Do retail traders suffer from high frequency traders?

Katya Malinova, Andreas Park, Ryan Riordan

November 15, 2013
Millions in Milliseconds

- Monday, June 03, 2013: a “minor clock synchronization issue” causes “market-moving manufacturing data” be released to select traders 15 milliseconds prior to the scheduled 10am release.
- Nanex (trading data analysis firm) estimates:
  - $28 million worth of shares changed hands in 15 milliseconds
  - 30,000 shares of SPY traded in 1 of these milliseconds
  - (average SPY volume $= 5.6$ shares in a millisecond).
  - 369 stocks were traded
- How many milliseconds does it take a human to blink?
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- How many milliseconds does it take a human to blink?
  - 300 – 400 milliseconds!
The Rise of the Machines: Background

- How did the machines rise?
- What are the main concerns?
- What we do address?
Trading Under a Buttonwood Tree
1792 agreement created a club, later known as NYSE
A Trading Floor in the Early 20th Century
A Trading Floor in the 1980s and 1990s
A Trading Floor in the New Millennium
A Trading Floor in the New Millennium

This is now the exchange!
A Trading Floor in the New Millennium

These are the traders/the trader’s gateways.
How did the machines rise?

- Technological advances
- Multiple electronic venues alongside traditional exchanges
- Trading venues compete for trading volume (and are for-profit!)
  → need to offer attractive quotes
  → encourage algorithmic trading
- Really, really fast trading & trading decisions at speeds way beyond human reaction time
And Then There is BIG Data
HFT is contentious

- Uneven playing field?
- Systematic rent extraction?
- Incentives to collect/generate information?
- Price efficiency?
- Market stability?
What do we know about HFT/AT?

1. HFTs facilitate price efficiency
   • Brogaard, Hendershott, and Riordan (2013)

2. HFTs make money
   • Baron, Brogaard, Kirilenko (2012), Menkveld (2013)

3. Possible negative externalities
   • Ye, Yao, Gai (2013); Egginton, Van Ness, and Van Ness (2013)

4. HFTs are a heterogenous group
   • Hagström and Nordén (2013)

5. HFT/Quoting Activities/AT & liquidity
   • (-) Chakrabarty, Jain, Shkilko, Sokolov (2013)

This paper: The impact of “message-intensive” AT on intraday costs & returns: market-wide vs. retail and institutional investors.
A long run view

Message = trade, order, cancellation, or modification

HFT Messages and Bid–Ask Spread

Log HFT Messages  Bid–Ask Spread
Research question:
What is the impact of “message-intensive” trading?
Message = trade, order, modification, or cancellation

- Casual observation: Suggests that as messaging activity (presumably by HFT) increases, market conditions improve.
- Problem 1: Causality?
  - Do spreads go down because of HFT? Or vice versa?
  - Difficult to disentangle technological progress, trading venue competition, new order types, lower trading costs.
- Problem 2: Who benefits and how?
  - Can unsophisticated traders “catch” the low spread when quotes change at speeds beyond human reaction time?
  - Is there a disadvantage to using limit orders? These now earn lower spreads and are more expensive to monitor.
The IIROC message fee

Addressing problem 1: event ⇒ causality

The Investment Industry Regulatory Organization of Canada (IIROC) is a self-regulatory body for investment-dealers and trading activity in Canada. IIROC is funded by its members.

- IIROC charges dealers → customers (some)
- April 01, 2012, IIROC switched their billing from volume-based to trade-based and message-based.
- Per message fee is relative to a trader’s/dealer’s share of messages across all marketplaces.
- → fee is endogenous → market participants did not know the amount ex-ante (ex-post message fee is ≈ $0.00022; typical HFT msg is for 100 shares).
- Per message fee is difficult to estimate (many marketplaces; so-called registered traders were exempt).
- ⇒ Change “scared” those with high message traffic.
Granular Data

Addressing problem 2: Who benefits and how?

- Study traders with different levels of sophistication
  - retail
  - institutions
- Compute standard market quality measures; compare market-wide vs. per trader group.
- Study:
  - costs and benefits to market vs. limit orders per group
  - intraday returns to all the group’s orders.
Data

- Very detailed data for the TSX for February to April 2012:
  - all messages (orders, cancellations, trades, etc)
  - trader-level unique identifiers for each order
  - \( \rightarrow \) most detailed data available to exchanges and regulators.
- Focus on S&P/TSX Composite index constituents (our sample: 248 firms).
- Event study using March and April data.
- First: classify traders: message-intensive algo traders, retail, institutional.
Classification

message-intensive algo traders: iAT

1. For this classification: use 248 stocks plus 42 active ETFs
2. Compute the monthly (February 2012, pre-sample) sum of
   - total messages (= trades, orders, cancellations, modifications, etc.)
   - total trades
3. Compute the message-to-trade ratio.
4. Compute percentiles message-to-trade and total messages.
5. Classify as iAT if
   - 95th percentile message-to-trade and
   - 95th percentile total number of messages
Classification

Retail

- Info from proprietary dataset that allows identification of a large number of retail traders.
- Specifically: traders that send market orders to Alpha IntraSpread.
- Important: Canada does not allow off-exchange internalization → all retail orders hit public markets.

