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Informed Trading Special Issue

SEC Tick Pilot – Unintended consequences?

Executive Summary

- It is too early to say whether the JOBS Act inspired initiative will meet the lofty aims of increasing jobs by incentivizing small company IPOs and improved research coverage of smaller firms, but sufficient data now exists to analyze the program's effect on how pilot stocks trade.
- All test groups saw significant increases in the size at the NBBO after the start of the pilot. Median quote sizes increased between 160-190% across all groups.
- Trading has shifted across venue types in all groups, with inverted venues and TRF venues the big winners in groups 1 and 2. In group 3, inverted exchanges alone gained market share.
- Traditional maker-taker venues have lost market share in each group, even in group 3, the trade-at group. Unsurprisingly, the TRF venues lost significant market share in group 3.
- Trade prices have shifted relative to the NBBO. Midpoint trading has increased for all groups, most notably for group 3. Intra-spread volume has decreased considerably, moving to the mid or the touch.
- Perhaps most surprisingly, overall traded volumes for group 3 stocks show a significant decline when adjusted for the control group. We determine that this decline is statistically significant (see Appendix B). The same decline is not seen for groups 1 and 2, indicating that the trade-at restriction has resulted in the unintended consequence of reducing overall liquidity in group 3 names.

Significant effects on trading mechanics

After a month-long phase-in period, the stocks making up the three tick pilot test groups completed their migration to the new trading regime on October 31st 2016. The primary goal of the pilot is "to study the effect of tick size on liquidity and trading of small capitalization stocks"[1]. Regulators have expressed the intention to use the significant quantity of data that will be collected over the two-year pilot program to "assess whether wider tick sizes enhance the market quality of these stocks for the benefit of issuers and investors – such as less volatility and increased liquidity"[1].

Our view is that it is too early to pass judgement on the success of the pilot program from an issuer's perspective. It remains unclear whether the tick size changes will incentivize small companies to raise capital through listing and for research providers to increase research coverage of small and mid-cap companies. What is clearer is the effect the program has had on how the pilot stocks actually trade. The restrictions applied in each of the test groups have resulted in several material changes to how and where trading takes place, some of which seem to run contrary to the intentions described above.

Wider spreads, deeper queues

Exhibit 1 highlights the first of these observations: spreads are wider when the nickel tick size is enforced. Prior to the commencement of the pilot program, each group of test stocks had a median spread value that was around six cents. The increase in median spread ranged from 50.0% for group 1 to 54.6% for group 3. As we discussed briefly in our earlier piece *"The Tick Pilot: Fasten Your Seatbelts,"*[2] a coarse calculation of spread costs accounting for the new nickel floor resulted in a spread cost increase to the end investor in the region of $500m per year.

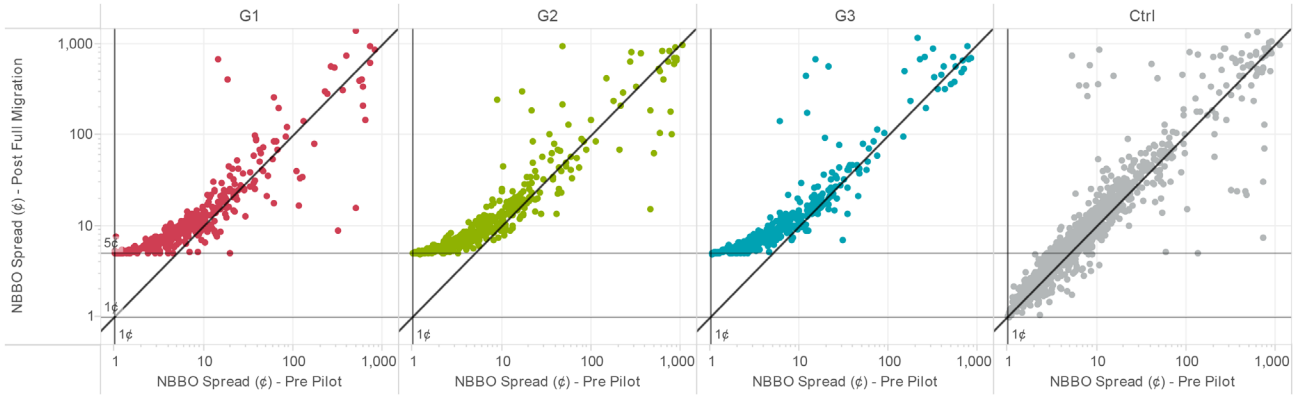
Exhibit 2 shows that, in addition to wider spreads, there is more liquidity visible at the NBBO for the vast majority of the pilot names in each group. With the tick size widened to a nickel, a large number of the pilot stocks have spreads constrained by a tick size that is now too large. The result is an increase in competition to provide liquidity across fewer levels and a thickening of NBBO quotes. This observation is particularly relevant to electronic platforms that use historical quote size distributions as context when making certain trading decisions, such as identifying large or fading quotes. It is apparent from these data that a quote size that could have been regarded as "large" prior to the pilot would now be considered "small". For example: a group 2 75th percentile quote size of 749 shares before the pilot is identical to the same group's 25th percentile quote size today. Failure to recalibrate to account for the significant shift in the quote size distribution will result in poorly informed decisions and potentially an increase in overall trading cost.

