Liquid Markets Analytics

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# Exchange Pricing Models and Optimal Venue Selection

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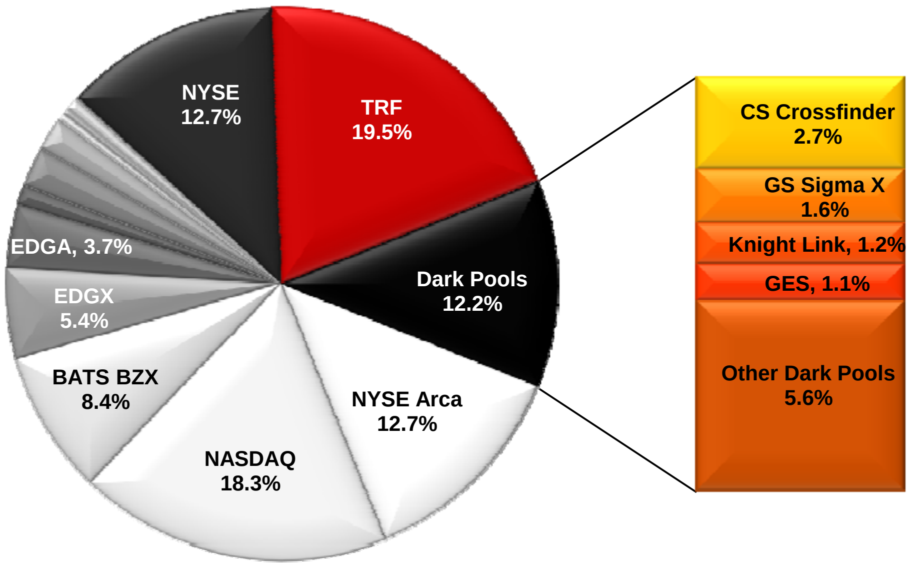
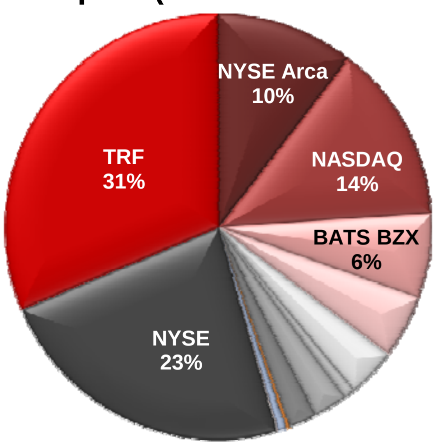
# US Liquidity Landscape

- The US equity market has more than 13 venues with varying pricing structures and market share:

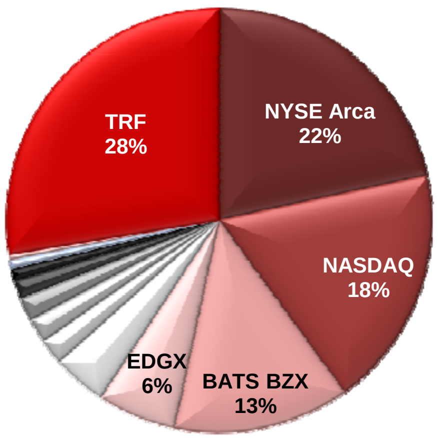



- The US market is also organized by tape, based on the primary exchange listing of the security

