed quotes.

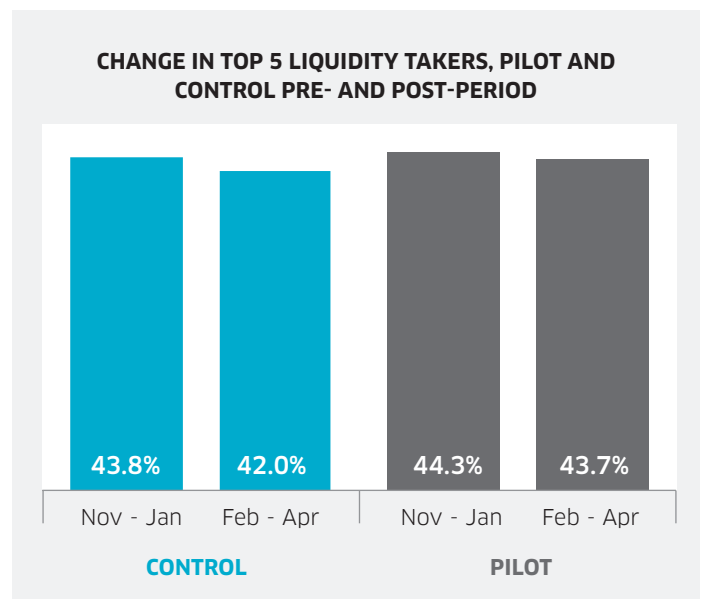
Figure 3



Liquidity Taking

As discussed in the initial report, the experiment induced little material change in the composition of the firms making up the top liquidity takers on Nasdaq. In each of the experiment stocks and control stocks we identify the top five liquidity takers in that stock during the pre-period. We then calculate the share of the same five liquidity takers in each stock in the post period in order to observe any effects of the experiment. The share of the top five liquidity takers in each of the experiment stocks decreased from 44.3% of shares traded in the pre-period to 43.7% in the post period (Figure 4). In the control stocks, the top five liquidity takers' share of activity declined from 43.8% to 42.0%. The difference-in-difference is an increase of 1.2% for the liquidity takers in the experiment stocks which is noise and not statistically significant.

Figure 4



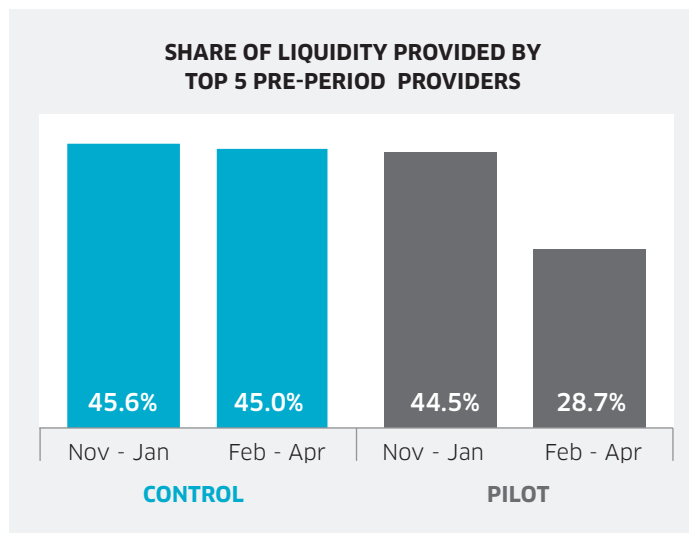
This report will not be offering conclusions on why liquidity takers do not appear to be responding to the reduced access fees. That topic we leave for the industry to discuss. We do believe, however, that there is value in sharing with the industry some of the conjectures we hear about why liquidity takers are apparently not responding to the reduction in access fees.

One such conjecture is that the number of stocks in the experiment is too low to justify recoding liquidity taking algorithms. A second conjecture is that liquidity taking activity for many firms is governed by best execution obligations and that access fees do not enter into consideration. A third conjecture is that some liquidity taking algorithms are based on displayed size and only changes in displayed size directly drive liquidity taking at a particular market. A fourth conjecture is that there is in fact an increase in attempts to take liquidity by firms who were not major liquidity takers before the pilot but these firms are less efficient (slower) than the incumbent liquidity takers and so no change in liquidity taking market share is observed. And, a fifth conjecture is that the economic incentives for taking liquidity from sources other than Nasdaq are not materially affected by the reduction in Nasdaq's access fees. Some of these conjectures are testable and we will test them in the final report. This list of conjectures is not an exhaustive list of possible explanations for the lack of change in liquidity taking behavior and we look forward to more discussions.