[1] https://www.sec.gov/oiea/investor-alerts-bulletins/ia_ticksize.html
[2] http://www.instinet.com/docs/msr/2016/Tick_Pilot_Fasten_Your_Seatbelts.pdf

Exhibit 1: Average NBBO spread

Time-weighted average spread before and after for each pilot group. "Pre-Pilot" refers to the 3-week period between Sep. 12th and Sep. 30th, while "Post Full Migration" refers to the period between Oct. 31st and Nov. 23rd.

(a)



(b)

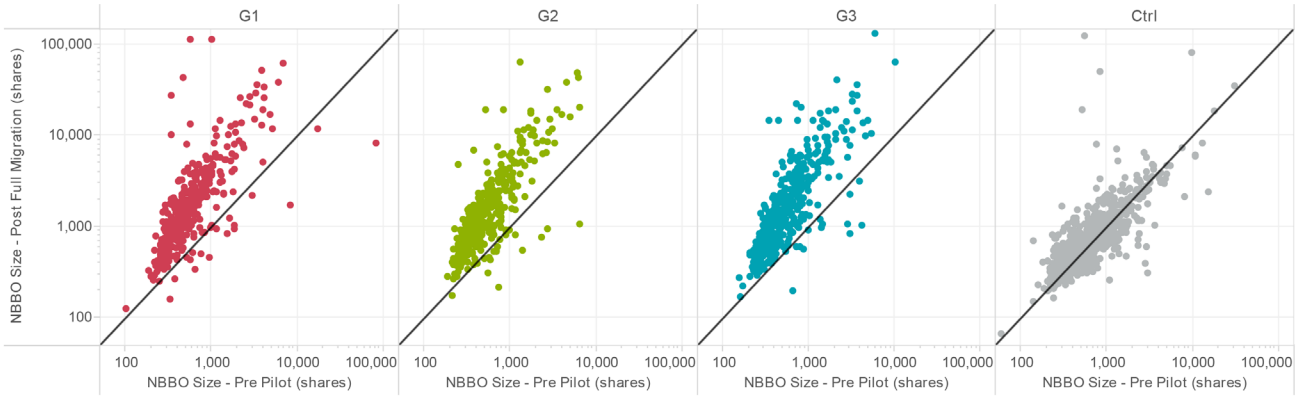
	G1	G2	G3	Ctrl
Pre Pilot	Median: 6.1¢ (1st, 3rd Qtile): (2.9¢, 14.4¢)	Median: 6.3¢ (1st, 3rd Qtile): (3.2¢, 16.0¢)	Median: 5.9¢ (1st, 3rd Qtile): (2.7¢, 14.4¢)	Median: 5.9¢ (1st, 3rd Qtile): (3.1¢, 14.1¢)
Post Full Migration	Median: 9.1¢ (1st, 3rd Qtile): (6.3¢, 16.1¢)	Median: 9.7¢ (1st, 3rd Qtile): (6.8¢, 18.8¢)	Median: 9.0¢ (1st, 3rd Qtile): (6.2¢, 17.0¢)	Median: 6.7¢ (1st, 3rd Qtile): (3.5¢, 17.2¢)
%Change	Median: 50.0% (1st, 3rd Qtile) = (119%, 12%)	Median: 54.6% (1st, 3rd Qtile) = (112%, 17%)	Median: 53.1% (1st, 3rd Qtile) = (128%, 18%)	Median: 14.0% (1st, 3rd Qtile) = (12%, 22%)

Source: Instinet

Exhibit 2: Average NBBO size

Time-weighted average NBBO size before and after for each pilot group. "Pre-Pilot" refers to the 3-week period between Sep. 12th and Sep. 30th, while "Post Full Migration" refers to the period between Oct. 31st and Nov. 23rd.