Institutional

- Idea: find traders that build large positions.
- Compute the cumulative inventory per stock
- If abs value of the inventory ever exceeds $25 million and not iAT or retail ⇒ institutional
## Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Market</th>
<th>iAT</th>
<th>Retail</th>
<th>Instit’s</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>unique identifiers</td>
<td>3,516</td>
<td>94</td>
<td>125</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>share of $-volume</td>
<td>19</td>
<td>10</td>
<td>19</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>share of messages</td>
<td>82.0</td>
<td>1.3</td>
<td>4.8</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>msgs per minute per ID</td>
<td>393</td>
<td>4</td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Market Quality Measures

- TSX operates as a limit order book
  - limit orders: set quotes, give others an option to trade
  - market orders: trade against “posted” limit orders
- Bid-ask spread measures:
  1. quoted spread: all posted/visible quotes
  2. effective half-spread:
     - uses prices that were actually paid
  3. price impact:
     - signed price movement after the trade (5 min).
     - adverse selection costs for the limit order
  4. realized half-spread
     - effective half-spread minus price impact
     - compensation for liquidity provision
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<td>74</td>
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</tr>
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<td>33</td>
<td>29</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>effective half-spread</td>
<td>6.4</td>
<td>5.3</td>
<td>7.1</td>
<td>6.0</td>
<td>bps</td>
</tr>
<tr>
<td>realized half-spread</td>
<td>-2.6</td>
<td>-1.8</td>
<td>-4.5</td>
<td>-3.7</td>
<td>bps</td>
</tr>
</tbody>
</table>
Regression Methodology

Two approaches

1. Event study:

\[ \text{dependent variable}_{it} = \alpha_1 \text{event}_t + \alpha_2 \text{VIX}_t + \delta_i + \epsilon_{it} \]

2. Instrumental Variable estimation:

\[ iAT \text{ activity}_{it} = \beta_1 \text{event}_t + \beta_2 \text{VIX}_t + \delta_i + \epsilon_{it} \]

\[ \text{dependent variable}_{it} = \beta_3 \hat{iAT \text{ activity}}_{it} + \beta_4 \text{VIX}_t + \delta_i + \epsilon_{it} \]

- \( iAT \text{ activity} \) measured by \( \%iAT \) of all messages and \( \ln(iAT \text{ messages}) \).
- For both cases: \( \delta_i \) are firm fixed effects and \( \text{VIX}_t \) controls for market-wide fluctuations.
- Presentation: event study
Questions

1. What happens to iATs and market quality after the fee is introduced?

2. How do the changes affect the trading costs for retail and institutional traders (vs. market average) and their order submission behaviour?

3. How did the change affect traders’ intraday returns?
Q.1: What happens to iAT and market-wide measures?

- Assumption: message-intensive = market making.
  - Baruch and Glosten (2013) support this theoretically.
  - See also: Getco letter to IIROC.
- Need to frequently “re-quote” in response to new info.
- Predictions:
  1. Market makers reduce (re-)quoting activities → higher risk of being adversely selected → require higher compensation (Copeland and Galai (1983), Foucault (1999))
  2. ⇒ price impact of market orders ↗ and bid-ask spread ↗ (e.g., Bernales (2013) or Getco’s comment to IIROC).
Q.1: The Impact of the Fee Change

All measures are in basis points

Time-weighted quoted spread vs. %iAT

<table>
<thead>
<tr>
<th></th>
<th>Mar 1</th>
<th>Apr 1</th>
<th>May 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>quoted spread, av. before/after</td>
<td>7.0</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>% iAT messages, av before/after</td>
<td>6.0</td>
<td>6.5</td>
<td>7.0</td>
</tr>
</tbody>
</table>
## Q.1: Effect of iAT on market quality

<table>
<thead>
<tr>
<th></th>
<th>time weighted quoted spread</th>
<th>effective spread</th>
<th>5-minute price impact</th>
<th>5-minute realized spread</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>event</strong></td>
<td>0.49*** (0.14)</td>
<td>0.35*** (0.13)</td>
<td>0.82*** (0.19)</td>
<td>-0.44*** (0.13)</td>
</tr>
</tbody>
</table>

- iAT messages ↓ by 31%. ✓
- Quoted, effective spreads, and price impact ↑ ✓
- Realized spread (compensation for liquidity provision) ↓.
Q.2: What happens to trading costs of retail and institutions?

- Market order trading costs:
  - Prediction 1: higher market-wide spread $\rightarrow$ higher per-group spread.
Q.2: What happens to trading costs of retail and institutions?

- Market order trading costs:
  - Prediction 1: higher market-wide spread $\rightarrow$ higher per-group spread.

