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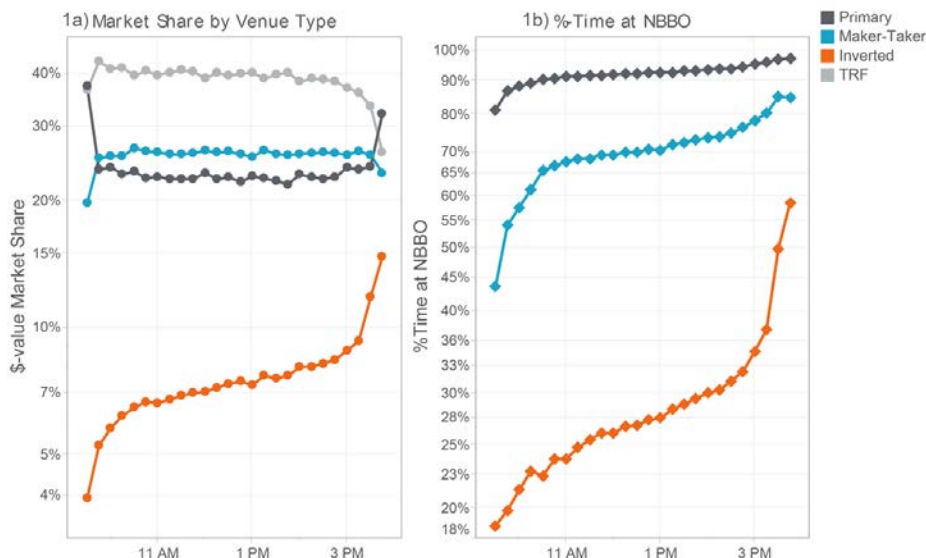
Informed Trading – April 2017

**Understanding Venue Dynamics**

In the current US equity market environment, volume allocation across trading venues is anything but stable. **Exhibit 1a** shows venues' market shares vary dynamically throughout the day, presumably in response to various factors affecting traders' preference for different liquidity sources. Exchanges' presence at the NBBO also changes drastically, as shown in **Exhibit 1b**.

Interestingly, these intraday variations do not seem driven by absolute volume levels because these curves do not follow the well-known "U-shaped" volume profile. Inverted exchanges consistently gain market share throughout the day with a sharp rise near the close. In contrast, maker-taker (excluding the primary-listing market) and off-exchange venues lose ground near close.

In this edition of Informed Trading, we investigate the factors motivating traders' choice of venue during the day, and expose underlying mechanisms we believe are accountable for such market behavior. We also review why a trader's venue selection should be informed by urgency, and the degree to which a stock's spread is constrained by its tick size ("*tick-constrained*" level) in real time.



**Exhibit 1:** Intraday variation of (a) venue market share and (b) venues' percentage time at NBBO. Cross-sectional data is for the most liquid 300 Nasdaq-listed securities by daily trading value for Dec 2016–Feb 2017. Auctions are not included.

