MARKET CONFLICTS & MARKET QUALITY
The Influence of Incentives on Best Execution

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July 11, 2017
AGENDA

1. Market structure today
2. Brokers’ duty of best execution
3. Conflicts in broker routing algos
4. Introduction to execution quality white paper
5. Trading performance
6. Price improvement
7. Queue sizes & length of lines to trade
8. Market stability
9. Cheat sheet to evaluate brokers
EQUITY TRADING: IMAGE VERSUS REALITY

PERCEPTION

Wall Street

REALITY

Mahwah, NJ

Times Square

Carteret, NJ

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Every second 1,000 equity trades are occurring; at this speed and frequency the onus is increasingly on fund managers to take control of their order flow and hold their broker dealers accountable.

Source: KCG “100 Years of Market Structure Improvement”.
This presentation will arm you with basic questions any responsible fund manager can ask their brokers to ensure they are fulfilling their best execution obligation given modern market complexity.
HOW EXCHANGES CHARGE FOR TRADING HAS EXACERBATED COMPLEXITY

Providing Liquidity: posting an order that is eventually executed; you are the liquidity “maker” or “adder”

Removing Liquidity: interacting with a posted order; you are the liquidity “taker” or “remover”

Exchange Fee Schedule

(mils, Top Tier, Tape A, $1+ Share Price, displayed)

<table>
<thead>
<tr>
<th>Exchange</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYSE Arca</td>
<td>9.6</td>
</tr>
<tr>
<td>NASDAQ BX</td>
<td>2.7</td>
</tr>
<tr>
<td>BATS BYX Exchange</td>
<td>4.4</td>
</tr>
<tr>
<td>BATS BZX Exchange</td>
<td>6.0</td>
</tr>
<tr>
<td>Chicago Stock Exchange</td>
<td>0.4</td>
</tr>
<tr>
<td>(CHX)</td>
<td></td>
</tr>
<tr>
<td>BATS EDGA Exchange</td>
<td>2.3</td>
</tr>
<tr>
<td>BATS EDGX Exchange</td>
<td>6.5</td>
</tr>
<tr>
<td>Investors Exchange (IEX)</td>
<td>2.0</td>
</tr>
<tr>
<td>NYSE MKT</td>
<td>0.2</td>
</tr>
<tr>
<td>Nasdaq Stock Market (NSDQ)</td>
<td>14.0</td>
</tr>
<tr>
<td>National Stock Exchange (NSX)</td>
<td>0.0</td>
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<tr>
<td>New York Stock Exchange (NYSE)</td>
<td>12.9</td>
</tr>
<tr>
<td>NASDAQ PSX</td>
<td>0.9</td>
</tr>
</tbody>
</table>
ABOUT IEX

IEX was created as a market that is faster than its fastest participant

Oct 2013
IEX launches as a dark pool

Sep 2015
Beginning of exchange application process

Aug-Sep 2016
IEX launches as the newest U.S. stock exchange

Apr 2014
Flash Boys is published, bringing public awareness to the problems caused by predatory high-frequency trading strategies

June 2016
SEC approves IEX’s exchange application
BROKERS’ DUTY OF BEST EXECUTION

PART I

• **Investor protection** - Best execution of customer orders is a key investor protection requirement. Brokers are legally required to seek the best execution available for their customers’ orders. This requirement is set forth in SEC guidance and in FINRA rules.

• **Agency duty of loyalty** - A broker-dealer’s obligation to obtain best execution of a customer's order in any security is based, in part, on the common law agency duty of loyalty, which obligates an agent to act exclusively in the principal's best interest, and also has been incorporated explicitly in FINRA rules.

• **Duty to exercise reasonable care** - As such, any broker-dealer, when acting as agent on behalf of a customer in a transaction, is under a duty to exercise reasonable care to obtain the most advantageous terms for the customer. In addition, best execution duties also arise when a broker-dealer is trading in a principal capacity with a customer.

• **Regular review required** - FINRA has stated that in light of the increasingly automated nature of the equities, options and fixed income markets, firms need to regularly review their systems and procedures relating to obtaining best execution for their customers’ orders.

*When serving fund clients, brokers are required under FINRA rules and common law to act exclusively in the fund’s best interests*
BROKERS’ DUTY OF BEST EXECUTION

PART II

- **As markets evolve, brokers must analyze several factors** - The SEC has recognized that the scope of the duty of best execution must evolve as changes occur in the market that give rise to improved executions for customer orders. The SEC has articulated a non-exhaustive list of factors that firms should consider as part of their best execution analysis as markets evolve:

  1) the size of the order;
  2) the trading characteristics of the security involved;
  3) the availability of accurate information affecting choices as to the most favorable market center for execution and the availability of technological aids to process such information; and
  4) the cost and difficulty associated with achieving an execution in a particular market center.