- Adverse selection for limit orders:
  - Based on Hoffman (2013) model of “slow” and “fast” traders.
  - only fast traders are able to re-quote if new info arrives.
  - $\rightarrow$ slow traders are always adversely selected if new info arrives.
  - $\rightarrow$ Prediction 2: slow traders’ adverse selection costs not affected by changes in iAT quoting.
Q.2: What happens to trading costs of retail and institutions?

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  - Based on Hoffman (2013) model of “slow” and “fast” traders.
  - only fast traders are able to re-quote if new info arrives.
  - $\rightarrow$ slow traders are always adversely selected if new info arrives.
  - $\rightarrow$ Prediction 2: slow traders’ adverse selection costs not affected by changes in iAT quoting.

- Trading costs/returns for limit orders:
  - No directional prediction.
  - Idea: indifferent between a market and a limit order.
  - $\rightarrow$ relationship between profits to market orders, profits to limit orders, and the fill rate for limit orders.
# Effective Spread

## Effective spreads

<table>
<thead>
<tr>
<th></th>
<th>paid for MO</th>
<th>received on LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>0.15</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Institutions</td>
<td>0.49***</td>
<td>0.41***</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.14)</td>
</tr>
</tbody>
</table>
Adverse Selection: Price Impact

<table>
<thead>
<tr>
<th></th>
<th>Price Impact caused by MO</th>
<th>Price Impact suffered on LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>0.35 (0.24)</td>
<td>0.94** (0.42)</td>
</tr>
<tr>
<td>Institutions</td>
<td>0.99*** (0.24)</td>
<td>1.14*** (0.29)</td>
</tr>
</tbody>
</table>
Q2: Effect on retail and institutional traders’ behavior
Changes in the usage of limit vs. market orders?

<table>
<thead>
<tr>
<th></th>
<th>% volume traded with LOs</th>
<th>% volume submitted as LOs</th>
<th>% orders submitted as LOs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Retail event</strong></td>
<td>0.42</td>
<td>0.92*</td>
<td>-0.51</td>
</tr>
<tr>
<td></td>
<td>(0.62)</td>
<td>(0.54)</td>
<td>(0.50)</td>
</tr>
<tr>
<td><strong>Institutional event</strong></td>
<td>-1.80**</td>
<td>-0.53</td>
<td>-1.30**</td>
</tr>
<tr>
<td></td>
<td>(0.71)</td>
<td>(0.61)</td>
<td>(0.63)</td>
</tr>
</tbody>
</table>
Q.2: What happens to trading costs of retail and institutions?

- **Retail:**
  - no change in the spread paid for MO or the price impact of MO → no change for MO
  - face higher adverse selection on LO but no change in the spread received → lose on LO.

- **Institutions:**
  - higher price impact of MO after the change, yet “underpay” for this increase → benefit on MO
  - face higher adverse selection when using LO, yet “undercompensated” for it → lose on LO
Realized Spread

<table>
<thead>
<tr>
<th></th>
<th>Realized spread</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>paid for MO</td>
<td>received on LO</td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td>-0.19 (0.25)</td>
<td>-0.70* (0.41)</td>
<td></td>
</tr>
<tr>
<td>Institutions</td>
<td>-0.48*** (0.18)</td>
<td>-0.71*** (0.23)</td>
<td></td>
</tr>
</tbody>
</table>
Step 3: Effect of iAT on intraday returns?
Instead of a 5-minute benchmark, use the closing price

- Intraday return: “profits” from buying and selling. On day $t$, for each group, compute:

$$\text{profit}_t = \text{sell } \text{volume}_t - \text{buy } \text{volume}_t + (\text{buy volume}_t - \text{sell volume}_t) \times \text{closing price}_t$$

scale by: $\text{buy } \text{volume}_t + \text{sell } \text{volume}_t$

- gain/loss relative to the end-of-the-day price
- captures intraday price movements subsequent to trade
- Compute returns to:
  - market orders
  - limit orders
  - all orders
### Step 3: Effect of iAT on trading costs & returns?

Intraday Returns by Groups of Traders

<table>
<thead>
<tr>
<th></th>
<th>Intraday return</th>
<th>mean (March)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>all orders</td>
<td>market orders</td>
</tr>
<tr>
<td>Retail traders</td>
<td>-3.93**</td>
<td>-1.85</td>
</tr>
<tr>
<td></td>
<td>(1.64)</td>
<td>(1.49)</td>
</tr>
<tr>
<td>Institutional traders</td>
<td>1.36</td>
<td>5.20***</td>
</tr>
<tr>
<td></td>
<td>(1.11)</td>
<td>(1.97)</td>
</tr>
</tbody>
</table>
Summary

- IIROC fee change led to a significant reduction in message-intensive activities.
- Reduction caused an increase in market-wide bid-ask spread.
- Yet: retail traders’ costs for market orders are unaffected, but they lose more on limit orders.
- → in our data, iAT activities are beneficial for retail.
- Institutions pay larger spreads, but the increase is smaller than the increase in their price impact.
- → institutions earn higher intraday returns on market orders.
  - Easier to capitalize on information?