The HOT Study
Phases I and II of IIROC’s Study of High Frequency Trading Activity on Canadian Equity Marketplaces

Appendix B

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Appendix B

Study Period August 1, 2011 to October 31, 2011

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I. Introduction
This Appendix contains further supplemental analysis to the “The HOT Study Phases I and II of IIROC’s Study of High Frequency Trading Activity” (“the HOT Study”). For ease of reference, section references have been structured in the same manner as the HOT Study.

II. Overview of IIROC’s Study

Market Share by Traded Marketplace

*Figure 1: Market Share by Volume Traded over Study Period*

*Figure 2: Market Share by Value Traded over Study Period*
Figure 3: Market Share by Trades Executed over Study Period

Calculating Volatility
Two measures of volatility are used, as described below:

**Intra-Day Volatility** describes the range of value of the TSX Composite for an individual day, relative to the midpoint between the high and low value. The formula is as follows:

\[
\text{Intra-Day Volatility} = \frac{\text{High Value} - \text{Low Value}}{\left(\frac{\text{High Value} + \text{Low Value}}{2}\right)}
\]

**Inter-Day Volatility** describes the difference between the closing values of consecutive days, relative to the current day’s closing value. The formula is as follows:

\[
\text{Inter-Day Volatility} = \frac{\text{Today’s Closing Value} - \text{Yesterday’s Closing Value}}{\text{Today’s Closing Value}}
\]
III. Phase I – Determination of the Study Group

The following methodology was used to identify User IDs which exhibited a high order-to-trade ratio, or “HOT User IDs”.

Methodology for Identifying HOT User IDs

For the Study Period, the following data points were calculated from the Regulatory feed for each User ID for each month of the Study Period:

- Number of Trades – buy and sell sides of the trades were attributed to the buying User ID and the selling User ID.
- Number of New and Amended Order Messages (Cancelled Orders Messages were not included in this number).

Notes on the trade and order data:

Trades

A single order can result in multiple trades as a result of partial fills.

Orders

During the Study Period, marketplaces treated a request to “Change Former Order” (“CFO”) differently with respect to how the information is sent to IIROC. Some marketplaces sent one “amend order” message. Other marketplaces sent a “cancel order” message followed by a “new order” message. The effect (an amended order) was the same, but for the purposes of calculating an order-to-trade ratio using IIROC’s Regulatory Feed, the numbers of orders were sometimes doubled when both “cancel order” and “new order” messages are included in the measure. By excluding “cancel order” messages, we are able to treat CFO orders on all marketplaces equitably. This issue has since been resolved and all marketplaces now send CFO messages in a similar manner.

Table 1 illustrates the difference in order-to-trade ratio which would result from placing the same series of instructions on different marketplaces. The sequence of events in this hypothetical example is:

- Place new order
- Amend the order three times
- The order trades
Table 1: Order-to-trade Ratio - Message Comparison

<table>
<thead>
<tr>
<th>CFO = Cancel Order + New Order</th>
<th>#</th>
<th>CFO = Amend Order</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Order</td>
<td>1</td>
<td>New Order</td>
<td>1</td>
</tr>
<tr>
<td>Cancel Order</td>
<td></td>
<td>Amend Order</td>
<td></td>
</tr>
<tr>
<td>New Order</td>
<td>6</td>
<td>Amend Order</td>
<td>3</td>
</tr>
<tr>
<td>Cancel Order</td>
<td></td>
<td>Amend Order</td>
<td></td>
</tr>
<tr>
<td>New Order</td>
<td></td>
<td>Amend Order</td>
<td></td>
</tr>
<tr>
<td>Cancel Order</td>
<td></td>
<td>New Order</td>
<td></td>
</tr>
<tr>
<td>New Order</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>1</td>
<td>New Order</td>
<td></td>
</tr>
<tr>
<td>Order-to-trade Ratio (including cancelled orders)</td>
<td>7</td>
<td>Order-to-trade Ratio (including cancelled orders)</td>
<td>4</td>
</tr>
<tr>
<td>Order-to-trade Ratio (excluding cancelled orders)</td>
<td>4</td>
<td>Order-to-trade Ratio (excluding cancelled orders)</td>
<td>4</td>
</tr>
</tbody>
</table>

For each User ID for each month, the number of trades was plotted against the number of new and amended orders. Figure 4 shows the resulting 8513 data points, which have been plotted on a logarithmic scale.

Figure 4: Actual Orders vs. Trades

![Actual Orders vs. Trades](image)

Next, the log was taken of the number of orders and trades, and the transformed data points were plotted with a line of best fit, based on a linear least squares regression, as seen in Figure 5.
The slope of the line of best fit is 1.0038, or very close to 1, and the intercept of the line is 0.1819. The line of best fit shows that for the bulk of User IDs, the order-to-trade ratio is very close to one order per one trade. The R-squared value of 0.7751 indicates that the line is a good description of the relationship between the orders and trades.

The line of best fit was then used to de-trend the relationship between orders and trades, as seen in Figure 6.

Figure 6: De-trended Log Orders vs. Log Trades
From Figure 6, we can observe that the bulk of User IDs cluster near 0, and that there are a few outliers near and below -1, and a large number of outliers near 1 (corresponding to an order-to-trade ratio in the order of 10:1) and ranging to almost 4 (corresponding to an order-to-trade ratio in the order of 10,000:1).

We can also look at a histogram of the de-trended log orders in order to observe the shape of the distribution (Figure 7).

*Figure 7: Frequency of De-trended Log Orders*

The standard deviation of the de-trended log orders is 0.6903.

Based on the shape of the distribution seen in Figure 7 and the dispersion of the observations seen in Figure 6, a cut-off point of 1.25 standard deviations was chosen to divide the observations into an inlier group, categorized as “OTHER” in the Study (in blue) and an outlier group, categorized as “HOT” (in red). Based on this methodology, the HOT group has an order-to-trade ratio which is greater than approximately 11.2:1. A total of 947 observations are captured in the HOT group, representing approximately 11% of the User ID population.

*Table 2: Characteristics of Study Period HOT Group*

<table>
<thead>
<tr>
<th>Standard Deviation</th>
<th>Number of Standard Deviations</th>
<th>% of Observations</th>
<th>Number of Observations</th>
<th>Approximate Minimum Order-to-trade Ratio</th>
<th>Minimum Detrended Log Orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6903</td>
<td>1.25</td>
<td>11.13%</td>
<td>947</td>
<td>11.20</td>
<td>0.8635</td>
</tr>
</tbody>
</table>
Figure 8: De-trended Log Orders vs. Log Trades – HOT & OTHER

Figure 8 shows the de-trended log orders plotted against the log trades including User IDs which were categorized as part of the HOT group (in red) and User IDs which fall into the OTHER group (in blue).

Figure 9: Orders vs. Trades – HOT & OTHER

In Figure 9, we have returned to our original Figure showing Orders vs. Trades, but we have again used colour to represent HOT group (red), and the OTHER group (blue).
As a final step, the observations were divided by month in order to identify the separate lists of HOT User IDs for each month in the Study Period. In the subsequent analysis of trading activity (Phase II), the HOT User IDs for each month were used to evaluate that month’s trading activity. For example, only HOT User IDs which were active and HOT in August were used to evaluate the HOT trading activity in August. This took into account:

- User IDs which were only used in certain months; and
- User IDs which changed strategies (some months exhibiting HOT trading activity and other months exhibiting OTHER trading activity).