Source: Instinet



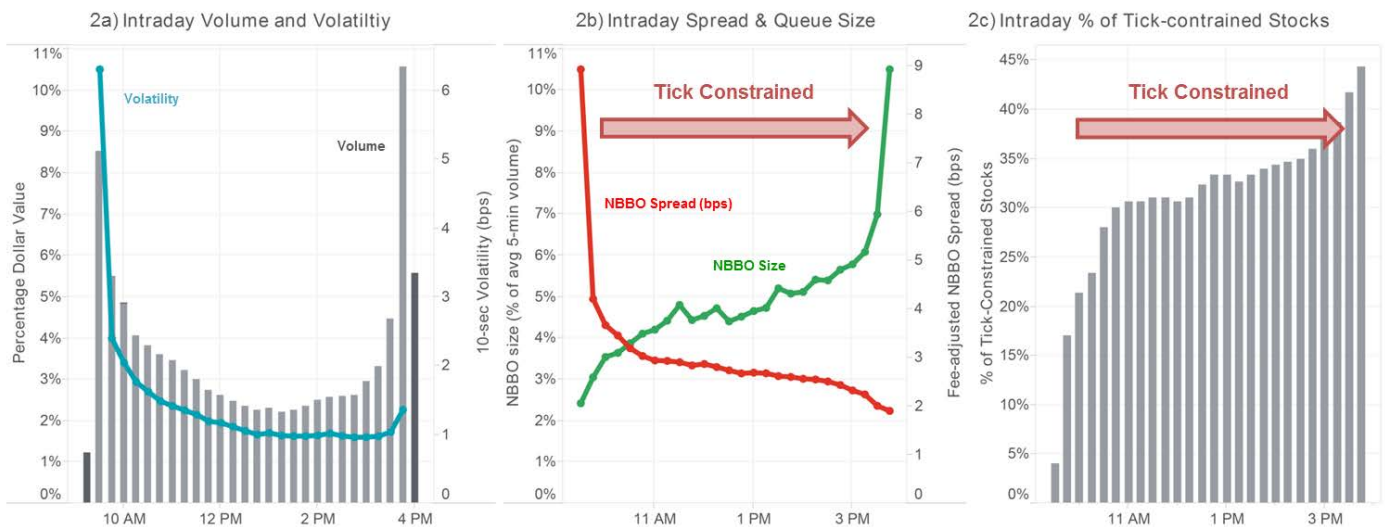
## Understanding Venue Dynamics

### Three Pillars of Trading

In our previous piece, [Three Pillars of Trading](#), we discussed how volume, volatility and spread are the three most important factors affecting various aspects of trading. Each of these factors exhibits a distinct, well-known intra-day profile. As shown in **Exhibit 2a**, trading volume is heavily concentrated in both the first and last hours of the trading session, with the first hour being significantly more volatile than the rest of the day. This combination of U-shaped volume and L-shaped volatility profiles leads to two other interesting intra-day effects: the narrowing of the bid-ask spread, and the increase of the NBBO size (**Exhibit 2b**).

As shown below, the narrowing spread, combined with the access fee and rebate structure of different venues, has significant implications for trading venue selection. In order to investigate the underlying mechanisms of venue switching, we define what we call a “tick-constrained” stock – a stock that has a bid-ask spread that is almost always equal to its tick size.<sup>1</sup> **Exhibit 2c** illustrates that more and more stocks become tick-constrained through the day.

In the next section, we explore how exchanges’ access fees/rebates impact the trader’s incentive for tick-constrained stocks.



**Exhibit 2:** Stock trading becomes more tick-constrained from the opening to the close. Cross-sectional data is for the top 300 NASDAQ-listed securities by daily trading value for Dec 2016–Feb 2017.