(a)



(b)

	G1	G2	G3	Ctrl
Pre Pilot	Median: 464.5 sh (1st, 3rd Qtile): (319 sh, 773 sh)	Median: 447.0 sh (1st, 3rd Qtile): (325 sh, 749 sh)	Median: 491.6 sh (1st, 3rd Qtile): (334 sh, 811 sh)	Median: 466.9 sh (1st, 3rd Qtile): (332 sh, 767 sh)
Post Full Migration	Median: 1,351.2 sh (1st, 3rd Qtile): (758 sh, 2,828 sh)	Median: 1,181.5 sh (1st, 3rd Qtile): (749 sh, 2,459 sh)	Median: 1,334.7 sh (1st, 3rd Qtile): (742 sh, 3,408 sh)	Median: 496.6 sh (1st, 3rd Qtile): (364 sh, 818 sh)
%Change	Median: 191% (1st, 3rd Qtile) = (137.6%, 266%)	Median: 164% (1st, 3rd Qtile) = (130.8%, 228%)	Median: 171% (1st, 3rd Qtile) = (122.0%, 320%)	Median: 6% (1st, 3rd Qtile) = (9.7%, 7%)

Source: Instinet

Volume shifts between venue types

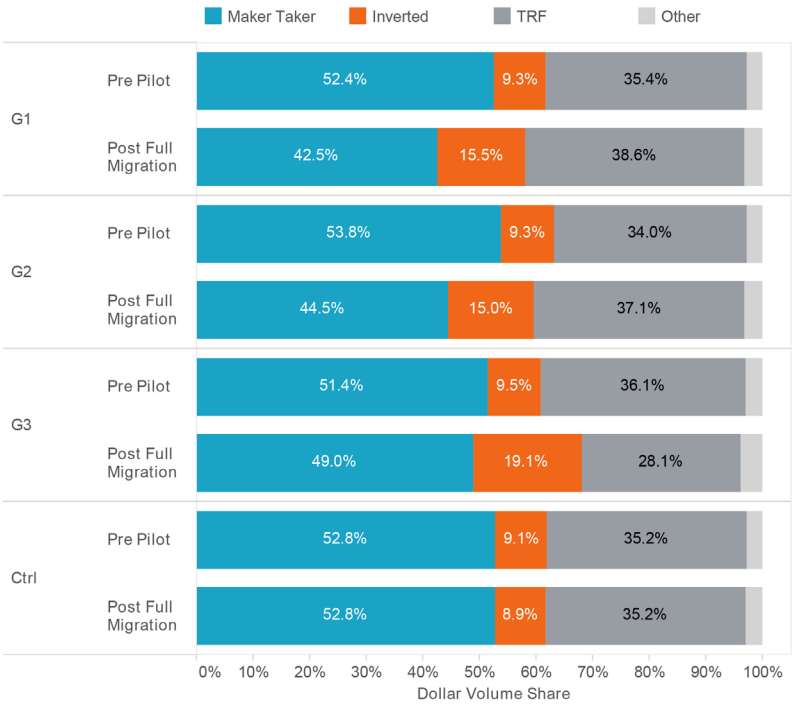
In conjunction with the spread and size changes, the distribution of trading by venue type has also changed as a result of the pilot. The data show that significant percentages of trading have shifted from one venue type to another in each of the test groups. **Exhibit 3** describes these changes:

- For groups 1 and 2, trading has moved from maker-taker to inverted and off-exchange venues. Maker-taker exchanges collectively have lost nearly 10% of their market share for the test stocks. Inverted exchanges have captured slightly more than half of the outflow, with the rest moving to TRF reporting venues. It is likely that the increase in market share for both inverted exchanges and off-exchange venues is a queue-jump approach by less patient traders attempting to get ahead of the now thicker quote sizes in pilot names. Trading at the touch in the dark can be an effective approach when queue jumping, but it seems likely that driving liquidity away from lit venues in this way is an unintended consequence of a program intent on evaluating options for improving visible liquidity.

- For group 3, trading has moved from maker-taker and TRF venues to inverted exchanges. TRF venue market share has fallen by 8.1% and maker-taker by 2.4%, with inverted exchanges increasing by 9.6%. As with groups 1 and 2, it is likely that the shift is caused by a desire to jump the queue in tick-constrained names. However, the "trade-at" restriction means that doing so in the dark is no longer an option for group 3.

Exhibit 3: Volume shifts by venue type

"Pre-Pilot" refers to the 3-week period between Sep. 12th and Sep. 30th, while "Post Full Migration" refers to the period between Oct. 31st and Nov. 23rd. Auction trades are not included.