**Table 3: Number of HOT User IDs by Month**

<table>
<thead>
<tr>
<th></th>
<th>August</th>
<th>September</th>
<th>October</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of HOT User IDs</td>
<td>331</td>
<td>325</td>
<td>291</td>
</tr>
<tr>
<td>Total Number of Trades</td>
<td>83,149,180</td>
<td>74,535,609</td>
<td>69,421,714</td>
</tr>
<tr>
<td>% of Trades by HOT User IDs</td>
<td>42.87%</td>
<td>42.72%</td>
<td>39.53%</td>
</tr>
</tbody>
</table>

In summary, 221 User IDs were identified as HOT User IDs in all three months of the Study Period. These 221 User IDs were responsible for more than 95% of the number of trades by the HOT User IDs in each of the months. An additional 201 User IDs, present in the HOT group in either one or two months, were responsible for the remainder of the number of trades by the HOT group. This gives confidence that we are identifying User IDs displaying consistent behavior.

**Table 4: Monthly Comparison of HOT User IDs**

<table>
<thead>
<tr>
<th></th>
<th>August No. IDs</th>
<th>August % No. Trades</th>
<th>September No. IDs</th>
<th>September % No. Trades</th>
<th>October No. IDs</th>
<th>October % No. Trades</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT IDs Common to 3 Months of Study Period</td>
<td>221</td>
<td>41.51%</td>
<td>221</td>
<td>41.48%</td>
<td>221</td>
<td>38.13%</td>
</tr>
<tr>
<td>HOT IDs in this Month plus 1 other Month</td>
<td>54</td>
<td>0.78%</td>
<td>76</td>
<td>0.96%</td>
<td>36</td>
<td>0.70%</td>
</tr>
<tr>
<td>HOT IDs in this Month only</td>
<td>56</td>
<td>0.58%</td>
<td>28</td>
<td>0.28%</td>
<td>34</td>
<td>0.70%</td>
</tr>
<tr>
<td>Total HOT IDs in Study Period</td>
<td>331</td>
<td>42.87%</td>
<td>325</td>
<td>42.72%</td>
<td>291</td>
<td>39.53%</td>
</tr>
</tbody>
</table>

Validation – Identifying HOT User IDs by Month

A similar analysis (analyzing the log of the number of orders vs. the log of the number of trades, de-trending, creating a histogram & evaluating the resulting distribution) was conducted for each month. The resulting HOT and OTHER groups based on a 1.25 standard deviation were very similar to the HOT and OTHER groups established for the full Study Period.
**Table 5: Characteristics of HOT Groups (calculated Monthly) compared to Study Period HOT Group**

<table>
<thead>
<tr>
<th>Period</th>
<th>Standard Deviation</th>
<th>% of Observations</th>
<th>Number of Observations</th>
<th>Approximate Minimum Order-to-trade Ratio</th>
<th>Minimum Detrended Log Orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>0.6904</td>
<td>11.69%</td>
<td>331</td>
<td>11.49</td>
<td>0.8662</td>
</tr>
<tr>
<td>September</td>
<td>0.6906</td>
<td>11.41%</td>
<td>323</td>
<td>10.67</td>
<td>0.8654</td>
</tr>
<tr>
<td>October</td>
<td>0.6898</td>
<td>10.66%</td>
<td>294</td>
<td>11.30</td>
<td>0.8654</td>
</tr>
<tr>
<td>Study Period</td>
<td>0.6903</td>
<td>11.13%</td>
<td>947</td>
<td>11.20</td>
<td>0.8635</td>
</tr>
</tbody>
</table>

Further, the distribution of observations for August, September and October are very similar to the distribution of observations for the Study Period as a whole. The observations which are greater than 1.25 standard deviations from the mean are clearly outliers when compared to the remaining observations, both in the Study Period as a whole, and in the individual months.

Based on this additional analysis, we were satisfied that there were no significant changes to trading patterns over the 3 months of the Study Period which would require us to use different criteria to identify the HOT group month by month.
IV. Phase II – Statistical Analysis of HOT Activity

Notes to the Phase II Appendices
The majority of the Canadian equity marketplaces\(^1\) provide trading data in a standardized form to IIROC via a real-time regulatory feed (“the Regulatory Feed”). This data includes all trade, order and quote messages and contains both public and confidential regulatory information.

During the time period of our study, the marketplaces providing data through the Regulatory Feed included Alpha ATS (“ALF”), Chi-X Canada (“CHX”), Instinet Canada Cross Limited (“ICX”), MATCH Now (“TCM”), Omega ATS (“OMG”), Pure Trading (operated by CNSX Markets Inc.) (“PTX”), Sigma X Canada ATS (“SGX”), TMX Select (“TMS”), Toronto Stock Exchange (“TSX”) and TSX Venture Exchange (“TSXV”).

Further information was provided directly by CNSX Markets Inc. (“CNSX”) and was included in all analysis of trading broken out by listed marketplace.

Unless otherwise indicated:

- the results refer to trading activity (including orders and trades) in all TSX- and TSXV-listed securities on all Canadian equity marketplaces in the Regulatory Feed during the Study Period;
- the results compare activity by the the HOT Group with the OTHER group; and
- each trade is considered twice - once for the buyer and once for the seller - resulting in two times the exchange-reported volume, value and number of trades.

Throughout the appendices, trading activity is measured by share volume traded, dollar value traded and number of trades executed. In most cases, consistent colour conventions are used:

- volume is indicated by shades of blue;
- value is indicated by shades of red; and
- number of trades is indicated by shades of green.

---

\(^1\) During the time period of our study, Liquidnet Canada Inc. was not providing data through the Regulatory Feed; accordingly, Liquidnet Canada trading activity was not included in the Study data. Note that Liquidnet Canada was providing data through another means during the period of the study, and now provides data through the Regulatory Feed.
H. Who are HOT User IDs?

Overview

Figure 10: Number of HOT User IDs

The HOT Group accounts for 11% of the User IDs active in the Study Period.

Figure 11: Volume of Trading by HOT User IDs

The HOT Group accounts for 22% of the volume traded in the Study Period.
The HOT Group accounts for 32% of the value traded in the Study Period.

Figure 12: Value of Trading by HOT User IDs

The HOT Group accounts for 42% of the number of trades executed in the Study Period.

Figure 13: Number of Trades by HOT User IDs
The HOT Group accounts for 94% of the new and amended orders entered during the Study Period.

Table 6: Additional Comparisons between HOT and OTHER

<table>
<thead>
<tr>
<th>Trading Activity</th>
<th>Average Price per Share</th>
<th>Average Value per Trade</th>
<th>Average Volume per Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT</td>
<td>$14.88</td>
<td>$4,145</td>
<td>278</td>
</tr>
<tr>
<td>OTHER</td>
<td>$8.92</td>
<td>$6,280</td>
<td>704</td>
</tr>
</tbody>
</table>

The HOT Group trades in more higher-priced securities, in smaller volumes per trade and slightly smaller values per trade than the OTHER Group.

Composition of the HOT Group

The following section explores how the HOT User IDs access the Canadian marketplaces. The terms used in the figures below are defined as follows:

- DMA\(^2\) - Participants provide to IIROC (either directly, or through TMX Group Inc.) a list of clients with whom they have a DMA relationship and the User ID(s) used by the client to access Canadian equity marketplaces. These lists are updated periodically by the Participant. For the purposes of this study, we used the August 2011 DMA client lists.

\(^2\) See TSX Rules and Policies 2-501 through 2-503 which set out requirements for TSX Participants that offer DMA, including a list of categories of clients who are eligible to be DMA clients. Other marketplaces have similar rules and policies.
• NDMA-IN – Non-DMA trades indicated as “inventory” based on the account type provided on the Regulatory Feed. Generally, “inventory” activity refers to a Participant’s proprietary trading activity.