Source: Instinet

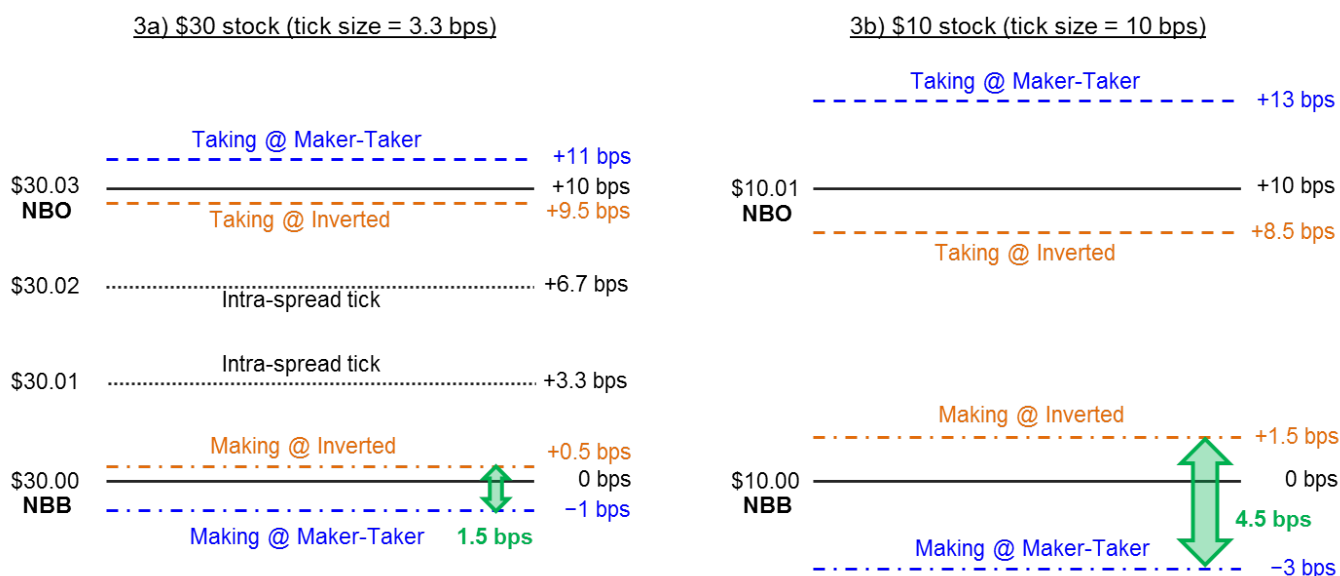
<sup>1</sup> Throughout this paper, we categorized a stock as “tick-constrained” when the time-weighted average spread is less than 1.2 ticks, “moderately-constrained” for 1.2–2.5 ticks spread, and “non-constrained” otherwise.



## Understanding Venue Dynamics

### Inverted Exchanges: A Tool for Intra-Spread Trading

As exchanges charge fees or award rebates for transactions, the prices at which traders and liquidity providers actually execute their orders are not equal to the published prices. **Exhibit 3** illustrates the virtual price levels formed around the published prices when the pricing models of both maker-taker and the inverted exchanges<sup>2</sup> are taken into account.



**Exhibit 3:** Shows synthetic price levels formed by the combination of tick size and access fees/rebates. Fee/rebate rates of 30 mils per share (maker-taker) and 15 mils per share (inverted) are assumed.<sup>3,4</sup>

Source: Instinet

**Exhibit 3a** shows a case, in which the stock is bid at \$30.00 (NBB) and offered at \$30.03 (NBO), resulting in an NBBO spread of 10 basis points. Posting an order at an inverted exchange is more aggressive than posting at a maker-taker exchange, due to the fee charged to liquidity providers. Similarly, taking liquidity at an inverted exchange costs less than taking it at a maker-taker exchange because of the rebates. Assuming fee/rebate rates of 30 and 15 mils per share for maker-taker and inverted exchanges respectively<sup>2,3</sup>, the difference in the effective price between the two models for an order posted passively at the NBB is 1.5 bps.

This pricing structure changes according to stock price, as shown in **Exhibit 3b**, with the example of a \$10 stock. Even though the NBBO spread is the same at 10 bps, the economic impact of the access fee/rebate is significantly larger. The difference of 4.5 bps is equivalent to the full spread cost of a \$22 stock (assuming one-penny spread).

<sup>2</sup> We included in the analysis four maker-taker exchanges (Nasdaq, NYSE-Arca, Bats-Z, Edge-X) and three inverted exchanges (Bats-Y, Edge-A, Nasdaq-BX).

<sup>3</sup> 1 mil equals \$0.0001. For a \$30-stock, 30 mils per share correspond to  $\$0.0030 / \$30 = 1$  bps.