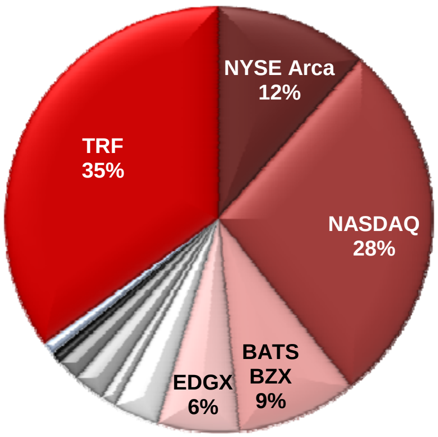
**Tape A (NYSE/Amex Listed)**




**Tape B (Arca Listed)**




**Tape C (NASDAQ Listed)**




*Sources: BATS, Rosenblatt*

# Pricing Models

| Lit Venue | Pricing Model | Provider (Mils) | Taker (Mils) |
|---|---|---|---|
| NYSE | Maker-taker | 15 | -23 |
| ARCA | Maker-taker | 29 | -30 |
| Nasdaq PSX | Maker-taker | 24 | -25 |
| Direct Edge X | Maker-taker | 26 | -30 |
| BATS | Maker-taker | 27 | -28 |
| NASDAQ | Maker-taker | 29 | -30 |
| Boston | Inverse Maker-taker | -18 | 14 |
| BATS-Y | Inverse Maker-taker | 0 | 3 |
| Direct Edge A | Inverse Maker-taker | -2.5 | 1.5 |

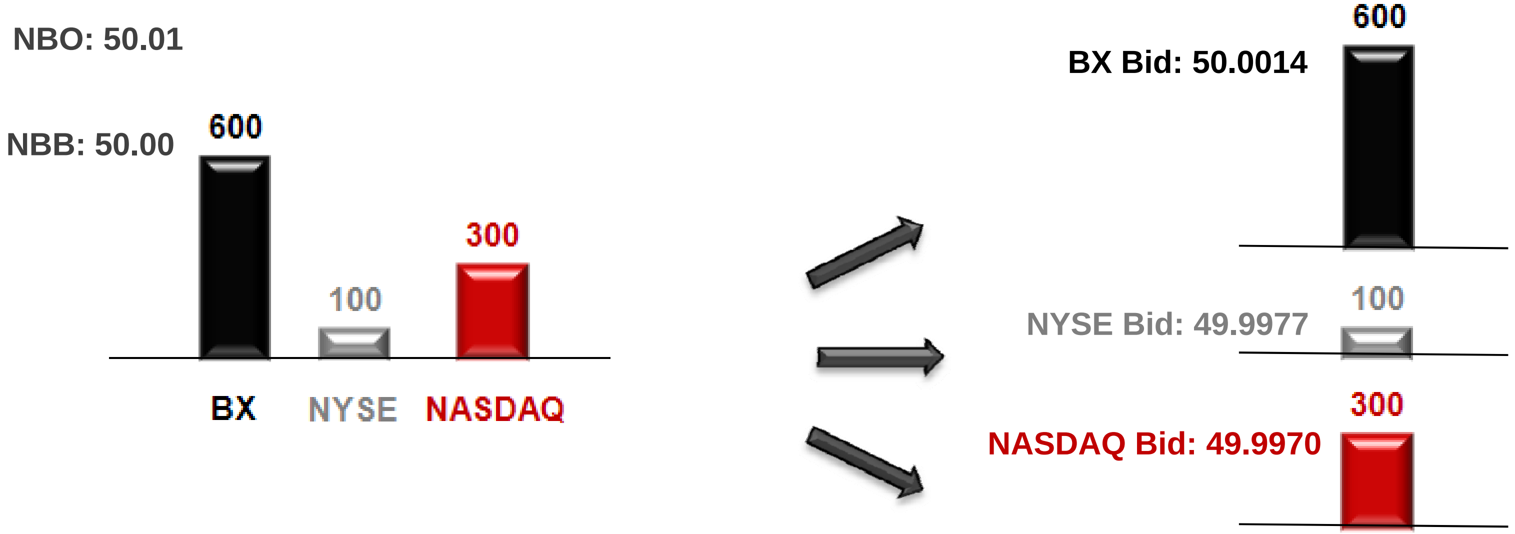
- Within **lit venues**, there are two primary pricing models:
  - **Maker-Taker:** Liquidity **providers** get **rebates**, liquidity **takers** are charged a **fee**
  - **Inverse Maker-Taker:** Liquidity **takers** get **rebates**, liquidity **providers** are charged a **fee**

- Within **dark venues**, pricing structures vary by the type of dark pool:
  - **Broker/Dealer Pools:** Negotiated through reciprocity, both sides pay a fee
  - **Enhanced Liquidity Provider (ELP) Pools:** Option for price Improvement or rebate
  - **Block Pools:** Tariff structure, usually much higher cost