		Pre Pilot	Post Full Migration	%Change
G1	Maker Taker	52.4%	42.5%	-9.9%
	Inverted	9.3%	15.5%	6.2%
	TRF	35.4%	38.6%	3.2%
	Other	2.9%	3.4%	0.5%
G2	Maker Taker	53.8%	44.5%	-9.3%
	Inverted	9.3%	15.0%	5.7%
	TRF	34.0%	37.1%	3.2%
	Other	2.9%	3.3%	0.4%
G3	Maker Taker	51.4%	49.0%	-2.4%
	Inverted	9.5%	19.1%	9.6%
	TRF	36.1%	28.1%	-8.1%
	Other	3.0%	3.9%	0.9%
Ctrl	Maker Taker	52.8%	52.8%	0.0%
	Inverted	9.1%	8.9%	-0.2%
	TRF	35.2%	35.2%	0.0%
	Other	3.0%	3.1%	0.2%

Source: Instinet

Trade prices shift relative to the NBBO

Exhibit 4 compares volumes before and after the start of the tick pilot at various points at or within the NBBO:

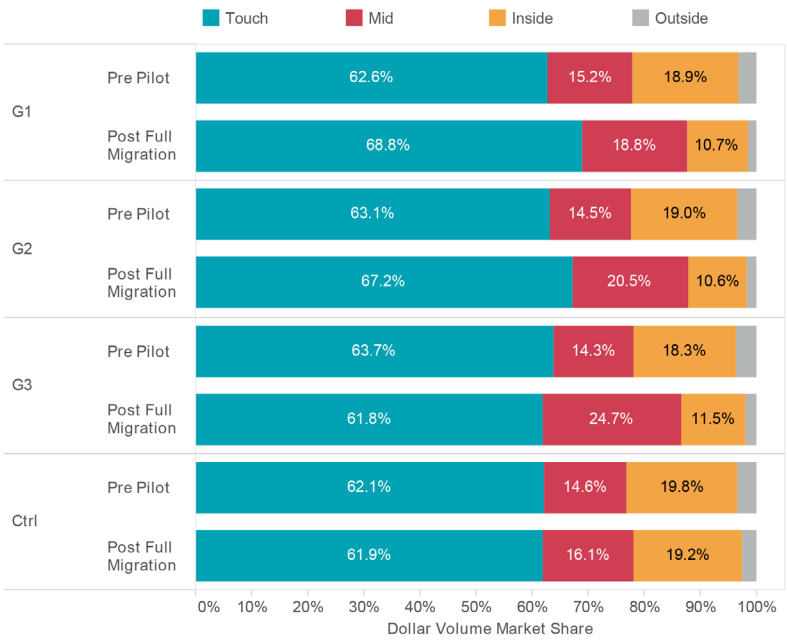
- Groups 1 and 2 show very similar shifts in trading relative to the NBBO. In both groups, trading at the touch on maker-taker venues has fallen significantly, while trading at the touch on inverted and TRF venues has increased. This finding is consistent with the view that less patient traders are using inverted and TRF venues in an attempt to queue-jump.

- Maker-taker, inverted and TRF venues all show similar changes in mid-point and intra-spread trading for stocks in groups 1 and 2. The fact that the decline in intra-spread trading (excluding mid-point) is broadly the same between group 1 and group 2 (-8.2% and -8.4% respectively) is interesting given the rule differences between those groups in this respect. It is our view that the intra-spread price advantages allowed in group 1 stocks are being underutilized because of the complexity involved in providing liquidity at such prices when orders are restricted to nickel-rounded limits.

- Group 3 shows a significant decline in trading at the touch on TRF venues. This is to be expected, given that the trade-at rule essentially prohibits such trading for group 3 stocks. Instead, this touch flow looks to have shifted partly to the TRF mid-point, but mostly to the touch on inverted exchanges. In this sense, the trade-at restriction has achieved its intention of increasing the visible liquidity in these names, albeit quoted liquidity rather than actual traded volume (see later).

Exhibit 4: Trade position shifts in tick pilot securities

"Pre-Pilot" refers to the 3-week period between Sep. 12th and Sep. 30th, while "Post Full Migration" refers to the period between Oct. 31st and Nov. 23rd. Auction trades are not included.