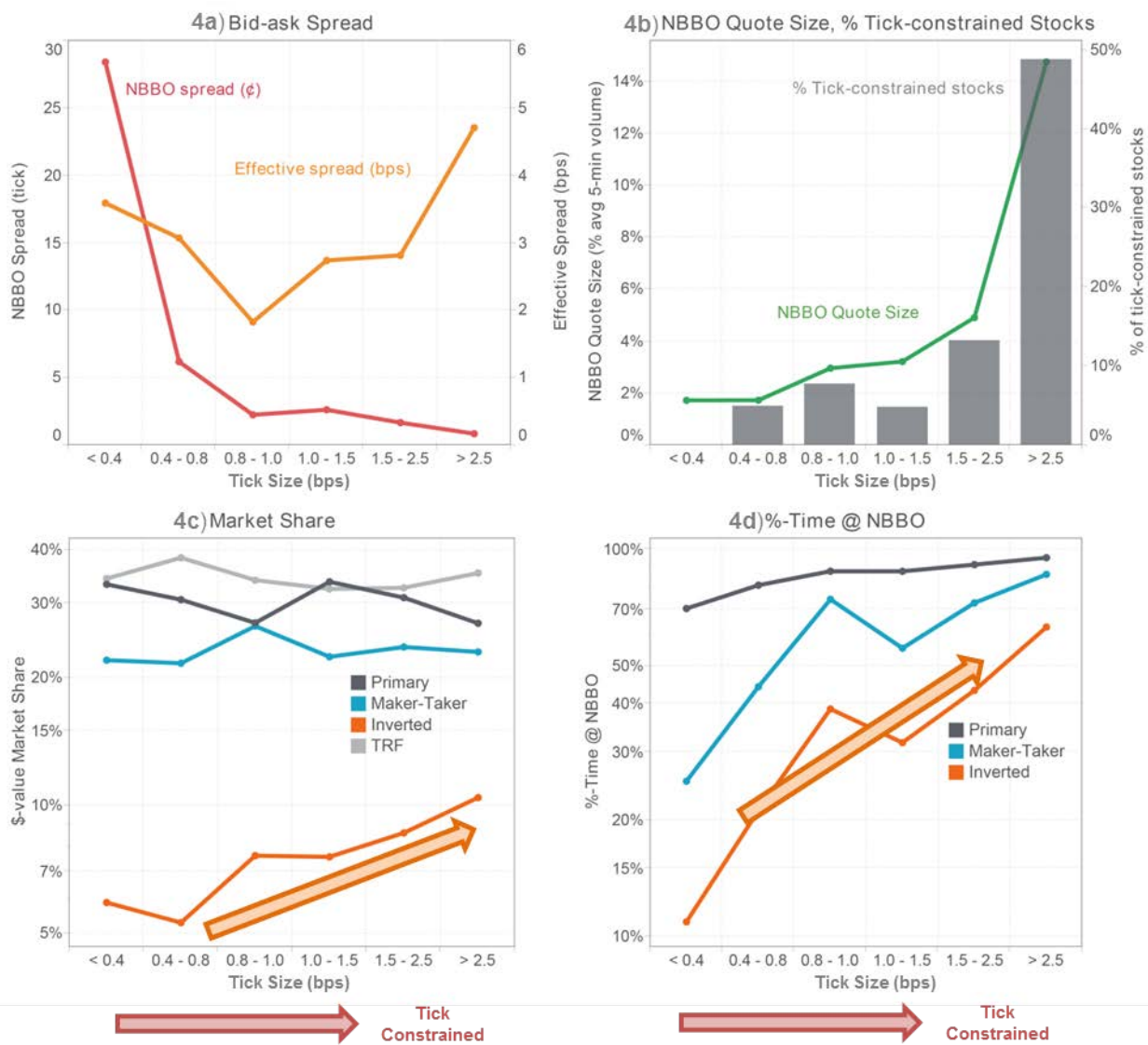
<sup>4</sup> Each exchange's fee/rebate schedule can be found at [Nasdaq](#), [Nasdaq-BX](#), [NYSE-ARCA](#), [Bats-Z](#), [Bats-Y](#), [Edge-X](#), [Edge-A](#).

## Understanding Venue Dynamics

Although there is no nominal tick level inside the spread, traders can utilize inverted exchanges to post quotes that are essentially more aggressive than those on maker-taker exchanges.

The diagrams in **Exhibit 3** greatly aid in our understanding of when inverted exchanges are most useful: they are more frequently accessed for lower priced stocks and when the bid-ask spread is close to one tick. In other words, inverted exchanges can provide an opportunity to post more aggressive quotes when the bid-ask spread is constrained by the tick size.

