The Value of a Millisecond: Harnessing Information in Fast, Fragmented Markets

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WHAT IS A SPEEDBUMP?
WHY WOULD WE NEED ONE?
The language of modern capital markets

VISIT US AT TRADETECH TO SEE OUR SPECIAL GREAT OFFERS!

NEW FASTER ROUTES

152.5 ms
Shanghai
Aurora (CME)

35 ms
Frankfurt
Istanbul

165 ms
London
Hong Kong

161 ms
London
Johannesburg

108.5 ms
Mumbai
London

NEW FINANCIAL CLOUD
Special Offer
Fragmented Liquidity: Problem

- In modern markets liquidity is fragmented across venues
Quote Fade: Problem

- Liquidity supply is fragmented across venues
- Accessing this liquidity requires interacting with all venues
Liquidity “Fades” due to HFT

- HFT may be faster than regular traders
- Trader receives a fill on LSE, but orders are cancelled elsewhere
Consequences of Liquidity Fade

- Trader receives low fill rate
Consequences of Liquidity Fade

- Or trader is forced to pay more
- HFT can extract rents
Solution: Speedbump

- Trader can send order to IEX earlier, to ensure that both the LSE and IEX order arrive at the same time.
- This minimises opportunity for HFT to remove liquidity.
EXPERIMENT:
ALPHA SPEED BUMP IN CANADA
Not All Speed Bumps Are Created Equal...

• Relaunched on the 21\textsuperscript{st} of September 2015

• Speed bump, randomised between 1 and 3 milliseconds, for all orders except post only

• What are “post only” orders?
  – Limit orders unable to remove liquidity, i.e. opposite of “fill or kill”

• Inverted maker-taker pricing
  – Means Rebates are paid to those who “take” liquidity with market orders
  – Fees are charged to those who “supply” liquidity with limit orders
Comments from Industry

- **ITG Canada**
  - The new Alpha design ... will allow passive “post only” resting orders ... the ability to fade should they see trading on another venue.

- **TD Securities**
  - The introduction of speed bumps on both Alpha and Aequitas will slow down the operation of smart order routers, making it more difficult to access liquidity at depth and aggravating quote fade across all marketplaces.

- **Scotia Capital**
  - Often shares will be withdrawn from the market as soon as the order begins to execute (i.e. liquidity fade).
Methodology + Metrics

• Event study around Alpha’s market structure changes

\[ y_{i,d} = Post_{d} + Price_{i,d} + Turnover_{i,d} + Volatility_{i,d} + FE_{i} + e_{i,d} \]

• Standard market quality metrics
  – NBBO quoted spreads and depth
  – Effective spreads, realised spreads and adverse selection

• New market quality metrics
  – Depleted Orderbook: instantaneous adverse selection costs
  – Taking one level of the NBBO: “walking the book”
  – Quote Fade: inaccessibility of displayed quotes
IMPACT OF ALPHA’S SPEEDBUMP
Alpha Quote Fade Increases Dramatically

**Graph:**
- **X-axis:** Date (from 21SEP14 to 21SEP16)
- **Y-axis:** Quote Fade Percentage
- **Legend:**
  - Red: Alpha
  - Blue: Chi-X
  - Green: CX2
  - Brown: TSX

**Observation:**
- There is a noticeable increase in Alpha's quote fade percentage after a certain date, which is marked as Alpha Relaunch.
- The graph shows fluctuations in the quote fade percentage over time for different categories represented by different colors.
Rebates Attract Retail Liquidity Takers

Percentage of Active Trading

Date

21SEP14 21DEC14 21MAR15 21JUN15 21SEP15 21DEC15 21MAR16 21JUN16 21SEP16

Alpha Relaunch

Retail  Other  Anon
HFT Willing to Pay to Access Retail Flow
Smart order Routing (Alpha)

Significant **increase** in small orders which execute at only one venue
Significant **reduction** in large orders which execute across multiple venues
Significant **increase** in rewards for liquidity provision on Alpha

Slight **reduction** in rewards for liquidity provision on CX2
IMPACT ON THE CANADIAN EQUITIES TRADING LANDSCAPE
Transaction Cost Metrics

Other Markets

- Increase in market wide order flow toxicity
- Reduction in market wide liquidity provider profits
- Overall increase in Canadian transaction costs