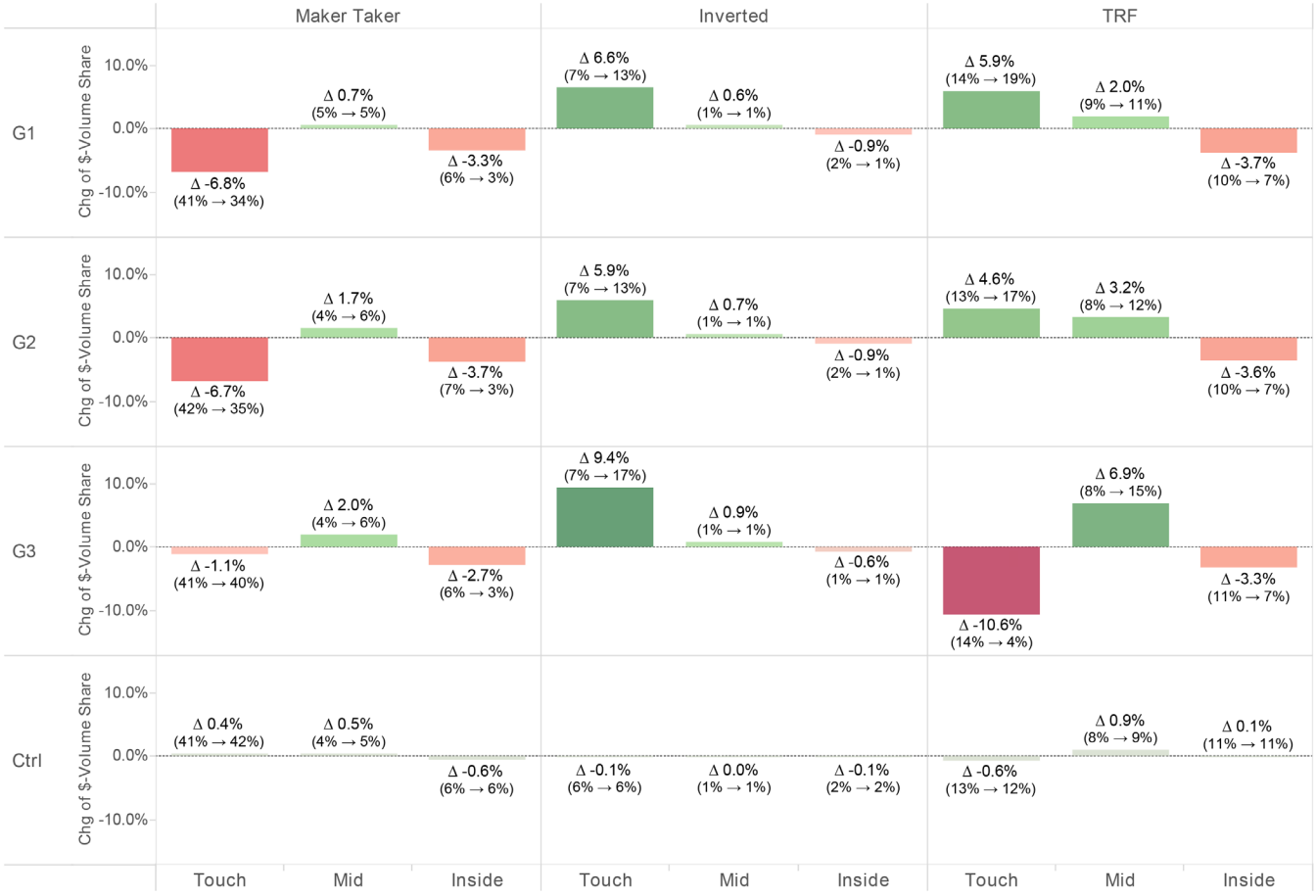


		Pre Pilot	Post Full Migration	%Change
G1	Touch	62.6%	68.8%	6.2%
	Mid	15.2%	18.8%	3.5%
	Inside	18.9%	10.7%	-8.2%
G2	Touch	63.1%	67.2%	4.1%
	Mid	14.5%	20.5%	6.0%
	Inside	19.0%	10.6%	-8.4%
G3	Touch	63.7%	61.8%	-1.9%
	Mid	14.3%	24.7%	10.4%
	Inside	18.3%	11.5%	-6.7%
Ctrl	Touch	62.1%	61.9%	-0.2%
	Mid	14.6%	16.1%	1.6%
	Inside	19.8%	19.2%	-0.6%

Source: Instinet

Exhibit 5: Trade position shifts by venue type

Dollar volume market share shifts are shown by venue type and trade prices relative to the NBBO. Percentage market shares and their changes are normalized to the overall dollar volume for the pilot group. Auction volumes are included.



Source: Instinet

"Trade-at" harms market quality?