In the next section, we demonstrate how the proportional tick size affects the usage of inverted exchanges, among other trading characteristics.



**Exhibit 4:** Tick size affects bid-ask spreads, average quote size, and the usage of inverted exchanges. Data shown is from the 300 NASDAQ-listed securities with the largest daily dollar trading value from December 2016 - February 2017.

Source: Instinet



## Understanding Venue Dynamics

### Tick Size Affects Activity at Inverted Exchanges

**Exhibit 4a** shows the tick size converted to basis points vs average bid-ask spread. As the tick size in basis points increases (*i.e.*, the price of the stock comes down), the NBBO spread quickly narrows and nears one cent. In conjunction with this narrowing of spread, the average NBBO quote size increases drastically, as shown in **Exhibit 4b**. These two attributes – an average spread close to the tick size and a large NBBO quote size – characterize what we refer to as a “tick-constrained trading environment”.

**Exhibit 4c** shows how the relative market share of different trading venue types changes with the basis point tick size. The market share of inverted exchanges increases rapidly as the tick size in basis points increases and the stock becomes more tick-constrained. Similarly, **Exhibit 4d** shows that inverted exchanges provide NBBO quotes much more frequently when the stock is tick-constrained.

Before moving on to a discussion of intraday variation, it is worth noting that the effective spread bottoms out for tick sizes of around one bps (**Exhibit 4a**). This occurs for two main reasons:

- 1) Larger basis-point tick sizes tend to constrain bid-ask spreads, as the pricing restrictions imposed by Regulation NMS prevent traders from establishing sub-penny levels.
- 2) Smaller basis-point tick sizes reduce the incentive for market makers to display aggressive quotes, as additional Regulation NMS-compliant price levels likely exist, making it comparatively cheap for someone to step in front of a passive post.

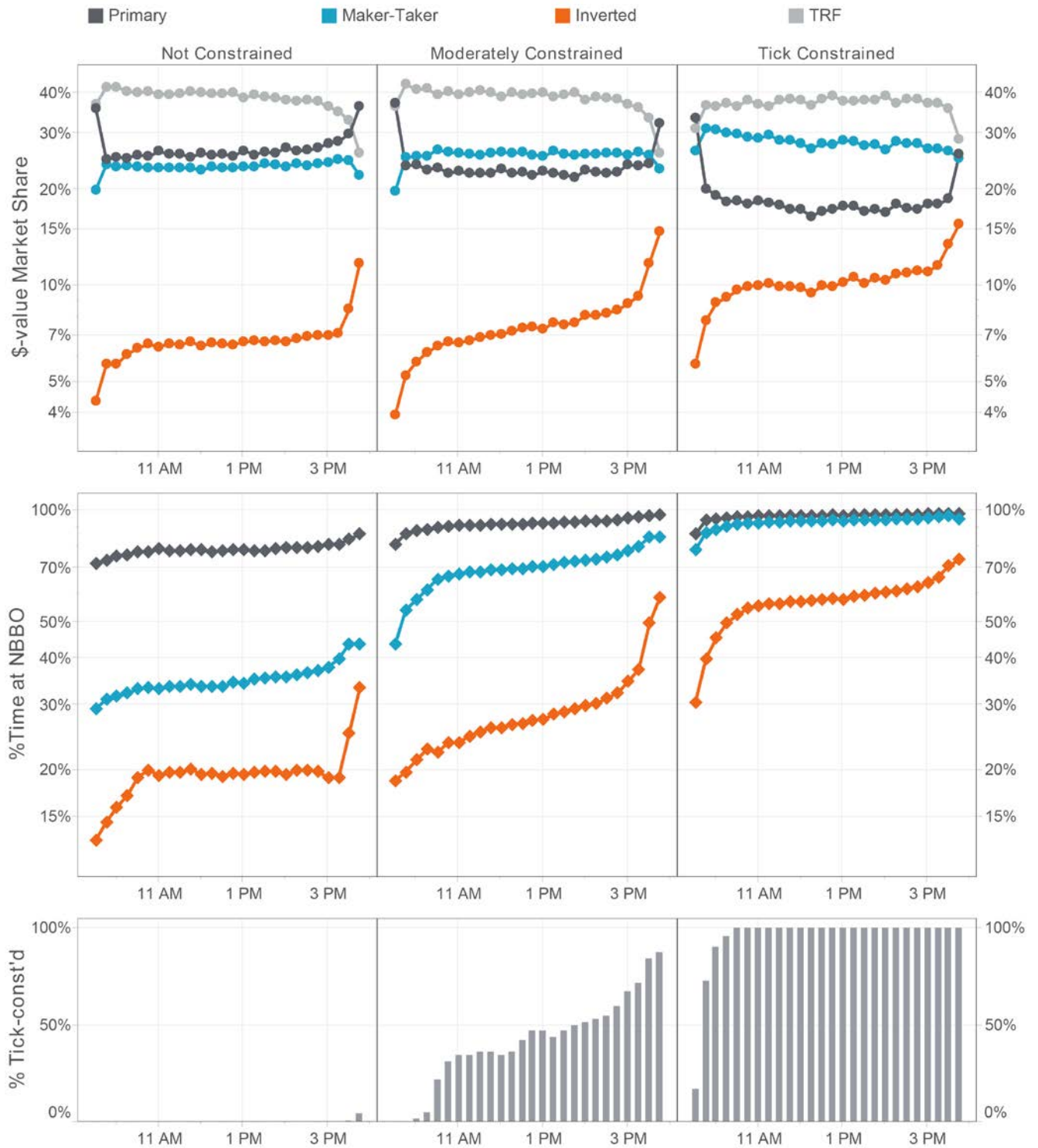
### Tick-constrained Levels Drive Activity at Inverted Exchanges