• NDMA-CL – Non-DMA trades indicated as “client” based on the account type provided on the Regulatory Feed.

• NDMA-Other – Non-DMA trades indicated as “specialist”, “non-client” or “options market maker” based on the account type provided on the Regulatory Feed.

Please note that the DMA attribute applies to the User ID, so all trades by a particular User ID will be included in the DMA category. However, the attribute of account type is particular to the order or trade and can be modified on an order by order basis. The following analysis reflects the account type used for each trade.

*Figure 15: Number of HOT User IDs by DMA and Non-DMA Account Type*

As the following figures show, while 40% of the HOT User IDs are identified as DMA, they are responsible for a large percentage of the volume traded, value traded and number of trades executed by all HOT User IDs.
HOT User IDs identified as DMA are responsible for 75% of the volume traded. The remainder of the volume is traded by HOT User IDs identified as NDMA.

HOT User IDs identified as DMA are responsible for 75% of the value traded. The remainder is traded by HOT User IDs identified as NDMA.
HOT User IDs identified as DMA are responsible for 82% of the trades executed. The remainder is traded by HOT User IDs identified as NDMA.

**Figure 19: Order-to-trade Ratio of HOT User IDs by DMA and Non-DMA Account Type**

HOT User IDs with DMA have an average order-to-trade ratio of 46, which is below the average order-to-trade ratio for all HOT User IDs of 56 (marked on the chart with a pale purple line). The average order-to-trade ratio is 54 for NDMA-CL, 151 for NDMA-IN and 147 for NDMA-Other.
Figure 20 compares the order-to-trade ratio for common shares (“Common”) and exchange traded funds and notes (“ETF/Ns”) by DMA and Non-DMA account type.

Figure 20: Order-to-trade Ratio of HOT User IDs by DMA and Non-DMA Account Type in selected Security Types

Figure 20 shows that the average order-to-trade ratio is higher in ETF trading for all groups, but particularly for the NDMA groups.

Figure 21: Percentage of Volume Traded by HOT User IDs by DMA and NDMA in Selected Security Types

<table>
<thead>
<tr>
<th>Volume Traded</th>
<th>Common</th>
<th>ETF</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA</td>
<td>76%</td>
<td>21%</td>
<td>3%</td>
</tr>
<tr>
<td>NDMA – CL</td>
<td>74%</td>
<td>17%</td>
<td>9%</td>
</tr>
<tr>
<td>NDMA – IN</td>
<td>28%</td>
<td>70%</td>
<td>2%</td>
</tr>
<tr>
<td>NDMA – Other</td>
<td>43%</td>
<td>55%</td>
<td>2%</td>
</tr>
<tr>
<td>Total HOT Trading Activity</td>
<td>68%</td>
<td>28%</td>
<td>3%</td>
</tr>
</tbody>
</table>

By volume, NDMA-CL and DMA both traded predominantly in common shares. In contrast, NDMA-IN traded predominantly in ETF/Ns while NDMA-Other traded more equitably between ETF/Ns and common shares.
Figure 22: Percentage of Value Traded by HOT User IDs by DMA and NDMA in Selected Security Types

<table>
<thead>
<tr>
<th>Value Traded</th>
<th>Common</th>
<th>ETF</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA</td>
<td>84%</td>
<td>15%</td>
<td>1%</td>
</tr>
<tr>
<td>NDMA-CL</td>
<td>81%</td>
<td>14%</td>
<td>4%</td>
</tr>
<tr>
<td>NDMA-IN</td>
<td>43%</td>
<td>55%</td>
<td>2%</td>
</tr>
<tr>
<td>NDMA-Other</td>
<td>54%</td>
<td>45%</td>
<td>2%</td>
</tr>
<tr>
<td>Total HOT Trading Activity</td>
<td>78%</td>
<td>21%</td>
<td>1%</td>
</tr>
</tbody>
</table>

By value, NDMA-CL and DMA both traded predominantly in common shares. In contrast, NDMA-IN and NDMA-Other traded more equitably between common shares and ETFs.

Figure 23: Percentage of Trades Executed by HOT User IDs by DMA and NDMA in Selected Security Types

<table>
<thead>
<tr>
<th>Trades Executed</th>
<th>Common</th>
<th>ETF</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMA</td>
<td>93%</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>NDMA-CL</td>
<td>93%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>NDMA-IN</td>
<td>73%</td>
<td>25%</td>
<td>2%</td>
</tr>
<tr>
<td>NDMA-Other</td>
<td>74%</td>
<td>23%</td>
<td>3%</td>
</tr>
<tr>
<td>Total HOT Trading Activity</td>
<td>91%</td>
<td>7%</td>
<td>1%</td>
</tr>
</tbody>
</table>

NDMA-CL and DMA both executed a high percentage of their trades in common shares. NDMA-IN and NDMA-Other also executed a high percentage of trades in common shares but also traded in ETF/Ns.

In summary:

- The majority of trading activity by HOT User IDs is conducted by those identified as DMA.
- NDMA had a higher order-to-trade ratio than DMA.
- NDMA-CL traded in a similar pattern to DMA as measured by volume traded, value traded and number of trades executed.
- NDMA-CL and DMA are more active in common shares as measured by volume traded, value traded and number of trades executed.
- NDMA-IN and NDMA-Other are more active in ETF/Ns as measured by volume traded, value traded and number of trades executed.

Who are HOT User IDs Trading With?
The following figures explore how different participants are interacting in the market and seek to answer questions such as:

- Who are HOT User IDs trading with?
- How much do HOT User IDs trade with other HOT User IDs?
• Who is taking the other side of retail trading?

The following terms are used in the figures below:

• Retail - Six of the most active Participants whose business model is known to encompass a large retail component were asked to provide the User IDs which were used exclusively (more than 95%) to direct order execution or full service retail order flow to the marketplace during the period of the study. As such, the Retail category describes a specific subset of all possible retail order flow.

• Other (ex R) – all other trading (excluding Retail)

In this section the data has been analyzed on a single counted basis. All other analysis in this report (unless noted) was conducted on a double counted basis. The following information is provided to clarify the difference between the two methods of counting.

**Use of Single Counting vs. Double Counting**

As discussed above, HOT User IDs are responsible for 22% of all volume, 32% of all value and 42% of all trades. These figures were calculated using a double counting method, in which the volume, value and number of trades for each HOT User IDs was noted for both the buyer and seller of each trade. These figures were then divided by a double count of the total volumes, values & numbers of trades. An example follows:

**Figure 24: Example of Double Counting Volume**

<table>
<thead>
<tr>
<th>Percentage Volume</th>
<th>= 22 HOT buy volume + 22 HOT sell volume</th>
<th>= 22% (Double counted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 buy volume + 100 sell volume</td>
<td></td>
</tr>
</tbody>
</table>

In contrast, as we will demonstrate below, on a single counted basis, HOT User IDs are involved in 37% of the volume of all trades, as the buyer, the seller, or both. Using this method, the volumes, values & numbers of trades for HOT User IDs were noted on either the buy side, the sell side, or both sides of a trade. These figures were then divided by a single count of the volume, value or number of trades. An example follows:

**Figure 25: Example of Single Counting Volume**

<table>
<thead>
<tr>
<th>Percentage Volume</th>
<th>= 22 HOT to Other (ex R) volume + 8 HOT to Retail volume + 7 HOT to HOT volume</th>
<th>= 37% (Single counted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 trade volume</td>
<td></td>
</tr>
</tbody>
</table>

We can reconcile the two methods as follows:
Figure 26: Example of Single Counting Volume (Reconciling to Double Count)

<table>
<thead>
<tr>
<th>Percentage Volume</th>
<th>=</th>
<th>22 HOT buy volume + 22 HOT sell volume – 7 HOT buy to HOT sell volume</th>
<th>=</th>
<th>37%</th>
<th>(Single counted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 trade volume</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Trading by Market Participant and Counterparty

Analysis was conducted to explore the trading activity by HOT User IDs, broken out by the types of market participants with whom they traded. The following charts compare the trading activity of the HOT group to the trading activity of the Retail group, and the Other (ex R) group.