Displayed liquidity

We begin by updating the finding in the first month's report that firms who were major liquidity providers in the pre-period significantly reduced their liquidity providing activity on Nasdaq once the pilot began. We calculate the percentage of liquidity providing volume executed on Nasdaq by the top five liquidity providers in each of the experiment and control stocks in the pre-period and then the percentage of liquidity providing volume by the same "pre-period" top liquidity providers in the same experiment and control stocks in the post period. The top pre-period liquidity providers account for 44.5% of the liquidity in the experiment stocks in the pre-period and 28.7% in the post period, a decline of 15.8 percentage points (Figure 5). In the control stocks the decline between the pre-and post- periods is 0.6 percentage points. The 15.2 percentage point difference between the experiment and control stocks is statistically significant. The results for both the experiment and control stocks are very similar to those reported in the first month's report.

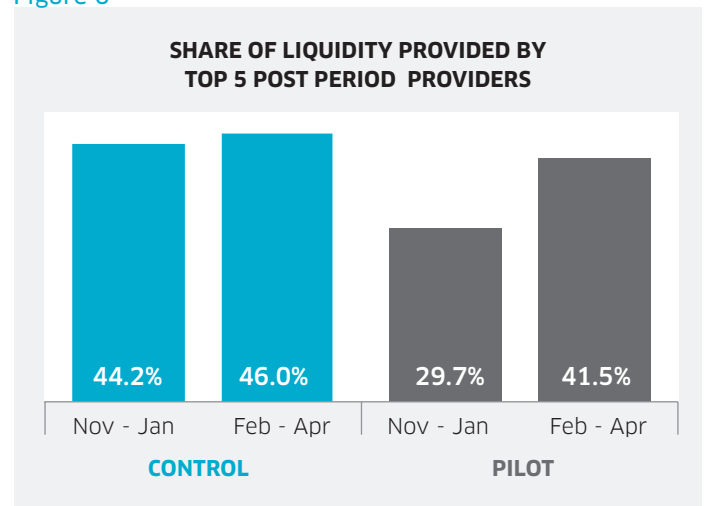
Figure 5



We invert the approach taking in Figure 5 and instead calculate the percentage of liquidity providing volume executed on Nasdaq by the top five liquidity providers in each of the experiment and control stocks in the post period and then the look back at the percentage of liquidity providing volume by the same "post period" top liquidity providers in the same experiment and control stocks in the pre-period. The top post period liquidity providers account for 29.7% of the liquidity in the experiment stocks in the pre-period and 41.5% in the post period, an increase of 11.8 percentage points (Figure 6). In the control stocks the increase between the pre-and post-periods is 1.8 percentage

points. The 10.0 percentage point difference between the experiment and control stocks is statistically significant. Liquidity provision by other large liquidity providing firms filled the gap left by "pre-period" top liquidity providers cutting back their liquidity provision on Nasdaq.

Figure 6



Before turning to the market quality results we wish to point out that liquidity providing firms responding to the experiment have very diverse order placement strategies. For example, one firm, Firm A, that was a large limit order poster in the pre-period decreased the number of its order submissions to Nasdaq by 99.9%. The median duration of Firm A's orders is approximately 1 second. In contrast another firm, Firm B, submitted approximately as many orders as Firm A during the pre-period, and similar to Firm A also reduced its order submissions by 95%. But, Firm B has a median order duration of approximately 30 seconds which is very different than Firm A. In like manner, the firms that increased their order submissions to Nasdaq also follow very diverse strategies. It is consequently difficult to characterize the firms reducing displayed liquidity beyond noting the obvious sensitivity to liquidity provider rebates.