**Exhibit 5** shows the intraday variations of inverted exchange activity for three different stock groups, defined according to their average tick-constrained level. The elevation of tick-constrained levels through the trading session (**Exhibit 2c**) drives the market volume and quote activity to inverted exchanges.

- Comparing the three stock groups, we can identify the same cross-sectional trend: the more tick-constrained a stock is, the greater the access of inverted exchanges.
- The intraday usage of inverted exchanges is highly variable.
- For example, the market share of BATS-Y in the moderately constrained group starts at ~2% after open and ends at ~7% before close. Similarly, the percentage time at NBBO triples from ~20% to ~60%.
- These trends appear highly consistent for all three stock groups presented in **Exhibit 5**.



## Understanding Venue Dynamics

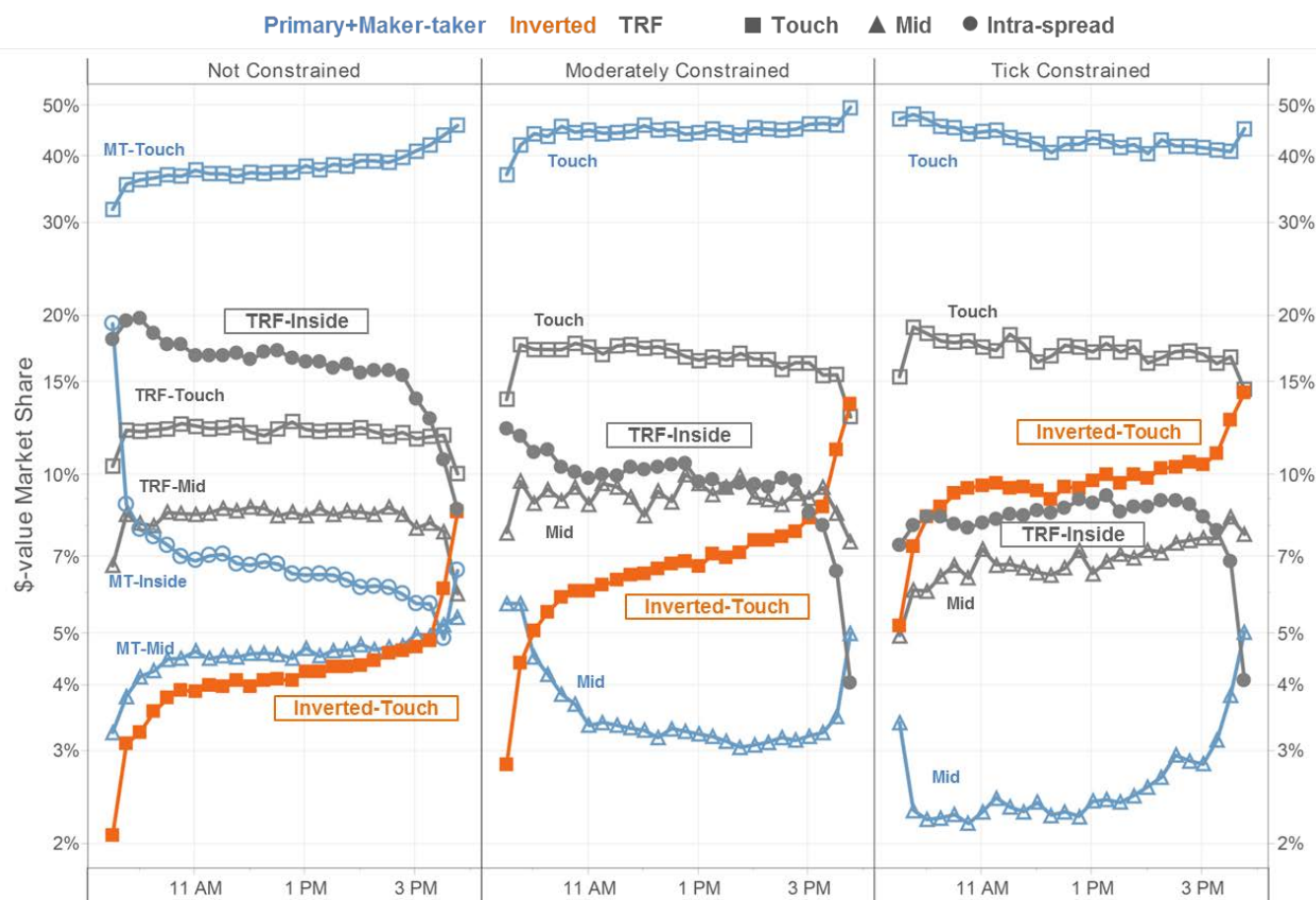


**Exhibit 5:** Market share and percentage of time at NBBO of inverted exchanges vary considerably during the day. Data shown is from the 300 NASDAQ-listed securities with the largest daily dollar trading value from December 2016 - February 2017.

Source: Instinet