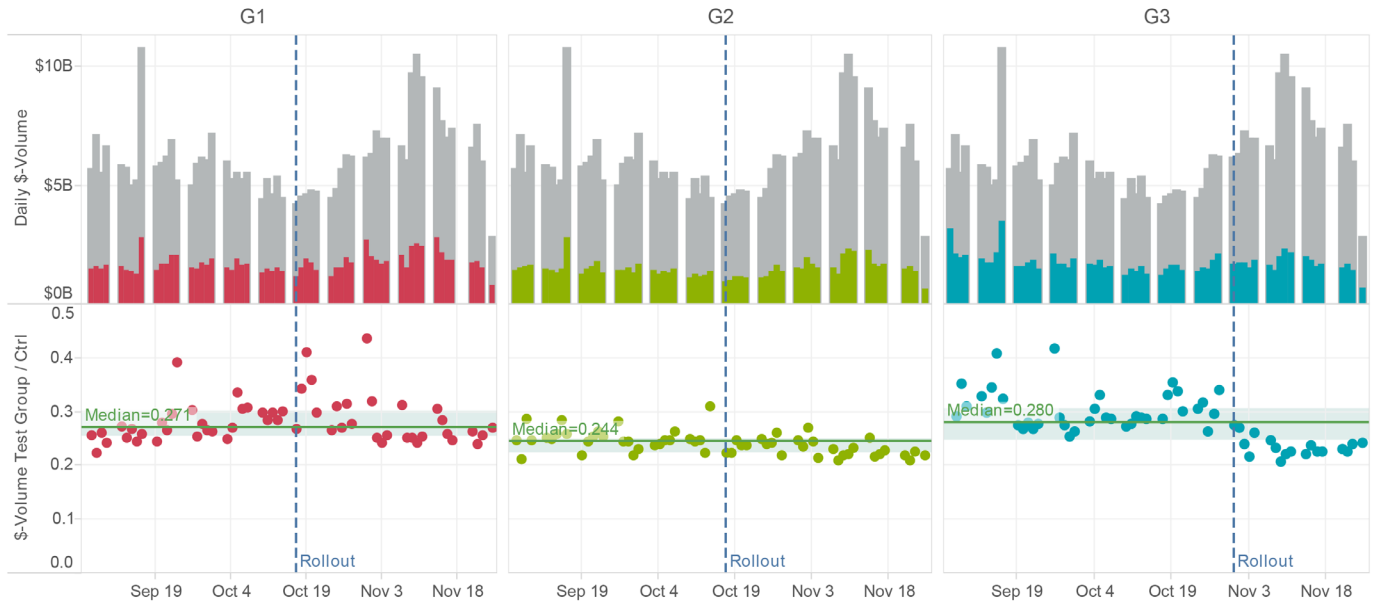
Perhaps the most surprising – and unintended – effect observed to date is a drop in volume for group 3 stocks relative to the control group. **Exhibit 6** shows a noticeable fall in group 3 dollar traded volume versus the control group since the pilot rollout. Neither a decrease nor an increase is evident for group 1 or 2. Having applied statistical testing techniques to this observation (see **Appendix B**), it is clear that this decline in volume is indeed statistically significant. **Exhibit 7** shows the changes in volume broken down by the degree to which the spread of the stock is constrained (floored) by the new nickel tick size. The greater the degree to which the spread is constrained, the greater the drop in volume since the start of the pilot.

The trade-at restriction in group 3 was intended to encourage liquidity providers out of TRF venues and onto lit exchanges. Considering the larger lit quote sizes and the large drop in trading activity on TRF venues evident post-

pilot for group 3 stocks, it would be reasonable to conclude that visible liquidity has indeed improved and "trade-at" has fulfilled its purpose. In stark contrast to this, however, it is now clear that the trade-at restriction is very likely responsible for a statistically and economically significant drop in overall traded volume for group 3 names. This observation is consistent with prior academic research studying similar market structures elsewhere in the world – notably Canada and Australia – that concluded that "trade-at" restrictions have harmed market quality.[3,4]

Exhibit 6: Daily dollar volume of test securities vs control group

Upper panels: Daily variation of dollar trading volumes from Sept. 6th to Nov. 23rd. The overall volume for each test group (color bars) is superimposed on the overall volume of the control group (gray bars). Lower panels: The ratio between the two volume series. The ratios represent the market-adjusted volume change for each test group. To highlight any potential changes due to the trade and quote restrictions, only the securities that were rolled out on Oct. 17th (groups 1 and 2, approximately 300 stocks each) and Oct. 31st (group 3, approximately 300 stocks) are included. Auction volumes are included.