- **Need to consider different markets for different types of orders or securities** - The SEC also has stated that the best execution analysis may evolve due to changes in the market that give rise to improved executions, including the opportunity to trade at more advantageous prices. If different markets may be more suitable for different types of orders or particular securities, the broker-dealer will also need to consider such factors.

-Brokers have to adapt their tools and methodology to account for new market innovations and trading behaviors-
CASE STUDY: CONFLICTED ORDER ROUTING

A broker may preference its own “dark pool” over other sources of liquidity, which can lead to poor venue-level performance and inferior execution quality for buy-side investors.

- After 3,100 shares were executed on Venue A, there were 19 routes to other venues before the broker returned to Venue A.
- 7 of these were to the algo provider’s own venue, resulting in only 100 shares executed.
- Broker accesses its own pool often despite limited fills.
- Venue A generally gets less than 5% of routes while providing over 20% of fills.
- This is the opposite of how a liquidity-seeking algo should behave.

ANOTHER CHALLENGE: THERE IS NO STANDARD TO EVALUATE BEST EXECUTION

We compare execution quality of existing US stock exchanges (NYSE, NASDAQ, BATS) vs IEX

- Used publicly available data
- Published the methodology used for our analyses
- Promotes independent validation of our results
DIMENSIONS OF EXECUTION QUALITY

Rather than offering a prescriptive definition of what execution quality means, we studied market quality across four different dimensions.

Liquidity
- Increase natural investor interaction
- Avoid unnecessary interaction with intermediaries

Execution Costs
- Provide better prices than National Best Bid and Offer

Price Discovery
- Contribution to the National Best Bid and Offer quotation

Market Stability
- Avoid immediate buyer’s / seller’s remorse
TRADING PERFORMANCE

One of our primary measures of execution costs is trade markouts, which capture the potential profitability of an execution assuming it is closed out at some price some time after the trade.

- **What is a markout?**
  - Measure of potential profitability
  - If you opened a position at time=$t_0$ and price=$p_0$, then closed your position at time=$t_1$ and price=$p_1$, how much money did you make / lose?
  - More positive markouts indicate higher potential profit
  - More negative markouts reflect the presence of adverse selection

- **Methodology**
  - Isolate executions occurring at the NBBO
  - Compute from the perspective of the resting order, and assume that the adder is the buyer for all trades at the NBB and the seller for all trades at the NBO
  - Measured trade-to-mid, expressed in mils/share, weighted by volume
IMPACT OF MAKER-TAKER ON MARKOUTS

Until recently, there was no exchange offering an alternative to the maker-taker pricing system.

PNL at 1 Minute

<table>
<thead>
<tr>
<th>Venue</th>
<th>PNL at 1 Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCA</td>
<td>-57,886,675</td>
</tr>
<tr>
<td>BZX</td>
<td>-38,759,215</td>
</tr>
<tr>
<td>EDGX</td>
<td>-52,541,420</td>
</tr>
<tr>
<td>NSDQ</td>
<td>-109,639,454</td>
</tr>
<tr>
<td>NYSE</td>
<td>-68,521,543</td>
</tr>
<tr>
<td>Q2</td>
<td>-327,348,307</td>
</tr>
<tr>
<td>Annualized</td>
<td>-1,309,393,230</td>
</tr>
</tbody>
</table>

**Trade Markouts: Q2 2017, IEX vs. Maker-Taker Venues**

(Adder’s perspective, executions at NBBO, trade-to-mid, mils/share, non-locked/crossed markets)

PNL is calculated by the net loss of the 1-minute markouts (vs. 0), multiplied by shares traded, and annualizing over 4 quarters.

Source: Daily Trade and Quote Data for all NMS Securities (“TAQ”)

**Buyer’s / seller’s remorse is more likely to occur when trading on the exchanges that pay maker-taker rebates versus those that don’t**
2 KEY NUANCES

1. Execution costs are typically absorbed by brokers rather than the end investor
   - Brokers have a clear economic incentive to route passive order flow to traditional maker-taker exchanges
   - In those circumstances, worse execution quality is borne by the investor, but the economic benefit belongs to the broker

2. Markouts across exchanges do not fully converge over time
   - Rebates, even if passed on to the customer, may not provide adequate compensation for the inferior execution quality they create
PRICE IMPROVEMENT

Price improvement is defined as receiving a fill at a price better than what is currently quoted.

