High-frequency trading (HFT) in the CGB bond future

2 February 2017
“HFT” firms are identified empirically using characteristics common to the HFT literature,\textsuperscript{1} such as high volumes and rare overnight inventory, based on consolidated MX data.

\textbf{Chart 1: Number of HFTs active on the CGB}

\begin{quote}
\textit{monthly average of daily HFTs active}
\end{quote}

Source: Montreal Exchange data, Bank of Canada calculations

Last observation: 26 March 2016

\textsuperscript{1} Securities and Exchange Commission (2010); Kirilenko, Kyle, Samadi, and Tuzun (2014); Brogaard and Garriott (2016).
As we know, spreads improved over the period

**Chart 2:** Daily average CGB futures bid-ask spread
rolling 20-day moving average

Notes: Using dataset of daily 15s tick data 8:20-16:00
Source: Montreal Exchange data, Bank of Canada calculations

Last observation: 21 March 2016
Is some of the improvement attributable to HFT?

- Event study: Compare liquidity before and after HFT entries
  - 11 entry events: Dates on which an “HFT” started trading the CGB
  - Include controls for volume, price, open interest, and 10-day volatility

**Chart 3: Effective bid-ask spreads averaged across entry dates**

Source: Montreal Exchange data, Bank of Canada calculations
According to the study, the average impact of one HFT entry is:

- **Average effective spread**: -8 basis points
- **Average bid-ask spread**: -16 basis points
- **Average depth (10¢ from mid-quote)**: +74 contracts ($7.4M)
- **Average 5-second volatility**: -0.81pp annualized
A different measure: implementation shortfall (IS)

- IS: the difference between the signed (buy or sell), volume-weighted cost of a series of trades less the mid-quote at the time of first trade.

We compute the IS of “trade strings” executed by the unidentified participants.

“Strings” are unidirectional series of buys or sells of total size greater than 20 contracts ($2M), and with no more than 20-minute gaps between trades.
Smaller-sized “trade strings” are the most common

Chart 4: **Notional volume traded by volume bucket of trade string**
Quarterly sum

Note: Volume buckets categorize trade strings by the size of the position constructed during the string. A string is identified when a series of trades occur over time (non-instantaneous) in the same direction (either buy or sell) at least 95% of the time, with no more than a 20-minute gap.

Source: Montreal Exchange, Bank of Canada calculations

Last observation: 26 March 2016
Implementation shortfall by volume bucket

Quarterly median implementation shortfall

Source: Montreal Exchange data, Bank of Canada calculations

Last observation: 26 March 2016
Event-study results—IS by **volume bucket**

- According to the study, the average impact on IS of one HFT entry is:

<table>
<thead>
<tr>
<th>Volume Bucket</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2M-$10M</td>
<td>-8 basis points</td>
</tr>
<tr>
<td>$10M-$25M</td>
<td>No effect</td>
</tr>
<tr>
<td>$25M-$50M</td>
<td>No effect</td>
</tr>
<tr>
<td>$50M-$100M</td>
<td>No effect</td>
</tr>
</tbody>
</table>

Market data provided by Montreal Exchange in accordance with section 5.10 of Regulation 21-101 respecting marketplace operation.
Appendix

Implementation shortfall by duration (volume-weighted time to finish)
Appendix: IS by duration

Quarterly median implementation shortfall

Chart A: 0-1 minutes

Note: the duration is the volume-weighted average time of trade execution

Source: Montreal Exchange, Bank of Canada calculations

Last observation: 26 March 2016
Appendix: Cross-category IS (0-1min)

Quarterly median implementation shortfall

Chart D

Chart E

Chart F

Chart G

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016
Appendix: Cross-category IS (1-5min)

Quarterly median implementation shortfall

Chart H

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart I

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart J

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart K

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016
Appendix: Cross-category IS (5-15min)

Quarterly median implementation shortfall

Chart L

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart M

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart N

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016

Chart O

Source: Montreal Exchange, Bank of Canada calculations
Last observation: 26 March 2016