*Positive entries represent a rebate. Negative entries represent a cost.*

# Inverse Pricing – Narrowing Spread

- Reg NMS prevents sub-penny spreads for dollar stocks; inverse pricing models effectively reduce this
  - For an aggressive Sell order for 800 shares of a security with liquidity present at NYSE, NASDAQ and BX, each at the NBB

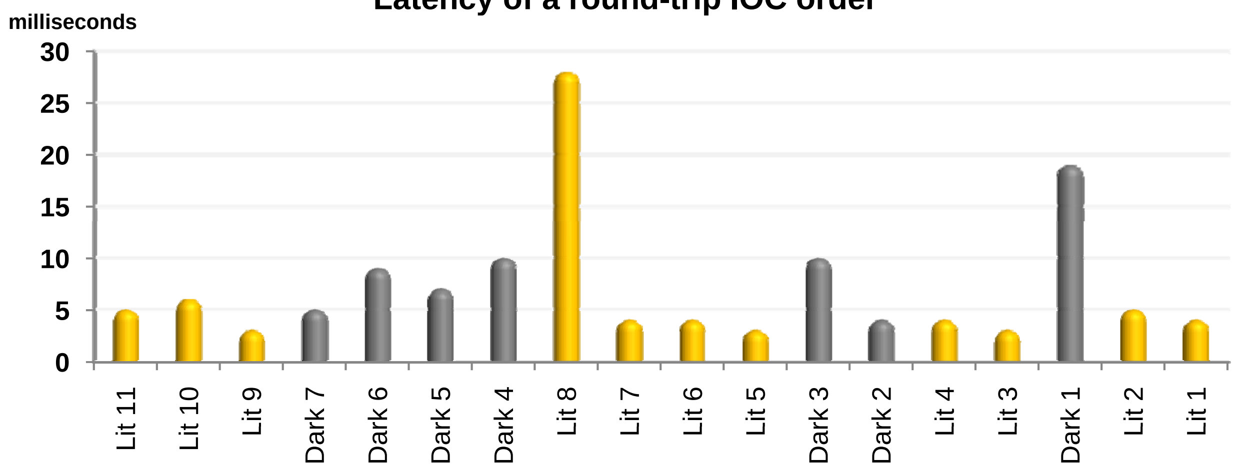



- Due to inverse pricing structure, **BX** is the **cheapest** venue, hence top priority for SOR
- Due to liquidity taker fees, **NASDAQ** is the most **expensive** venue, hence lowest priority for SOR
- Original penny spread is narrowed due to varying pricing models

# Smart Order Router Considerations

- In general, SOR routing logic relies on four major factors:
  - **Liquidity:** Includes available published liquidity, hidden liquidity as well as venue latency
  - **Costs/Rebates:** Pricing structures across lit and dark venues affect aggressive and passive orders differently
  - **Latency:**
    - Significant variation among venues when measured
    - Quantitative measures of venue latency include quote lifetimes and quote update frequencies