## Understanding Venue Dynamics



**Exhibit 6:** Shows a breakdown of market volume by the venue type and the price point with respect to the outstanding NBBO. The line color represents the venue type; the marker shape represents the price point. We've excluded data for price points with an average market share of less than 2%. Data shown is from the 300 NASDAQ-listed securities with the largest daily dollar trading value from December 2016 - February 2017.

Source: Instinet

### Inverted Exchange: Activity Surges Near Close

Our last observation presented in **Exhibit 6** is a breakdown of market share by venue fee/rebate model, as well as by trade price with respect to the outstanding NBBO. The migration of volume across venues and price points reveals that venue choice and order submission tactics do change dynamically in response to the highly variable trading environment during the day.

Below is a summary of our key findings for three characteristic time periods during the day. For simplicity, the descriptions are based on the moderately tick-constrained group, but the overall trends are equally applicable to other stock groups presented in **Exhibit 5 and 6**.



## Understanding Venue Dynamics

- **Open (Market open to ~10:30)**

As shown in **Exhibit 5**, market share of inverted exchanges is the lowest after the open but quickly rises to ~6% in the first hour. High volatility, wide spreads, thin queues and high quote turnover lead to comparatively fewer incentives for using inverted exchanges. In contrast, off-exchange trading has relatively high market share.