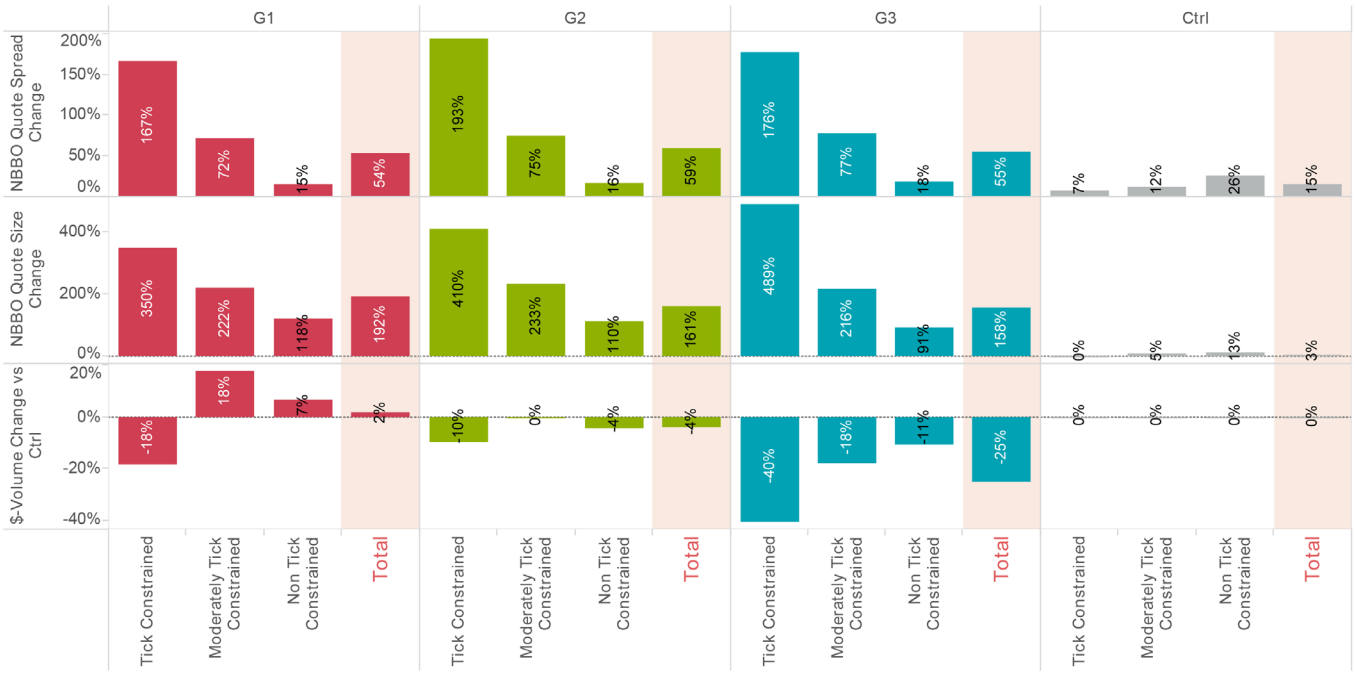


Source: Instinet

[3] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2279719
[4] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1923946

Exhibit 7: Tick Pilot's effects on market liquidity characteristics

Stocks in each pilot group are grouped by the average NBBO spread during the pre-pilot period. The "Tick Constrained" group consists of stocks with the average spread less the 3¢. For the "Moderately Tick Constrained" stocks, the spreads were between 3¢ and 7¢, and the "Non Tick Constrained" group consists of the rest. Auction volumes are included.



Source: Instinet

Summary

With most of its two-year horizon still to run, it is too early to say conclusively whether or not the tick pilot program will address the intended macro factors effectively. What is clear, however, is that the pilot stocks no longer trade in the same manner as they did prior to the commencement of the program. Significant changes in distributions of quote size and spread size, as well as the shift in liquidity in terms of price point and venue type have necessitated the enhancement of automated trading systems to compensate effectively. The cost of these enhancements, together with the technology cost to the exchanges and the increased spread cost to the end investor (the latter of which we roughly estimate to be of the order of $500m per year) makes the pilot program an expensive undertaking for the industry. Most of our clients have expressed some degree of skepticism as to the ability of the pilot program to prove that a simple widening of the tick size to a nickel will result in the micro and macro benefits that have been associated with it. Even at this early stage, it is already clear that there is no evidence that any of the group structures has acted to increase traded volume in the pilot stocks. In fact, there is strong evidence that in the case of group 3 it has actually acted to reduce overall traded volume – clearly not the intention.

We believe that simply moving from a penny to a nickel is too coarse an adjustment to something as fundamental as the tick size. Incorrectly-sized ticks bring with them significant, but underappreciated costs in trading. If the tick size is too narrow, economic incentives for liquidity providers to provide begin to weaken, particularly in high priced names.

As a result, liquidity shifts intra-spread and to TRF venues as the cost for another participant to step in front falls. If the tick size is too wide and spreads become constrained by the tick size, competition for liquidity provision intensifies greatly, with some market participants taking advantage of any technological or pricing edge they can (low latency, complex order types, inverted fee structures) to provide liquidity efficiently as quote sizes thicken, most likely crowding out natural providers. In our view, establishing a graded tick size as a function of price and trading activity would best help control some of these underappreciated costs and help keep trading orderly across all names, not just small and mid-caps.

For now, we can only hope that the vast amount of data generated by the tick pilot program is scrutinized objectively and that any decisions taken on future tick-size regimes at the program's completion are supported by rigorous analysis – whatever those decisions turn out to be.