**Latency of a round-trip IOC order**



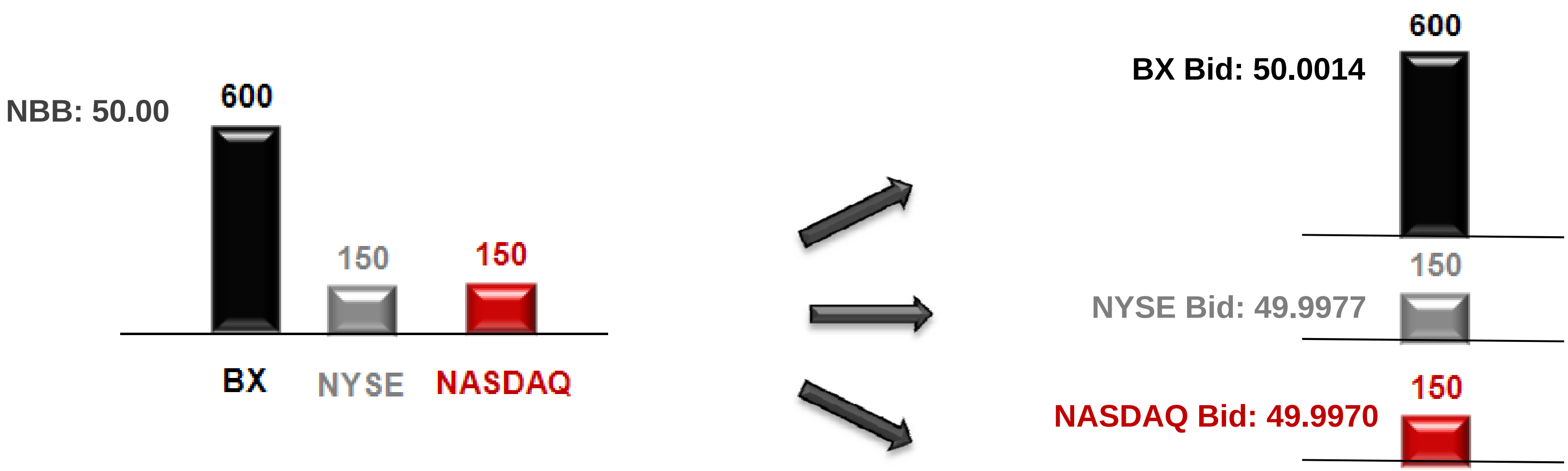

  - **Performance/Toxicity:**
    - Passive orders: Venue toxicity/adverse selection is measured as price reversion post-execution

# Smart Order Routing: Aggressive Orders

***OBJECTIVE: Maximize fill rate, minimize cost***

- **Liquidity:** Displayed liquidity is adjusted for venue latency and hidden liquidity estimation


- **Exchange Costs:** For liquidity available on multiple venues, costs/rebates decide routing logic



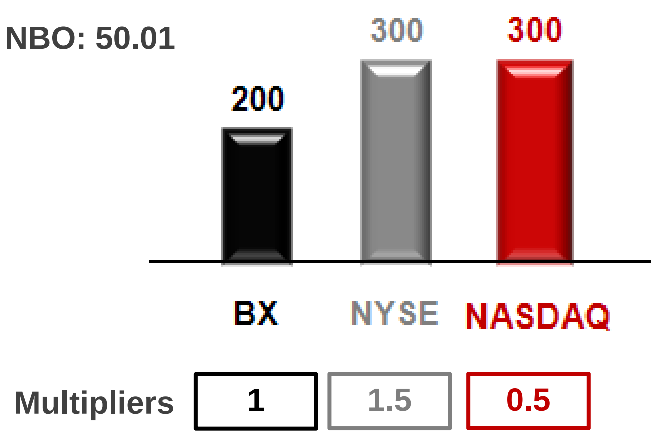
# Smart Order Routing: Passive Orders

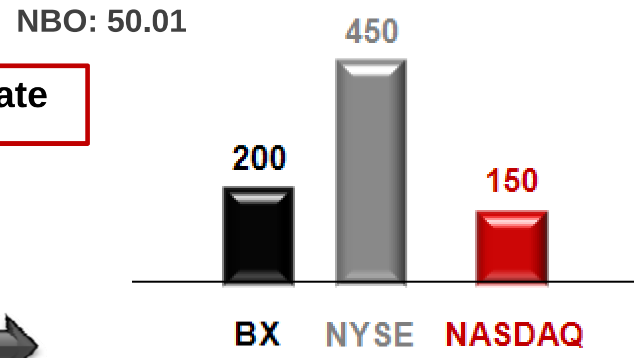
***OBJECTIVE: Maximize fill rate, minimize cost***