Table 5: Price improvement metrics by exchange. IEX router volume is the total volume routed and executed at each venue by the IEX order router. PI% is the percentage of volume receiving positive price improvement. PI is the total price improvement obtained, summed over all price-improved executions, in mils per share. Average PI is the expected price improvement per trade in mils per share, computed as the likelihood of price improvement (PI%) multiplied by the total price improvement obtained (PI).

<table>
<thead>
<tr>
<th>Exchange</th>
<th>IEX Router Volume</th>
<th>PI%</th>
<th>PI (mils/share)</th>
<th>Avg. PI (mils/share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARCA</td>
<td>402,400,350</td>
<td>4.9</td>
<td>117</td>
<td>5.8</td>
</tr>
<tr>
<td>BX</td>
<td>80,081,908</td>
<td>7.1</td>
<td>134</td>
<td>9.5</td>
</tr>
<tr>
<td>BYX</td>
<td>154,481,515</td>
<td>6.1</td>
<td>172</td>
<td>10.4</td>
</tr>
<tr>
<td>BZX</td>
<td>148,110,990</td>
<td>6.6</td>
<td>114</td>
<td>7.5</td>
</tr>
<tr>
<td>EDGA</td>
<td>26,336,597</td>
<td>5.6</td>
<td>140</td>
<td>7.8</td>
</tr>
<tr>
<td>EDGX</td>
<td>212,111,276</td>
<td>4.1</td>
<td>118</td>
<td>4.8</td>
</tr>
<tr>
<td>IEX</td>
<td>281,051,416</td>
<td>10.9</td>
<td>169</td>
<td>18.4</td>
</tr>
<tr>
<td>NSDQ</td>
<td>461,282,320</td>
<td>6.4</td>
<td>151</td>
<td>9.7</td>
</tr>
<tr>
<td>NYSE</td>
<td>579,631,179</td>
<td>4.7</td>
<td>103</td>
<td>4.9</td>
</tr>
<tr>
<td>PSX</td>
<td>29,169,849</td>
<td>4.4</td>
<td>88</td>
<td>3.9</td>
</tr>
</tbody>
</table>

*We note that orders that the IEX router sends to the IEX order book also traverse the POP. Despite the incurred 350-microsecond delay, the fill rate for such orders exceeds 99%. Hence, it does not appear that the speed bump would adversely affect the likelihood of execution via the IEX router, or the price improvement statistic we report here.

Higher price improvement means greater savings compared to the quoted price at the time the order is submitted.
QUEUE SIZES & LENGTH OF LINES TO TRADE

The probability of trading depends in part on the length of the line, and the longer the line, the longer it takes for an order at the end of the line to trade.

All things being equal, we would expect traders to prefer to place orders on a venue with a short line to trade versus an exchange with a much longer line.

Due to the maker-taker system, fund orders are being placed at the back of long lines, lowering their probability of trading.
Considerations for a broker looking to display an order to buy at $10.00

<table>
<thead>
<tr>
<th>Time to Fill¹</th>
<th>Cost (mils per share)</th>
<th>Price (per share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest</td>
<td>-29</td>
<td>$10.00</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>$10.00</td>
</tr>
<tr>
<td>Lowest</td>
<td>17</td>
<td>$10.00</td>
</tr>
</tbody>
</table>

Considerations for a broker looking to access bids and sell at $10.00

<table>
<thead>
<tr>
<th>Price (per share)</th>
<th>Cost (mils per share)</th>
<th>Price Improvement Probability²</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10.00</td>
<td>30</td>
<td>6.4%</td>
</tr>
<tr>
<td>$10.00</td>
<td>0</td>
<td>10.9%</td>
</tr>
<tr>
<td>$10.00</td>
<td>-16</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