Figure 27: Percentage of Volume by Type of Market Participant and Counter-Party

When we consider what type of market participant is on each side of the trade, and count each trade only once, Figure 27 shows that HOT User IDs are involved in 37% of the volume of all trades. In 7% of all single counted trades, HOT User IDs are trading with other HOT User IDs. In 8% of all single counted trades, HOT User IDs are trading with Retail.
HOT User IDs are the counter-party to 28% of all retail flow by volume traded (single counted).

When we consider what type of market participant is on each side of the trade, and count each trade only once, Figure 29 shows that HOT User IDs are involved in 53% of the value traded. In 11% of all single counted trades, HOT User IDs are trading with other HOT User IDs. In 8% of all single counted trades, HOT User IDs are trading with Retail.
HOT User IDs are the counter-party to 50% of all retail flow by value traded (single counted).

When we consider what type of market participant is on each side of the trade, and count each trade only once, Figure 31 shows that HOT User IDs are involved in 68% of the number of all trades executed. In 14% of all single counted trades, HOT User IDs are trading with other HOT User IDs. In 8% of all single counted trades, HOT User IDs are trading with Retail.
HOT User IDs are the counter-party to 53% of all retail flow by number of trades executed (single counted).

The following summary points can be drawn from the preceding figures:

- HOT User IDs are involved in a large percentage of all trading; 37% by volume traded, 53% by value traded and 68% by number of trades executed.
- When we considered the trades where Retail is on one or both sides, it is found that HOT User IDs traded against a large portion of Retail trading: 28% by volume traded, 50% by value traded and 50% by number of trades executed.
- HOT User IDs trade with HOT User IDs 7% of the volume traded, 11% of the value traded and 14% of the number of trades executed.

I. How do HOT User IDs Trade?

**Response Time of HOT User IDs**

The following section explores the response times of which HOT User IDs are capable, using resting time as a proxy.

**Definition of Resting Time**

High speeds and fast response times are often associated with HFT. Ideally, we would like to be able to measure the response time of decision making – the time taken for an entity (human or computer) to observe a change in the trading environment and take action. However, given the complexity of linking trigger and reaction events using our data, we chose instead to measure
resting time, defined as the time elapsed between placing an order and cancelling it, to provide a proxy for measuring the response time capabilities of a User ID.

Determining Response Time Categories – Methodology

- For each User ID, for each month, we sampled 2000 cancellation times. Where there were fewer than 2000 cancels attributed to a User ID, we included all cancels in the sample.
- We determined that there were two cancellation times which were of particular importance:
  - The time of human reaction: Observation of known retail User IDs and other known human traders resulted in setting the cut off for human reaction time at 00:00:00.864, slightly less than a second.
  - The fastest reaction time provided by all marketplaces: During the period of our study, several marketplaces provided information in the Regulatory feed in 1/100 of a second (although our feed allows 1/1000 of a second).
- The Percentage of Fast Resting Times was calculated for each User ID using the following calculation.

\[ \text{Percentage of Fast Resting Times} = \frac{\text{Number of cancellations conducted at resting times } \leq 00:00:00.010}{\text{Number of cancellations in sample}} \]

- A cut-off was chosen, such that the outliers could be clearly differentiated. Figure 34 is a histogram in which each User ID is grouped into a bucket based on their percentage of fast resting times. The two largest buckets are clearly the 0% bucket and the 0% to less than 5% bucket. The User IDs which had a Percentage of Fast Resting Times equal to or more than 5% are outliers.
Figure 34: Histogram of User IDs by Percentage of Fast Resting Times – August 2012

- Response time categories were then established:
  - Slow – User IDs for which all observed resting times ≥ 00:00:00.864
  - Fast – User IDs for which 5% or more of all observed resting times were ≤ 00:00:00.010 and there were more than 20 observations in the month
  - Inconclusive - User IDs for which at least one observed resting time is faster than human (< 00:00:00.864) but which did not meet the criteria of a Fast User ID. This included many of the User IDs which had less than 20 (including zero) cancel observations in the month.

**Number of HOT User IDs by Response Time Category**

The following figures explore the number of HOT User IDs in each response time category. Each User ID is included once for each month of the Study Period.
Figure 35: Number of HOT User IDs by Response Time Category

Approximately one third of all HOT User IDs are classified as Fast, 12% are classified as Slow, and 56% are classified as Inconclusive.

Figure 36: Response Time Categories of HOT User IDs by DMA and NDMA

Approximately half of the HOT User IDs identified as DMA are classified as Fast, and a very small percentage are classified as Slow. In contrast, approximately a quarter of the NDMA HOT User IDs are classified as Fast, and a relatively large percent are classified as Slow.
Trading Activity by HOT User IDs by Response Time Category and DMA

The following figures explore the volume traded, value traded and number of trades executed by HOT User IDs categorized by response time.

Figure 37: Average Daily Volume of Trading by Market Participant and Response Time Category

84% of all HOT trading by volume is by IDs categorized as Fast. In contrast, a smaller percentage of average daily volume is traded by Other (ex R) and Retail User IDs categorized as Fast.

Figure 38: Volume of Trading by HOT User IDs by Response Time Category
A small percentage of the volume traded by HOT User IDs is Inconclusive (15%) or Slow (1%).

Figure 39: Average Daily Volume of Trading by HOT User IDs by DMA and Response Time Category

![Average Daily Volume Chart]

91% of the average daily volume traded is by DMA HOT User IDs categorized as Fast. In contrast, 63% of the average daily volume traded is by NDMA HOT User IDs categorized as Fast.

Figure 40: Average Daily Value of Trading by Market Participant and Response Time Category

![Average Daily Value Chart]

87% of average daily value traded by all HOT trading is by User IDs categorized as Fast. In contrast, a smaller percentage of average daily value traded by Other (exR) and Retail User IDs categorized as Fast.
A small percentage of the value traded by HOT User IDs is Inconclusive (12%) or Slow (<1%).

95% of the average daily value is traded by DMA HOT User IDs categorized as Fast. In contrast, 64% of the average daily value traded is by NDMA HOT User IDs categorized as Fast.
90% of all trades are executed by the HOT User IDs categorized as Fast. In contrast, a smaller percentage of trades are by Other (ex-R) and Retail categorized as Fast.

Figure 44: Number of Trades by HOT User IDs by Response Time Category

Figure 44 shows that relatively few trades attributed to the HOT group are executed by User IDs categorized as Inconclusive (9%) or Slow (<1%).
95% of the trades executed by DMA HOT User IDs are by User IDs categorized as Fast. In contrast, 69% of the trades executed are by NDMA HOT User IDs categorized as Fast.