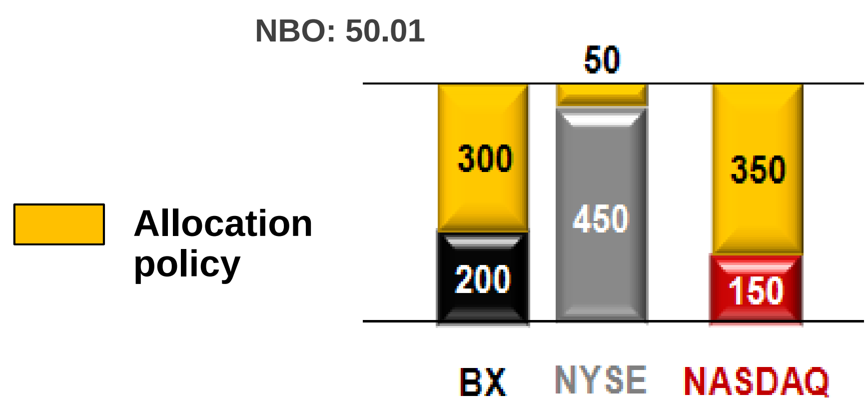
- **Liquidity:** Displayed queues are adjusted by multipliers, which are a function of:
  - **Queue Length:** Shorter queue lengths are preferable
  - **Trading Rate:** Higher trade rates are preferable
  - **Exchange Costs:** Maker-taker venues are preferable

**Multiplier = Queue length x Cost / Trading rate**

**For a 700 share passive order:**



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# Characteristics of Venue Liquidity

| Venue | Avg. % of NBBO | Max. % of NBBO | % Time Outside NBBO | % Market Share | Pricing Model |
|---|---|---|---|---|---|
| NYSE | 28% | 100% | 13% | 28% | Normal |
| ARCA | 19% | 77% | 18% | 17% | Normal |
| Nasdaq PSX | 2% | 16% | 60% | 2% | Normal (price-size) |
| Direct Edge X | 6% | 44% | 40% | 8% | Normal |
| BATS | 12% | 50% | 25% | 13% | Normal |
| NASDAQ | 24% | 89% | 13% | 21% | Normal |
| Boston | 1% | 8% | 63% | 2% | Inverse |
| BATS-Y | 1% | 7% | 72% | 2% | Inverse |
| Direct Edge A | 4% | 25% | 49% | 5% | Inverse |

- **Proportion of the NBBO Size:**
  - *Inverse maker-taker exchanges typically represent a small portion of the total NBBO volume*
- **Probability of Being Outside NBBO:**
  - *Inverse maker-taker exchanges have a higher probability of being outside the NBBO*
- **Provision of Unique Liquidity**
  - Maximum contribution to total NBBO liquidity per venue
  - For example, the max. contribution of BATS-Y to total NBBO liquidity in the Feb. 2011 in any S&P 500 symbol was only 7.13%
  - ***Inverse maker-taker exchanges rarely provide unique liquidity to the market***

*Venue analytics are generated for the month of February 2011 for members of the S&P 500 index*

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# Venue Quote Dynamics

| Quote Turnover | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Price Band | NYSE | ARCA | PSX | Edge X | BATS | NASDAQ | Boston | BATS-Y | Edge A |
| < $10 | 3.9 | 0.7 | 5.0 | 1.5 | 0.5 | 1.0 | 16.7 | 5.8 | 8.8 |
| $10 - $40 | 1.4 | 0.9 | 5.5 | 1.1 | 0.8 | 1.0 | 2.2 | 1.9 | 2.0 |
| > $40 | 1.5 | 1.0 | 0.7 | 0.5 | 0.6 | 1.0 | 0.3 | 0.4 | 0.9 |

| Market Share | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Price Band | NYSE | ARCA | PSX | Edge X | BATS | NASDAQ | Boston | BATS-Y | Edge A |
| < $10 | 25.7% | 18.7% | 1.4% | 12.9% | 16.6% | 34.5% | 3.9% | 4.2% | 9.0% |
| $10 - $40 | 17.3% | 11.5% | 0.7% | 4.4% | 8.0% | 21.1% | 1.5% | 1.8% | 3.7% |
| > $40 | 16.3% | 16.2% | 0.6% | 5.1% | 9.7% | 20.6% | 0.9% | 1.1% | 2.8% |