**Price improvement Metrics by Exchange**

<table>
<thead>
<tr>
<th>Exchange</th>
<th>IEX Router Volume</th>
<th>P1%</th>
<th>Avg. PI (mils/share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEX</td>
<td>280,075,405</td>
<td>10.9</td>
<td>18.4</td>
</tr>
<tr>
<td>BX</td>
<td>156,459,515</td>
<td>6.3</td>
<td>10.4</td>
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<tr>
<td>USDDQ</td>
<td>461,282,330</td>
<td>6.4</td>
<td>9.7</td>
</tr>
<tr>
<td>IEX</td>
<td>80,061,928</td>
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<td>9.6</td>
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<tr>
<td>EDGA</td>
<td>26,346,597</td>
<td>5.6</td>
<td>7.8</td>
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<td>BZX</td>
<td>148,103,990</td>
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<tr>
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<td>4.9</td>
<td>5.8</td>
</tr>
<tr>
<td>NYSE</td>
<td>579,631,579</td>
<td>4.7</td>
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<tr>
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</tr>
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 MAKER-TAKER PRICING INCENTIVIZES BROKERS TO SEND ORDERS TO VENUES WITH LOWER LIKELIHOOD OF TRADING AND LESS PRICE IMPROVEMENT

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MARKET STABILITY

IEX provides more price stability around trades based on the lowest percentage of midpoint volume occurring during an “unstable NBBO”

Other stock exchanges cater to high frequency trading market participants who want to trade when they know or anticipate that the stock is moving in a particular direction.

Market participants tend to only go to maker-taker exchanges when they need to capture all displayed liquidity, leading to a less stable trading environment on those venues.
Despite lower price improvement, greater market instability, and longer lines to trade, orders are still primarily going to the largest exchanges by market share.
WHAT DOES THIS ALL MEAN?

We observe that disparities in market quality across exchanges are an outgrowth of access fees & rebates, which suggests that maker-taker and inverted pricing paradigms perpetuate economic incentives misaligned with the tenets of best execution.

**Maker-taker exchanges** pay rebates to add liquidity

- Become most desirable to resting orders
- Resting orders are directed to these exchanges, forming long queues
- Long queues are accessed as a “last resort” for orders needing to capture a significant portion of displayed liquidity
- Maker-taker exchanges participate in a greater portion of market moving trades

**Inverted exchanges** pay rebates to remove liquidity

- Become most desirable to aggressive orders
- Resting orders are less likely to go to these exchanges, so the queues are shorter
- Orders needing to remove liquidity access these exchanges first
- Inverted exchanges participate in a greater portion of non-market moving trades

**Market participants who route orders in pursuit of rebates are self-selecting into trading during situations when prices are more likely to move, subjecting themselves to greater adverse selection.**
A CHEAT SHEET FUNDS CAN USE TO EVALUATE THEIR BROKERS

1. What rebates do you get from my order flow?  
   What access fees do you pay in routing my order flow?

2. What are the markouts of my order flow, by exchange?

3. How much price improvement do my executions receive, by exchange?

4. What percentage of my fund’s orders are first routed to your firm’s dark pool, or to a wholesaler?

5. Who do I trade against in your firm’s dark pool?

6. How often do I trade immediately before a better price (e.g., within 5 milliseconds)?

7. What percentage of all on-exchange shares traded for my fund result in you receiving a rebate?
APPENDIX: BROKERS’ DUTY OF BEST EXECUTION
FINRA RULES

• Broker-dealers that are FINRA members also have best execution obligations pursuant to FINRA Rule 5310. **FINRA Rule 5310(a)(1)** sets forth the factors to be considered by a broker-dealer in meeting its best execution obligation.

• In any transaction for or with a customer or a customer of another broker-dealer, a member and persons associated with a member shall use reasonable diligence to ascertain the best market for the subject security and buy or sell in such market so that the resultant price to the customer is as favorable as possible under prevailing market conditions. Among the **factors that will be considered in determining whether a member has used "reasonable diligence"** are:
  
  o  the character of the market for the security (e.g., price, volatility, relative liquidity, and pressure on available communications);
  
  o  the size and type of transaction;
  
  o  the number of markets checked;
  
  o  accessibility of the quotation; and
  
  o  the terms and conditions of the order which result in the transaction, as communicated to the member and persons associated with the member.

• In November 2015, FINRA issued guidance on best execution to remind firms of their obligations to provide best execution, reiterate best execution principles particularly relevant in automated markets and provide guidance on conducting regular and rigorous reviews.
SEC GUIDANCE

- To comply with this requirement, brokers evaluate the orders they receive from all customers in the aggregate and periodically assess which competing markets, market makers, or ECNs offer the most favorable terms of execution.
- Brokers must consider several factors when seeking best execution of customers’ orders, including the opportunity to get a better price than what is currently quoted, the speed of execution, and the likelihood that the trade will be executed.
  - e.g., Brokers are required to consider whether there is a trade-off between providing their customers’ orders with the possibility, but not the guarantee, of better prices and the extra time it may take to do so.