In summary:

- Fast HOT User IDs dominate the trading by HOT User IDs, whether measured by volume, value or number of trades;
- The trading by Fast Other (ex-R) User IDs form a smaller percentage of trading by Other (ex-R) User IDs (volume – 6%, value – 13%, number of trades – 14%), and a smaller portion of trading overall (volume – 4%, value – 8%, number of trades – 7%);
- The trading by Fast Retail User IDs form a very small percentage of the trading by the Retail group (volume – 0%, value – 0%, number of trades – 1%), and of trading overall (volume – <1%, value – <1%, number of trades – <1%);
- 32% of HOT User IDs categorized as Fast are responsible for the largest percentage of HOT trading, whether measured by volume (84%), value (87%) or number of trades (90%);
- 18% of DMA HOT User IDs categorized as both Fast are responsible for a large percentage of HOT trading (volume – 68%, value – 71%, number of trades – 78%);
- 37% of NDMA HOT User IDs categorized as Inconclusive are responsible for a small percentage of trading (volume – 8%, value – 9%, number of trades – 5%); and
- 12% of HOT User IDs categorized as Slow (either DMA or NDMA) are responsible for a very small percentage of trading (volume – 1%, value – <1%, number of trades – <1%).
How HOT User IDs Trade: Anonymous vs. Attributed

The following figures examine anonymous versus attributed trading by HOT User IDs. At the point of entering an order onto a marketplace, a trader can make the order:

- Attributed – the order and any subsequent trade will include the participant’s trading number in the public trade record; or
- Anonymous – the order and any subsequent trade will not include the participant’s trading number in the public trade record, instead, the generic “001” participant number will be displayed.

It should be noted that the Regulatory Feed contains full participant attribution with a flag to indicate that the orders and trades were marked anonymous.

Attribution and anonymity are features offered by marketplaces. Some marketplaces attribute orders and trades by default and some marketplaces anonymize by default.

The following figures compare the anonymous trading activity of the HOT User IDs to Retail and Other (ex-R).

Figure 46: Anonymous vs. Attributed Average Daily Volume

35% of all volume traded by HOT User IDs is marked anonymous, compared to 23% of volume traded by Other (ex R) and 3% of volume traded by Retail.
39% of all value traded by HOT User IDs is marked anonymous, compared to 21% of all value traded by Other (ex R) trading and 3% of all value traded by Retail.

46% of the average number of trades executed by HOT User IDs are marked anonymous, in contrast to 32% of all Other (ex R) trading and 4% of all Retail trading.

In summary, HOT User IDs use the anonymous marker more often than other market participants, whether measured by volume, value or number of trades.
How HOT User IDs Trade: Dark vs. Lit

We define “Dark” as encompassing activity, both orders and trades, on fully dark Canadian equity marketplaces and activity using fully hidden dark order types on lit Canadian equity marketplaces. The following figures compare dark versus lit trading by HOT User IDs. These charts compare trading by HOT User IDs and the trading by all remaining User IDs (“OTHER”).

Figure 49: Average Daily Volume Traded Dark vs. Lit

Dark trading represents 5% of all volume traded. Figure 49 shows that HOT User IDs trade proportionally more dark than lit when measured by volume traded (39% of all dark trading vs. 21% of all lit trading).

Figure 50: Average Daily Value Traded Dark vs. Lit
Dark trading represents 7% of all value traded. Figure 50 shows that HOT User IDs trade proportionately more dark than lit when measured by value traded (36% of all dark trading vs. 32% of all lit trading).

*Figure 50: Average Daily Number of Trades Dark vs. Lit*

Dark trading represents 6% of all trades executed. Figure 51 shows that HOT User IDs trade proportionately equal dark and lit when measured by number of trades executed (42% of all dark trading vs. 42% of all lit trading).

In summary, HOT User IDs are more active in the dark than in the lit, when measured by volume or value and proportionally equal dark and lit when measured by number of trades executed.

**How HOT User IDs Trade: Active vs. Passive**

The following figures explore active and passive trading by HOT User IDs based on flags found the Regulatory Feed. These charts compare trading by HOT User IDs and the trading by all remaining User IDs. Note that the trades marked NA are passive on both sides, a situation which occurs, for example, with intentional crosses and oddlot crosses. It would not be appropriate to add these trades to either the passive or the active categories as they are neither.
HOT User IDs are on the passive side of a trade 66% of the time when measured by volume traded.

Figure 52: Average Daily Volume of Trading by Active/Passive

HOT User IDs are on the passive side of a trade 66% of the time when measured by value traded.

Figure 53: Average Daily Value of Trading by Active/Passive
HOT User IDs are on the passive side of a trade 68% of the time when measured by number of trades executed.

In summary approximately two thirds of all trading by HOT User IDs is passive whether measured by volume traded, value traded or trades executed.

**How HOT User IDs Trade: Fees and Rebates**

Many Canadian marketplaces offer a rebate to parties that provide liquidity (or trade passively) and charge a fee to parties that take liquidity (or trade actively). In order to determine approximately how much HOT and Other User IDs made or spent via rebated and fees, a breakdown by marketplace and security type was required. Canadian marketplaces offer different pricing schemes dependent on factors such as the security type, the price range of the security, order types, and the session traded (e.g. opening or Market-on-Close trade). With so many variables, it was decided to focus the analysis on the trading which accounted for a significant percentage of activity during the Study Period and for which fees and rebates could be easily calculated using our data to use as a proxy.

The following chart accounts for all the trading in the Study Period, including the three categories for which we were able to calculate fees and rebates.
### Table 7: Percentage of Volume by Fee Category Breakdown

<table>
<thead>
<tr>
<th>Fee Category</th>
<th>Description</th>
<th>Overall % of Volume</th>
<th>HOT % of Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>• TSX-listed Common shares, Preferred shares or Units</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>• Executed on lit markets/against lit liquidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excludes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Opening/MOC Trades</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Must Be Filled</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Odd Lots</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intra-Spread and ALF Non-Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 2</td>
<td>• TSXV-listed Common shares, Preferred shares, Units or Capital Pool Company shares</td>
<td>20%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>• Executed on lit markets/against lit liquidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excludes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Opening/MOC Trades</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Must Be Filled</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Odd Lots</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intra-Spread and ALF Non-Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 3</td>
<td>• TSX-listed Exchange Traded Funds/Notes</td>
<td>8%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>• Executed on lit markets/against lit liquidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Excludes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Opening/MOC Trades</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Must Be Filled</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Odd Lots</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Intra-Spread and ALF Non-Intentional Crosses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crosses</td>
<td>All Intentional Crosses, regardless of the security type.</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
<td>Opening/MOC</td>
<td>All trades executed during the Opening or MOC sessions, regardless of the security type.</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Dark</td>
<td>All trades executed on dark markets/against dark orders, regardless of the security type.</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>Other</td>
<td>Everything else that did not fit into the above categories with specialized pricing schemes related to security or order type, such as Debentures, Notes, Must Be Filled orders, etc.</td>
<td>5%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Categories 1, 2 and 3 account for 73% of total traded volume in the Study Period, or 83% of volume traded by HOT User IDs in the Study Period. An additional 12% (<1% for the HOT User IDs) of trading was conducted as intentional crosses, which do not have a fee on most marketplaces. Trading categorized as Opening/MOC, Dark and Other accounted for 15% of the traded volume (15% for the HOT User IDs) in the Study Period; trading in these categories is subject to a wide variety of pricing models on Canadian marketplaces. Given this complexity we chose to focus on Categories 1 through 3 as a proxy for our analysis. The charts in the
remainder of this section are calculated based on these categories, and exclude all other trades (“trading fee sample”).

Of note, TSX and TSXV had additional fee and rebate structures for Participating Organizations which were based on either meeting certain passive volume thresholds, trading by Specialist and Responsible Designated Traders, and an Electronic Liquidity Provider program. Since determining which firms or parties qualified for the more favorable pricing was not in the scope of this phase of our study, base rates were used. For example, securities priced at over $1.00 per share on TSX or TSXV which traded passively were assigned to the $0.0031 rebate, $0.0001 less than the possible rebate for being an approved Electronic Liquidity Provider or meeting certain passive volume thresholds.