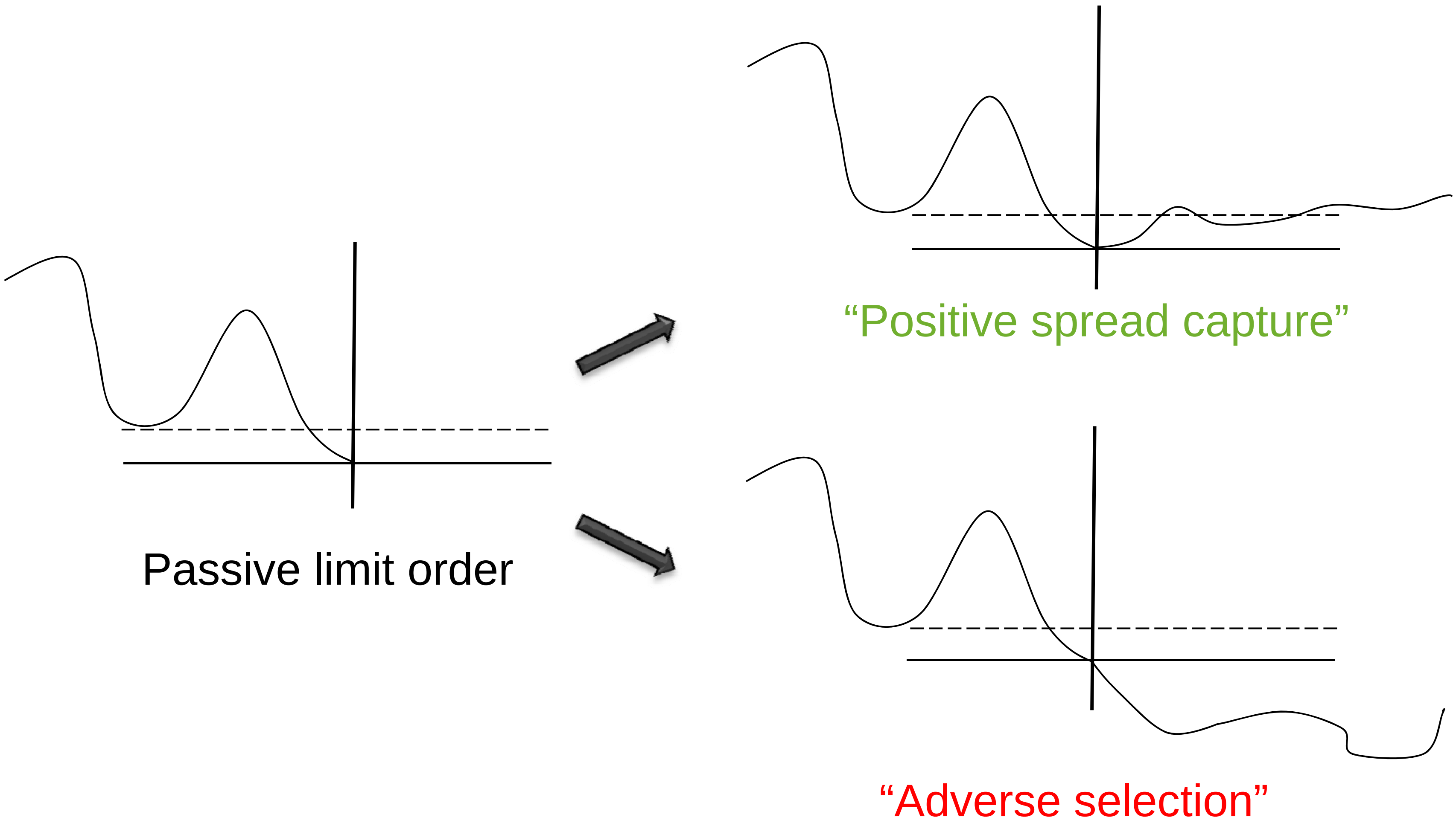
| % of Time Spent at NBBO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Price Band | NYSE | ARCA | PSX | Edge X | BATS | NASDAQ | Boston | BATS-Y | Edge A |
| < $10 | 25.7% | 18.7% | 1.4% | 12.9% | 16.6% | 34.5% | 3.9% | 4.2% | 9.0% |
| $10 - $40 | 17.3% | 11.5% | 0.7% | 4.4% | 8.0% | 21.1% | 1.5% | 1.8% | 3.7% |
| > $40 | 16.3% | 16.2% | 0.6% | 5.1% | 9.7% | 20.6% | 0.9% | 1.1% | 2.8% |