Appendix A: Migration of trading activity across individual venues

"Pre-Pilot" refers to the 3-week period between Sep. 12th and Sep. 30th, while "Post Full Migration" refers to the period between Oct. 31st and Nov. 23rd. Auction trades are not included.

		G1		G2		G3		Ctrl		G1	G2	G3	Ctrl
		Pre Pilot	Post Full Migration	Pre Pilot	Post Full Migration	Pre Pilot	Post Full Migration	Pre Pilot	Post Full Migration	%Change	%Change	%Change	%Change
Maker Taker	NASDAQ	23.6%	18.2%	25.6%	20.2%	24.3%	23.6%	25.6%	24.9%	-5.4%	-5.4%	-0.7%	-0.7%
	ARCA	8.4%	6.7%	8.1%	7.0%	8.0%	7.2%	8.3%	8.2%	-1.7%	-1.1%	-0.7%	0.0%
	NYSE	8.7%	7.2%	8.0%	6.8%	6.7%	6.6%	7.2%	7.9%	-1.5%	-1.2%	-0.1%	0.7%
	Edge-X	5.7%	5.1%	5.9%	5.4%	6.2%	5.9%	6.0%	6.7%	-0.6%	-0.5%	-0.3%	0.7%
	BATS-Z	6.0%	5.3%	6.2%	5.0%	6.2%	5.6%	5.7%	5.0%	-0.7%	-1.1%	-0.6%	-0.7%
Inverted	BATS-Y	4.1%	7.8%	4.1%	7.4%	4.2%	9.3%	4.1%	3.8%	3.6%	3.3%	5.1%	-0.3%
	NASDAQ-BX	3.0%	5.7%	3.0%	5.6%	2.9%	7.6%	3.0%	3.3%	2.8%	2.6%	4.7%	0.3%
	Edge-A	2.1%	2.0%	2.2%	2.0%	2.3%	2.1%	2.0%	1.8%	-0.2%	-0.2%	-0.2%	-0.2%
TRF	TRF-NASDAQ	31.9%	34.6%	30.7%	33.2%	32.7%	24.7%	31.7%	31.4%	2.7%	2.4%	-8.0%	-0.3%
	TRF-NYSE	3.5%	4.0%	3.2%	4.0%	3.4%	3.3%	3.5%	3.8%	0.5%	0.8%	-0.1%	0.3%
Other	IEX	2.0%	2.4%	2.0%	2.3%	2.2%	2.5%	1.9%	2.1%	0.4%	0.3%	0.3%	0.2%
	NASDAQ-PSX	0.8%	0.9%	0.8%	0.9%	0.8%	1.3%	0.8%	0.8%	0.1%	0.1%	0.5%	0.0%

Source: Instinet

Appendix B: Statistical assessment of overall volume change

Exhibit 6 and **Exhibit 7** show the aggregate dollar trading volume of group 3 securities has reduced relative to that of the control group, most likely due to the trading and quoting restrictions of the Tick Pilot program. The exhibits also show that the pilot program has not had as significant an effect on the volumes of group 1 and group 2 securities. This apparent discrepancy has an important implication: that the 'trade-at' restriction imposed on group 3 has detrimental effects on market liquidity, while the wider tick size neither increases nor decreases the market volume. We therefore conducted detailed statistical assessment of the observation.

We employed difference-in-difference analysis[5] to evaluate the statistical significance of the overall volume change. Namely, we compared the stock-by-stock volume changes of test securities — a series of ratios of each test security's pre-pilot volume to the post-migration volume — with the same volume ratios of the control securities. We then used a Mann-Whitney U test[6] to evaluate the statistical significance of the difference in the two series.

[5] https://en.wikipedia.org/wiki/Difference_in_differences
[6] https://en.wikipedia.org/wiki/Mann%E2%80%93Whitney_U_test

To mitigate the influence of potential news events affecting individual stocks' volumes, we excluded two days of data with the largest volume as well as two days with smallest volume for each stock from each of the pre-pilot and post-migration periods. Further, we randomly excluded 10% of stocks from the test group and the control group. The Mann-Whitney statistic was then evaluated for the two resultant lists. We repeated the random selection and evaluation process 1000 times and adopted the median p-value to represent the statistical significance associated with the two groups of securities.

With this methodology, only the difference between group 3 versus the control group was found statistically significant at 1% level. On the other hand, the differences between group 1 and group 2 versus the control group are not statistically significant even at 5% level. Our outcome is robust for different choices of pre-pilot and post-migration periods — 2, 3 and 4 weeks — as well as for reasonable choices of the number of days / stocks to exclude.