Figure 55: Average Daily Rebates Earned, Fees Paid and Net Rebates/Fees

HOT User IDs earn more rebates than they pay fees, for a net profit of approximately $250 thousand per day over the Study Period for securities included in the trading fee sample. Conversely, OTHER User IDs earn more rebates than the HOT User ID group, but pay more fees, for a net cost of approximately $462 thousand per day over the Study Period for securities included in the trading fee sample. By extension, it can be estimated that the marketplaces earned a profit of approximately $211 thousand per day.

J. Who are HOT User IDs Trading Through?

Our review revealed that the majority of trading activity by the HOT User group is executed through seven Participants, which are responsible for 90% of the volume traded, 91% of the value traded, and 95% of the trades executed by the HOT User IDs.
**Same-Broker Trading by Participant**

The following figures explore trading where the buyer and seller traded through the same broker.

Same-broker trading encompasses both intentional and unintentional crosses.

**Figure 56: Average Daily Volume of Same-Broker Trading by Participant**

![Average Daily Volume Graph](image)

**Figure 57: Average Daily Value of Same-Broker Trading by Participant**

![Average Daily Value Graph](image)
Overall, HOT User IDs trade within the same broker 23% by volume, 19% by value and 18% by number of trades. This is less than Other (ex R) User IDs by volume (37%) and value (29%) and more than Other (ex R) User IDs by number of trades (9%). This is more than Retail User IDs by volume (20%), value (16%) and number of trades (12%).

K. What are HOT User IDs Trading?

Trading by HOT User IDs: Security Type
The following facts and figures explore the types of securities traded by HOT User IDs. Please note the following definitions used in the figures below:

- NEX is a separate board of TSX Venture Exchange which provides a trading forum for listed companies that have fallen below TSX Venture's ongoing listing standards – these symbols are differentiated by a “.H” suffix (“NEX listed”)
- Also, TSXV offers a Capital Pool Company program, in which a shell company can be listed on TSXV prior to acquiring an operating company that meets TSXV listing requirements. Until this acquisition is carried out, the company is listed as a Capital Pool Company (“Pool”)

![Figure 58: Average Daily Number of Same-Broker Trades by Participant](image)
Figure 59: Volume of HOT Trading by Security Type

The majority of HOT User IDs’ trading by volume is in common shares and ETF/Ns.

Figure 60: Value of HOT Trading by Security Type

The majority of HOT User IDs’ trading by value is in common shares and ETF/Ns.
The majority of HOT User IDs’ trades are in common shares and ETF/Ns.

In summary, most of HOT User IDs’ trading is in common shares followed by ETF/Ns. The remaining security types do not form a large part of HOT User IDs’ overall trading activity when measured by total volume, value or number of trades.

Figure 61: Number of HOT Trades by Security Type

Figure 62: Percentage of Trading by HOT User IDs by Security Type
In this and other similar charts throughout the report, the following study averages are indicated in the chart using a coloured line for comparison purposes: the blue line at 22% represents the average share volume traded by the HOT Group, the pink line at 32% represents the average dollar value traded by the HOT Group and the green line at 42% represents the average number of trades by the HOT Group.

Figure 62 shows that HOT User IDs traded more than their study average in ETF/Ns and Exchangeables but less than their study average in Common shares.

Also of interest, HOT User IDs are responsible for close to 60% of all the trading in ETF/Ns by all measures.

Trading in Securities which Exhibit a High Order-to-trade Ratio (”HOT Securities“)
The following facts and figures explore trading in securities with a high order-to-trade ratio (”HOT Securities“) by HOT User IDs.

Definition of HOT Securities
Using a process similar to the method used to identify HOT User IDs, we identified securities exhibiting a high order-to-trade ratio.

Figure 63: Number of Orders vs. Number of Trades – by Security

Figure 63 shows the number of orders plotted against the number of trades for each symbol, for each month of the Study Period (approximately 14,000 observations). The orange lines in Figure 63 represent a constant order-to-trade ratio, using the following categories:

- S1 – less than 10 orders for each trade
The HOT Study - Appendix B

- S2 – from 10 to less than 100 orders for each trade
- S3 – from 100 to less than 1000 orders for each trade
- S4 – 1000 orders or more for each trade

Unlike User IDs, which exhibit a large number of observations clustered around an order-to-trade ratio of 1:1, securities appear to cluster around an order-to-trade ratio of 10:1.

Figure 64: HOT User IDs Percentage of Trading in each HOT Security Category

HOT User IDs trade less than their Study Period average in S1, approximately the same as their Study Period average in S2, and higher than their Study Period average in S3 and S4. It would appear that HOT User IDs are trading more in HOT securities.

Trading in HOT Securities: Common Shares & ETF/Ns

Further investigation of the HOT securities categories was conducted of trading in common shares and ETF/Ns in which HOT User IDs are active.
Figure 65: Number of Orders vs. Number of Trades – Common Shares and ETF/Ns

Figure 65 shows orders versus trades for Common Shares (dark blue dots), US Inter-listed Common Shares (pale green dots) and ETF/Ns (pink dots). Of note:

- Common Shares cluster around the line representing an order-to-trade ratio of 10:1, with some outliers at higher order-to-trade ratios (with more outliers among securities which trade less often)
- The most liquid US Inter-listed Common Shares have an order-to-trade ratio between 10:1 and 100:1 (with more outliers among securities which trade less often)
- The less liquid ETF/Ns have high to very high order-to-trade ratios with many above 1000:1 – in contrast, the more liquid ETF/Ns have order-to-trade ratios around 100:1 or less

The following section explores trading in common shares and ETF/Ns by HOT User IDs analyzed by HOT Security category as a percentage of all User IDs trading activity in that security type and HOT Security category.
HOT User IDs trade more in the S2 and S3 categories of common shares. In the S2 category, the percentage of volume and number of trades exceeds the percentages for the Study Period (22% for volume and 42% of the number of trades). In the S3 category, the percentage of value and number of trades exceeds the percentages for the Study Period (32% for value and 42% of the number of trades). Although HOT User IDs do not trade as much in the S4 category relative to their study average, they are responsible for 97% of the order entry activity, and thus contribute to the classification of the security as a HOT security.

**Figure 66: Trading Activity by HOT User IDs in Common Shares as a Percentage of Trading in HOT Security Category**

**Figure 67: Trading Activity by HOT User IDs in ETF/Ns as a Percentage of Trading in HOT Security Category**
HOT User IDs represent a significant portion of the trading in S2, S3 and S4 in ETF/Ns. This matches the observations made earlier in the report that HOT User IDs are responsible for a disproportionate amount of the trading in ETF/Ns (approximately 60%). The portion of trading in ETF/Ns executed by HOT User IDs is much higher than their study average in the S2, S3 and S4 categories (between 10:1 to over 1000:1), and lower in S1.

It would appear that the observation made earlier in this section (see figure 64) that HOT User IDs are responsible for a higher percentage of trading in S3 and S4 may be attributed to their dominant participation in ETF/N trading.

**Trading by HOT User IDs: Liquidity Categories**

The following section explores trading activity by HOT User IDs in securities with different levels of liquidity.

**Definition of Liquidity Categories**

*Figure 68: Average Number of Trades vs. Average Value of Trades – September 2011*

The average number of trades was plotted against the average value of trades for each symbol, for one month of the Study Period (September 2011). The yellow shaded box represents securities which meet the criteria outlined in the UMIR definition of Highly Liquid, namely that over the previous 60 days, a security exhibited, on average:
- 100 trades per day, and
- $1,000,000 worth of trades per day.