- Quote turnover: Number of times a quote is fully filled, canceled (Base: NASDAQ)
- Lower-priced stocks have larger turnover, more pronounced in the inverse maker-taker venues
- Inverse maker-taker exchanges are less likely to be at the NBBO
- Inverse maker-taker venues have a higher market share in low priced stocks
- Profitability of taking rebates (in basis points) on low-price stocks is far greater than in higher priced stocks which may explain the bias towards low priced stocks in inverse price exchanges



*Venue analytics are generated on February 2011 for members of the S&P 500 index*

# Measuring Adverse Selection



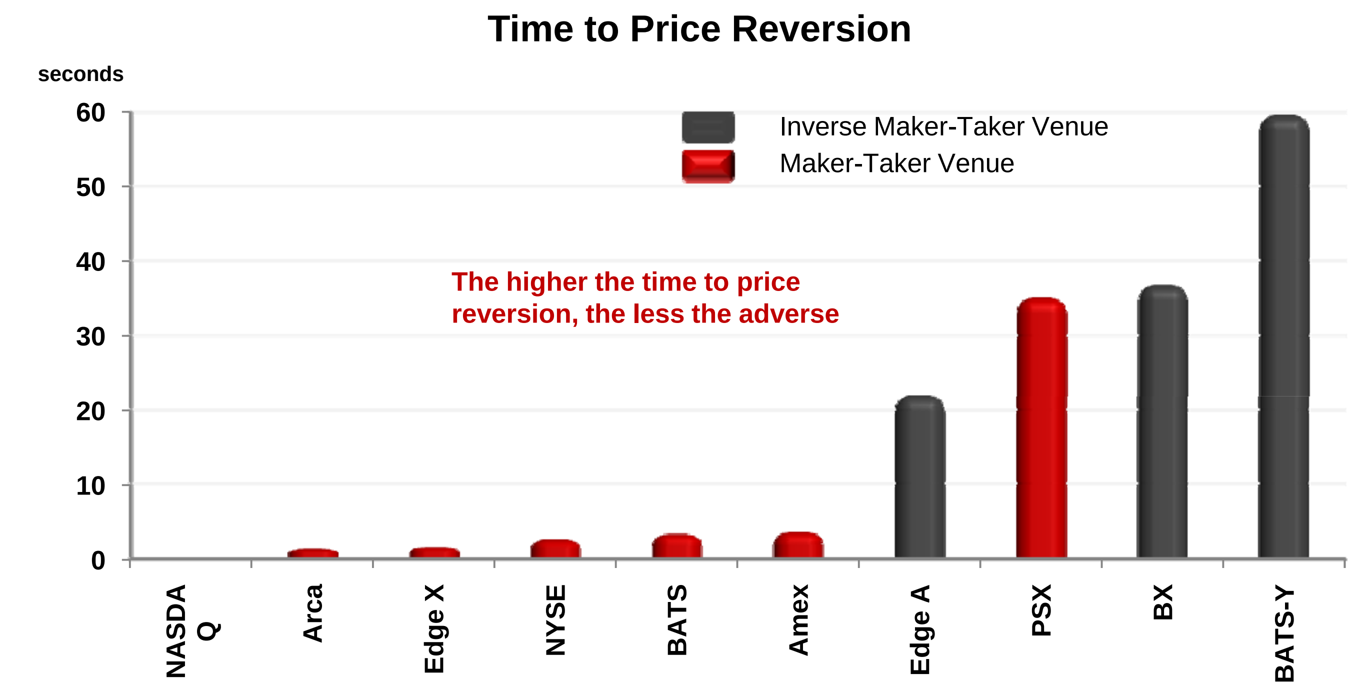
# Adverse Selection for Passive Orders

| Venue | Avg. Price | 5 Minute VWAP Slippage (bps) | Provider (Mils) | Taker (Mils) | Provider (Rebate + Price Reversion) (bps) |
|---|---|---|---|---|---|
| NYSE | 32.7 | -1.28 | 15 | -23 | -0.82 |
| ARCA | 36.5 | -1.08 | 29 | -30 | -0.29 |
| Edge X | 36.7 | -1.73 | 26 | -30 | -1.02 |
| BATS | 35.6 | -1.17 | 27 | -28 | -0.41 |
| NASDAQ | 39.2 | -1.47 | 29 | -30 | -0.73 |
| Boston | 32.9 | 0.25 | -18 | 14 | -0.30 |
| BATS-Y | 24.2 | -0.15 | 0 | 3 | -0.15 |
| Edge A | 26.1 | -0.37 | -2.5 | 1.5 | -0.47 |

- Exchanges differ in terms of explicit as well as implicit costs
- Implicit adverse selection costs for passive fills are measured as the price reversion or slippage against the 5-minute VWAP following the trade
- Cheaper-to-take venues (Boston, Edge A, BATS-Y) have smaller adverse selection for passive fills
- Expensive-to-take venues (NASDAQ, ARCA, Edge X) have larger adverse selection for passive fills
- Adjusting for rebate/fee for providing liquidity, the difference between venues is much smaller

*Venue analytics are generated for the month of February 2011 for members of the S&P 500 index*

# Adverse Selection: Time to Reversal




- Liquidity taking strategies trade in cheap venues first, expensive venue last
- Whenever a trade happens on a cheap venue, the price is less likely to move because the liquidity in more expensive venue provides support
- By the time a trade happens on an expensive venue, liquidity at the cheaper venues is already exhausted, and the price is likely to move adversely