- **Mid-day (~10:30 to ~15:00)**

As volatility and spread continue to decrease, inverted exchanges gain traction. Their volume market share and percentage time at NBBO gradually and consistently rise during this period. The collective market share increases from ~6% to ~8% (**Exhibit 5**). As shown in **Exhibit 6**, most of the inflow goes to at-the-touch trading and comes from the competing price point: intra-spread trading at off-exchange venues.

- **Close (~15:00 to Market close)**

Activity at inverted exchange surges in the last hour. Their collective market share almost doubles, accompanied by a similarly steep uptick in the percentage time at NBBO (**Exhibit 5**). The surge in inverted exchange activity is due to two factors: an increasing tick-constrained level (narrowing of spread) in the market, and the shift in trading from dark to lit.

As the at-the-touch volume of inverted exchanges increases significantly towards the close, the intra-spread volume at off-exchange venues plummets, accompanied by a slight volume increase at NASDAQ. As participants eager to complete their trading in time shift their trading toward liquidity taking and out of dark venues, it is clearly indicated that they prefer destinations with either an extra incentive for taking (inverted exchanges) or abundant liquidity (primary exchange).

### Venue Choice Boils Down to Controlling Aggressiveness

We observe variation of inverted exchange activity, both across stocks and time, in a way that is qualitatively consistent with the economic incentives these synthetic price levels represent, as shown in **Exhibit 3**. In this sense, a large part of venue selection for a limit order (maker-taker, inverted or ATS) boils down to choosing the right aggressiveness for the current trading environment and urgency for completion.

Based on the findings discussed above, we believe a trader or algorithm should consider the following when posting limit orders on an inverted exchange vs a maker-taker exchange:

- The general rule is that the comparative aggressiveness effectively gives the opportunity to queue jump, and the trader is likely rewarded with faster fills.
- This effect is more pronounced for lower-priced stocks and when stocks are tick-constrained.
- Therefore, in addition to various trading/quoting statistics per venue, a trader would benefit from real-time measurement of stocks' tick-constrained levels. If such measurements are not available, however, they can rely on intraday patterns, such as those presented in **Exhibit 5 and 6**.





## Understanding Venue Dynamics

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- For example, a trader would not benefit from posting on an inverted exchange in a particularly volatile period (e.g., after open), even for stocks that are tick-constrained in other times.
- On the other hand, it is generally more beneficial to post on an inverted exchange later in the day. The spread is narrower and quote length is longer, and therefore, a trader would likely be able to take advantage of queue jumping and achieve faster executions.
- Posting on an inverted exchange is particularly advantageous during the last hour. Liquidity coming out of dark venues near the end of day turns to aggressive liquidity taking at inverted exchanges, as seen in **Exhibit 6**, increasing quote turnover at these exchanges disproportionately.

### Conclusion and Application in Trading Algorithms

As described in this article, market shares of U.S. exchanges and dark venues are anything but stable. The relative volume allocation keeps changing minute by minute during the trading session in response to the varied trading environment. Exchanges' presence at the NBBO also changes significantly. In this article, we discussed that two market microstructure variables – tick size and access fee/rebate – set traders' incentive for choosing certain venues, and that venue usage is strongly driven by the combination of the urgency and the *tick-constrained* level – a proxy for the intensity of competition for liquidity provision.

It is clear that traders and algorithmic strategies should factor in these findings when determining venue selection strategies. It is important to know the stylized profiles of intraday venue usage and allocate orders accordingly. This is arguably as essential as knowing the overall volume profiles and aggregate market shares of the venues to which you are routing orders. **A trader or algorithm should track the stock's tick-constrained levels on a real-time basis: the combination of bid-ask spread, queue length and quote turnover, as well as the activity at inverted exchanges for each side of the spread.**

For more information on this subject, or for questions about Instinet's electronic trading capabilities, please contact your regional Instinet representative or [Informed.Trading@Instinet.com](mailto:Informed.Trading@Instinet.com).



## Understanding Venue Dynamics

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