<table>
<thead>
<tr>
<th></th>
<th>Effective Spread</th>
<th>Realized Spread</th>
<th>Adverse Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TSX</td>
<td>Chi-X</td>
<td>CX2</td>
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<tr>
<td>Post$_{d}$</td>
<td>0.24</td>
<td>0.29</td>
<td>0.13</td>
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<tr>
<td></td>
<td>(3.59)**</td>
<td>(3.50)**</td>
<td>(1.64)</td>
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<tr>
<td>Price$_{t,t}$</td>
<td>2.61</td>
<td>2.80</td>
<td>2.94</td>
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<tr>
<td></td>
<td>(3.18)**</td>
<td>(3.26)**</td>
<td>(3.19)**</td>
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<tr>
<td>Turnover$_{t,t}$</td>
<td>-0.52</td>
<td>-0.49</td>
<td>-0.49</td>
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<tr>
<td></td>
<td>(-7.39)**</td>
<td>(-8.54)**</td>
<td>(-7.25)**</td>
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<tr>
<td>Volatility$_{t,t}$</td>
<td>0.11</td>
<td>0.11</td>
<td>0.11</td>
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<tr>
<td></td>
<td>(6.18)**</td>
<td>(6.81)**</td>
<td>(7.49)**</td>
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<tr>
<td>Adjusted R$^2$</td>
<td>8.7%</td>
<td>6.2%</td>
<td>5.1%</td>
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<tr>
<td># Obs</td>
<td>21948</td>
<td>21939</td>
<td>21818</td>
</tr>
</tbody>
</table>
NBBO Liquidity Metrics for Canada

- Increase in overall quoted spreads
- Cost Canada approx $105m in the year since launch
- Decrease in overall order book resiliency

<table>
<thead>
<tr>
<th></th>
<th>Quoted Spread</th>
<th>Quoted Depth</th>
<th>Informed Percentage</th>
<th>Multi Take Ratio</th>
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<tbody>
<tr>
<td></td>
<td>Cents</td>
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<tr>
<td>Post$_d$</td>
<td>0.35</td>
<td>0.66</td>
<td>0.13</td>
<td>1.93</td>
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<tr>
<td></td>
<td>(4.05)***</td>
<td>(3.90)***</td>
<td>(8.98)***</td>
<td>(6.45)***</td>
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<tr>
<td>Price$_{i,d}$</td>
<td>3.15</td>
<td>85.56</td>
<td>0.33</td>
<td>11.51</td>
</tr>
<tr>
<td></td>
<td>(2.99)***</td>
<td>(32.01)***</td>
<td>(4.58)***</td>
<td>(8.38)***</td>
</tr>
<tr>
<td>Turnover$_{i,d}$</td>
<td>-0.96</td>
<td>-3.17</td>
<td>0.24</td>
<td>-4.74</td>
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<tr>
<td></td>
<td>(-9.57)***</td>
<td>(-14.13)***</td>
<td>(16.31)***</td>
<td>(-16.32)***</td>
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<tr>
<td>Volatility$_{i,d}$</td>
<td>0.13</td>
<td>0.43</td>
<td>-0.03</td>
<td>0.83</td>
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<tr>
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<td>(6.74)***</td>
<td>(14.29)***</td>
<td>(-17.61)***</td>
<td>(17.04)***</td>
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<tr>
<td>Adjusted $R^2$</td>
<td>10.6%</td>
<td>47.5%</td>
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<td>21,948</td>
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CONCLUSION
Implications

• Fairness of liquidity access
  – Randomised speed bumps are able to exclude active institutional flow
  – Is predominantly phantom liquidity on a lit trading venue acceptable?

• Increase in order flow toxicity across other trading venues
  – Higher adverse selection costs and wider effective spreads
  – Lower resiliency of consolidated liquidity at the NBBO

• Synthetic payment for order flow and regulatory arbitrage

• IEX’s registration as a National Securities Exchange has just been accepted by the SEC in the United States
  – Impact of discriminatory speed bump
  – Systematic latency advantages in the sub-millisecond environment
Questions?

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Trade Strings and Quote Fade

- For trade strings that displace entire NBB / NBO:
  \[ \text{Quote Fade} = 1 - \frac{\text{Traded Volume}}{\text{Starting Liquidity}} \]

- How much liquidity did I see which I couldn’t hit?
Avoid Multi-Venue Trade Strings if You Can!!!
Inverted Markets Comparison

• HFT are able to reduce adverse selection on Alpha – vs Chi-X 2
• Non-HFT suffer a detriment

<table>
<thead>
<tr>
<th></th>
<th>Adverse Selection</th>
<th>Realized Spread</th>
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<tr>
<td></td>
<td>HFT DMA</td>
<td>Anonymous</td>
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<tr>
<td>Alpha&lt;sub&gt;v&lt;/sub&gt;</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>-0.16</td>
<td>-0.50</td>
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<tr>
<td></td>
<td>(-5.62)**</td>
<td>(-8.90)**</td>
</tr>
<tr>
<td></td>
<td>0.93</td>
<td>1.17</td>
</tr>
<tr>
<td>Price&lt;sub&gt;i,d,v&lt;/sub&gt;</td>
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</tr>
<tr>
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<td>(6.15)**</td>
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<td>(3.79)**</td>
<td>(-8.49)**</td>
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<tr>
<td></td>
<td>0.04</td>
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</tr>
<tr>
<td></td>
<td>(9.25)**</td>
<td>(13.36)**</td>
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<tr>
<td>Adjusted R&lt;sup&gt;2&lt;/sup&gt;</td>
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<td></td>
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<tr>
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<td>46.2%</td>
<td>43.1%</td>
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<tr>
<td># Obs</td>
<td>21,235</td>
<td>18,124</td>
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