The liquidity categories adopted for this study build on these criteria. Rather than 60 days, the averages were calculated for each month separately (and as in all the other measures, each month’s definition was applied to the trading in that month only). Also, for the purpose of determining liquidity categories for the study, (contrary to the UMIR definition) use was made of the strong linear visual relationship (red line) observed in the chart. The following formula was applied to the data:

<table>
<thead>
<tr>
<th>Dividing Line Formula</th>
<th>=</th>
<th>(Average Number of Trades)^7 * (Average Value of Trades)^2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1,000,000,000</td>
</tr>
</tbody>
</table>

This resulted in the definition of the following categories which are represented in Figure 68 with light blue lines:

- L1: Dividing Line Formula < 0.00001
- L2: 0.00001 ≤ Dividing Line Formula < 1,000,000
- L3: 1,000,000 ≤ Dividing Line Formula < 1.0 X 10^18
- L4: 1.0 X 10^18 ≤ Dividing Line Formula < 1.0 X 10^29
- L5: 1.0 X 10^29 ≤ Dividing Line Formula
Trading by HOT User IDs by Liquidity Category: TSX Listed

Figure 69: Volume of trading by HOT User IDs by Liquidity Category: TSX-Listed

Figure 70: Volume of Trading by HOT User IDs by Liquidity Category: TSX-Listed
As seen in Figures 69-71, HOT User IDs are trading predominantly in highly liquid TSX-listed securities. HOT User IDs trading in TSX-listed securities trade less than their Study Period average in L1, L2, L3 and L4, and higher than their Study Period average in L5. In TSX-listed securities, HOT User IDs trade proportionally more in liquid securities, with the smallest portion of trading in the lowest liquidity category.
In summary, HOT User IDs are trading more in highly liquid TSX-listed securities in both absolute and relative terms.

**Trading by HOT User IDs by Liquidity Category: TSXV-Listed**

*Figure 73: Volume of trading by HOT User IDs by Liquidity Category – TSXV Listed*

*Figure 74: Value of trading by HOT User IDs by Liquidity Category: TSXV-Listed*
HOT User IDs trade predominantly in mid to highly liquid TSXV-listed securities, with volumes dominated by L3 and L4, values and number of trades dominated by L4.

HOT User IDs trade proportionally more in more liquid TSXV listed securities, with each liquidity category showing a higher portion of trading. In no category do the HOT User IDs trade as much as their Study Period average.
In summary, in TSXV-listed securities, although HOT User IDs are trading more in mid to high liquidity securities in absolute terms, they are trading proportionally more in the highly liquid securities.

**Trading by HOT User IDs: Price Categories**

**Definition of Price Categories**

The price of each order and trade as it was provided to IIROC in the Regulatory feed was categorized according to Table 8. This methodology was employed in preference to categorizing the orders and trades based on an average reference price for each security. It should be noted that some securities will have traded at the boundary of a price division over the Study Period. In these cases, the orders and trades for a security will sometimes be in one category and sometimes in another.

**Table 8: Price Categories**

<table>
<thead>
<tr>
<th>Price Category</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$10.00 and over</td>
<td></td>
</tr>
<tr>
<td>$5.00 to under $10.00</td>
<td></td>
</tr>
<tr>
<td>$1.00 to under $5.00</td>
<td></td>
</tr>
<tr>
<td>$0.10 to under $1.00</td>
<td></td>
</tr>
<tr>
<td>Under $0.10</td>
<td></td>
</tr>
</tbody>
</table>

**Trading by HOT User IDs by Price Category: TSX-Listed**

**Figure 77: Volume of trading by HOT User IDs by Price Category: TSX-Listed**
As seen in Figures 77-79, in TSX listed securities, HOT User IDs are trading predominantly at prices at or above $10.00. Further, HOT User IDs trade 97% of volume, 100% of value and 99% of trades at prices above $1.00.
Figure 80 shows that HOT User IDs trading in TSX listed securities trade below their Study Period average at prices below $1.00, and at their Study Period average at prices above $1.00. It appears that HOT User IDs trade proportionally more the higher the price; however, the proportion of trading in the $5.00 to under $10.00 and the $10.00 and over categories are almost the same, suggesting that above a certain price, HOT User IDs do not trade an increasing portion.

In summary, HOT User IDs are trading predominantly in TSX listed securities priced above $1.00 in both absolute and relative terms.
**Trading by HOT User IDs by Price Category: TSXV-Listed**

*Figure 81: Volume of Trading by HOT User IDs by Price Category: TSXV-Listed*

*Figure 82: Value of Trading by HOT User IDs by Price Category: TSXV-Listed*
As seen in Figures 81-83, HOT User IDs trade predominantly in TSXV listed securities in two categories, $0.10 to under $1.00 and $1.00 to under $5.00. These two categories account for 85% of the volume traded, 90% of the value traded and 94% of the number of trades executed by HOT User IDs in TSXV listed securities. More volume is traded by HOT User IDs in the $0.10 to under $1.00 category, and more value and number of trades is executed by HOT User IDs in the $1.00 to under $5.00 category.
Figure 84 shows that HOT User IDs trading in TSXV listed securities trade proportionally more in the price category $1.00 to under $5.00, with HOT User IDs trading proportionally less in the lesser and greater price categories. In no category do the HOT User IDs trade as much as their Study Period average.

In summary, HOT User IDs predominantly trade in TSXV listed securities priced above $1.00 and less than $5.00 in both absolute and relative terms.

**Trading in Inter-Listed Securities by HOT User IDs**

The following section explores the trading in US inter-listed securities by HOT User IDs.

**Definition of Inter-Listed Securities**

A list of securities inter-listed between TSX and a US exchange\(^3\) was obtained from the TMX Group Inc. and used to identify trades in inter-listed securities.

**Figure 85: Average Daily Volume of Trading by HOT User IDs in US Inter-Listed Securities**

HOT User IDs are responsible for 36% of all trading in US inter-listed securities by volume. This is higher than their percentage of trading in non-inter-listed securities, and higher than their Study Period average of 22%.

\(^3\) TMX Datalinx provided three lists of TSX-US inter-listed securities dated August 15, September 9 and October 19. These lists are created when there are changes to the list, rather than at regular monthly intervals.
HOT User IDs are responsible for 35% of all trading in US inter-listed securities by value. This is higher than their percentage of trading in non-inter-listed securities, and slightly higher than their Study Period average of 32%.

HOT User IDs are responsible for 48% of the number of trades in US inter-listed securities. This is higher than their percentage of trading in non-inter-listed securities, and slightly higher than their Study Period average of 42%.
In summary, HOT User IDs trade a higher percentage in US Inter-listed securities than in non-inter-listed securities, whether measured by volume, value, or number of trades executed.

Further (not illustrated), 23% by total volume traded, 59% of total value traded and 55% of total trades executed by all Participants is in US inter-listed securities.

**Trading in Securities in the S&P TSX 60 Index by HOT User IDs**

A list of securities which were components of the S&P TSX 60 Index\(^4\) (“S&P TSX 60”) during the Study Period was obtained from TMX Group Inc. and used to identify trades in securities which were constituents of the index. The following section explores trading by HOT User IDs in the S&P TSX 60 securities as a portion of all TSX listed securities (TSXV listed securities were excluded).

**Figure 88: Average Daily Volume by HOT User IDs in S&P TSX 60 Securities**

By volume, HOT User IDs trade more in S&P TSX 60 securities than their study average (33% vs. 22%) and more than in TSX-listed securities that are not constituents of the Index (33% vs. 26%).