Impact on Nasdaq's quote quality

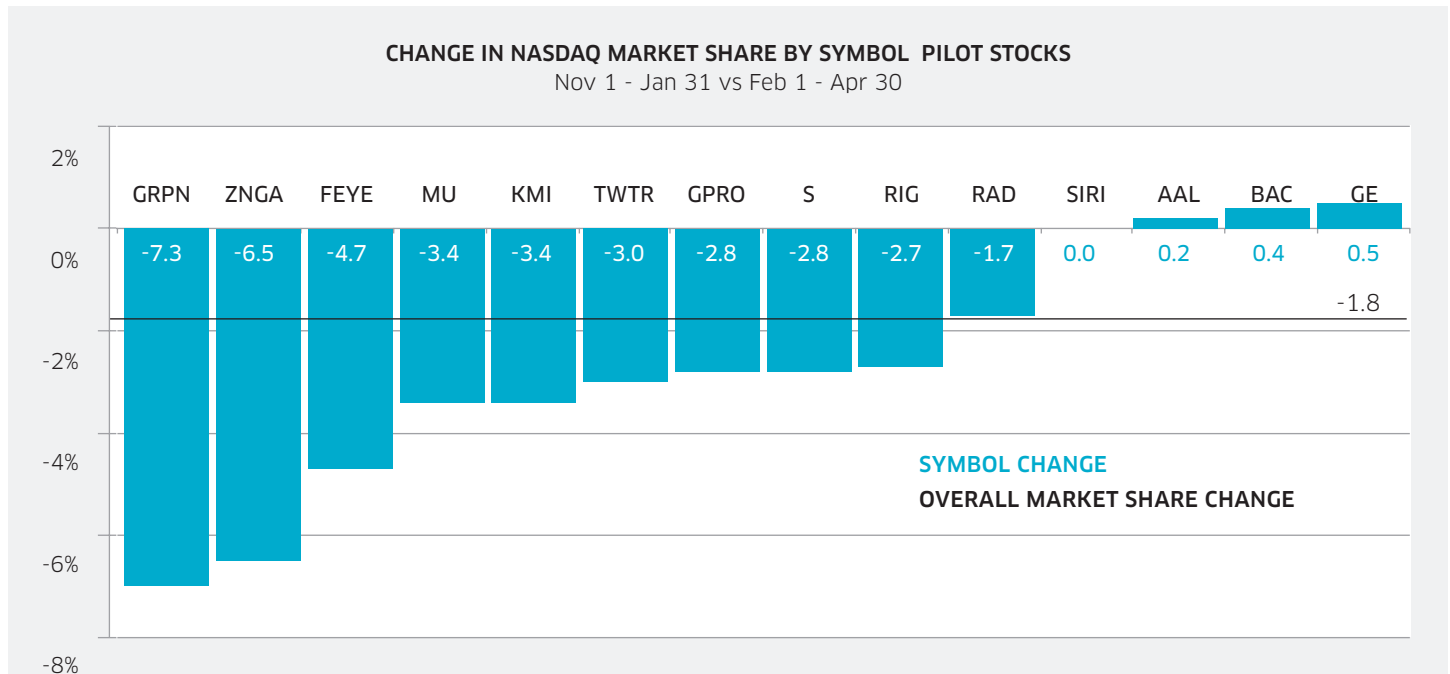
We find no evidence that the change in the identity of the firms driving Nasdaq's inside affected the quality of the quote available in the experiment stocks. Fill rates for booked orders on Nasdaq are essentially unchanged as is the price impact of executions trading against those orders¹. For the market in aggregate, there is no statistically significant difference between changes in the experiment and control stocks for the following metrics: variance ratio, realized spread, return autocorrelation, effective spread, relative effective spread,

quoted spread, relative quoted spread, displayed dollar depth at the NBBO, time between quote updates on the consolidated tape, time between price changes in the NBBO on the consolidated tape². It is worth noting that overall stock market volatility declines between the pre- and post- periods which causes similar changes in many of the above measures for the experiment and control stocks.

Market Share

In aggregate, Nasdaq's equally weighted market share in the control stocks declined by 1.8 percentage points in the experiment stocks between the pre- and post-periods with a decline of 0.3 percentage points in the control stocks. The change in observed market share is statistically significant. As was the case in the initial report, there is considerable variation across individual stocks (Figure 7) ranging from a market share gain of 0.5 percentage points to a loss of 7.3 percentage points.

Figure 7



1. Fill rates measured as the percent of booked orders receiving at least a partial partial execution. Price impact is measured as the realized spread.
2. Variance ratios are calculated as 1 sec/ 10 sec, 10 sec/60 sec, and 60 sec/300 sec. Price impact is measured as the realized spread of 0.1, 1, 30, 60 and 300 second time horizons. Return autocorrelation is measured at 1, 10, 30 and 60 second time horizons. Volatility is measure as return standard deviation at 1, 10, 30 and 60 second time horizons. Effective and relative effective spread is standard measures. Quoted and relative quoted spreads are duration weighted as is displayed depth.

CONCLUSION

Taken together these results show that the Nasdaq experiment resulted in changes in liquidity posting and consequently in market share. As discussed in the initial report, many of the firms decreasing their posting of liquidity on Nasdaq can be described as rebate sensitive electronic market makers. The loss of posted liquidity from some of these firms was made up by increased liquidity provision from electronic markets makers that continued posting liquidity on Nasdaq and by algorithmic traders responding in a similar fashion. Consequently, it is not surprising that many market quality measures for Nasdaq's quote do not show significant change.

We will be issuing the final report on the access fee experiment after it concludes. We thank market participants for the thoughts and comments they have shared with us and apologize for not incorporating every well considered suggestion we received into this report. We encourage market participants to continue sharing their thoughts with us and look forward to incorporating more of the industry's ideas into our final report on the fee experiment.

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