- Based on the overall objective, a provider may post in cheap-to-take venues to maximize their fill rate, or post in expensive-to-take venue to capture more rebates

*Venue analytics are generated for the month of February 2011 for members of the S&P 500 index*

# Trade-offs

- **Inverse pricing venues**:
  - **Expensive to provide liquidity, cheap to take → "paying a premium for queue priority"**
  - **High degree of competition for aggressive flow → high quote turnover**
  - **Low degree of competition for passive flow → "need conviction that price is right"**
  - **High degree of provider interest in low price "wide spread" stocks**
  - **First in the queue, gets first look but very little time to get out the way**

- **Regular pricing venues**:
  - **Expensive to take liquidity, cheap to provide → "paid a premium to compensate for adverse selection"**
  - **High degree of competition for passive flow → high quote update frequency**
  - **Lower degree of competition for aggressive flow → "need conviction to cross the spread"**
  - **Low latency platform is essential for managing queue priority and adverse selection**
  - **Last in the queue, can observe activity in queue ahead but has opportunity cost of not being filled**



*Venue analytics are generated for the month of February 2011 for members of the S&P 500 index*

# Implications for Optimal Venue Selection

- **Passive Orders**:
  - **Utilize alpha signals:** High-frequency alpha signals can be utilized to indentify opportune times to provide liquidity, i.e. cash flow, order-book pressure
  - **Maximization of fill rate:** Allocate and dynamically rebalance limit orders based on ratio of queue size to trading rate
  - **Adverse Selection:** Monitor adverse selection of venues can preference according to objectives
  - **Explicit Costs:** Utilize explicit costs as a factor in the limit order placement strategy

- **Aggressive Orders**:
  - **Utilize alpha signals:** Venue selection conditional on "aggressiveness" and size of the order
  - **Estimation of Dark Pool Liquidity:** Maximize hit rate, reduce inadvertent signaling and minimize latency
  - **Pinging:** Simultaneous access to all available liquidity in lit and dark pools
  - **Explicit Costs:** Utilize explicit costs as a factor in venue selection

# Questions?

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