\(^4\) TMX Datalinx provided information regarding the constituents of the S&P TSX 60 Index for the Study Period.
By value, HOT User IDs trade approximately the same amount in S&P TSX 60 securities as their study average (33% vs. 32%) and approximately the same amount in TSX-listed securities that are not constituents of the Index (33% vs. 31%).

**Figure 90: Average Daily Number of Trades by HOT User IDs in S&P TSX 60 Securities**

By number of trades, HOT User IDs traded slightly more in S&P TSX 60 securities than their study average (45% vs. 42%) and slightly less than in TSX-listed securities that are not constituents of the Index (45% vs. 40%).
In summary, HOT User IDs trade a higher percentage in S&P TSX 60 securities than in TSX-listed securities that are not constituents of the Index, whether measured by volume, value or number of trades executed.

Further (not illustrated), 27% of total volume traded, 59% of total value traded and 49% of total trades executed by all Participants is in securities in the S&P TSX 60.

**Trading in Securities in the S&P TSXV 30 Index by HOT User IDs**

A list of securities which were components of the S&P TSXV 30 Index\(^5\) (“S&P TSXV 30”) during the Study Periods was obtained from TMX Group Inc. and used to identify trades in securities which were constituents of the index. The following figures explore the trading by HOT User IDs in the S&P TSXV 30 securities as a portion of all TSXV listed securities (TSX listed securities were excluded).

*Figure 91: Average Daily Volume by HOT User IDs in S&P TSXV 30 Securities*

By volume, HOT User IDs trade less in S&P TSXV 30 securities than their study average (14% vs. 22%) and more than in TSXV-listed securities that are not constituents of the Index (14% vs. 4%).

\(^5\) TMX Datalinx provided information regarding the constituents of the S&P TSXV 30 Index for the Study Period.
Figure 92: Average Daily Value by HOT User IDs in S&P TSXV 30 Securities

By value, HOT User IDs trade less in S&P TSXV 30 securities than their study average (11% vs. 32%) and more than in TSXV-listed securities that are not constituents of the Index (11% vs. 6%).

Figure 93: Average Daily Number of Trades by HOT User IDs in S&P TSXV 30 Securities

By number of trades, HOT User IDs trade less in S&P TSXV 30 securities than their study average (28% vs. 42%) and more than in TSXV-listed securities that are not constituents of the Index (28% vs. 15%).
In summary, HOT User IDs trade a higher percentage in S&P TSXV 30 Index securities than in TSXV-listed securities that are not constituents of the Index, whether measured by volume, value or number of trades executed.

Further (not illustrated), 10% of total volume traded, 33% of total value traded and 33% of total trades executed by all Participants is in securities in the S&P TSXV 30.

L. Where are HOT User IDs Trading?

*Where are HOT User IDs Trading: Summary by Listed Marketplace*

The following section explores the trading by HOT User IDs by the listing marketplace of a security. Please note that the information for CNSX was provided to IIROC separately from the Regulatory feed and analyzed independently to be included in these figures. CNSX currently provides trading data to IIROC through the Regulatory feed.

*Table 9: Trading by HOT User IDs by Listed Marketplace*

<table>
<thead>
<tr>
<th>Listed Market</th>
<th>TSX</th>
<th>TSXV</th>
<th>CNSX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>94%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Value</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Number of Trades</td>
<td>98%</td>
<td>2%</td>
<td>0%</td>
</tr>
</tbody>
</table>

By volume, value and number of trades, HOT User IDs trade predominantly TSX listed securities.

*Figure 94: Percentage of Trading by HOT User IDs by Listed Market*

HOT User IDs trade at least the study average in TSX listed securities and less than the study average in TSXV and CNSX listed securities. As a proportion of trading in each market’s listed
securities, HOT User IDs trade most in TSX listed securities, less in TSXV listed securities and least in CNSX securities.

In summary, HOT User IDs trade most in TSX listed securities in both absolute and relative terms.

**Where are HOT User IDs Trading: Summary by Traded Marketplace**

The following section discusses trading by HOT User IDs by traded Marketplace. The trading venues include eight ATS’ and three Exchanges, including CNSX. Please note that the trading venues have been anonymized.

*Figure 95: Volume of HOT Trading by Traded Marketplace*

HOT User IDs trade the most volume on three trading venues.
Figure 96: Value of HOT Trading by Traded Marketplace

HOT User IDs trade the most value on three trading venues.

Figure 97: Number of HOT Trades by Traded Marketplace

HOT User IDs executed the most trades on three trading venues.
By volume (illustrated below), value or number of trades, the majority of trading by HOT User IDs is conducted on three trading venues. In summary, by volume, value or number of trades, the majority of trading by HOT User IDs is conducted on the same three trading venues.

Figure 98: Percentage of Trading by HOT User IDs by Traded Market

HOT User IDs trade more than their study average on five trading venues, and slightly less than the study average on two trading venues. HOT User IDs trade well below the study average on the remaining 4 trading venues.

In summary, only two of the trading venues showed both absolutely and proportionally more trading by HOT User IDs.

---

6 The trading venues include eight ATS’ and three Exchanges, including CNSX.
M. When are HOT User IDs Active?
The following sections explore trading by HOT User IDs by month, day and intra-day periods.

**When are HOT User IDs Trading: by Month**

*Figure 99: Volume by Month*

Total traded volume decreased slightly over the three months of the Study Period. The percentage volume of trading by HOT User IDs also declined slightly over the Study Period, from 24% to 20%.

*Figure 100: Value by Month*
Total value traded decreased markedly over the three months of the Study Period. The percentage value of trading by HOT User IDs also declined in absolute and relative terms over this period, from 34% to 29%.

Figure 101: Number of Trades by Month

The total number of trades decreased over the three months of the Study Period. The number of trades by HOT User IDs also declined in absolute and relative terms over this period, from 43% to 39%.

In summary, market activity declined over the three month Study Period, whether measured by volume, value, or number of trades. The percentage of activity by all measures by HOT User IDs also declined over the period.
When are HOT User IDs Trading: by Day

Figure 102: Volume by Day

Figure 102 shows the fluctuations in daily trading volume. The percentage of daily volume by HOT User ID also fluctuates, ranging from 16.76% to 28.08%, and exhibits the general downward trend observed in the monthly charts. The standard deviation of the percentage volume traded by HOT User IDs is 2.52%.

Figure 103: Value by Day

Figure 103 shows the fluctuations in daily trading value. The percentage of daily value by HOT User ID also fluctuates, ranging from 22.49% to 38.28%, and exhibits the general downward trend observed in the monthly charts.
trend observed in the monthly charts. The standard deviation of the percentage value traded by HOT User IDs is 3.47%.

Figure 104: Actual Number of Trades by Day

Figure 104 shows the fluctuations in the daily number of trades executed. The percentage of trades by HOT User ID also fluctuates, ranging between 35.61% and 45.23%, and exhibits the general downward trend observed in the monthly charts. The standard deviation of the percentage of trades by HOT User IDs is 2.36%.

Both total and HOT User ID activity (as an absolute and as a percentage) decreased over the Study Period, when measured by volume, value or number of trades. The percentage of trading by HOT User IDs is fairly consistent, with some variation and overall trending, but still bounded within a 10% to 15% range.

**When are HOT User IDs Trading: Intra-Day**

For the purposes of this analysis, we have broken the trading day into three sections:

- The Common Trading Session, defined as the period during which all marketplaces are open, (between 9:30 am and 4:00 pm). The market-on-close session on TSX (“TSX MOC”) was included (although it is technically after 4:00pm) as it trades significant volumes and is of interest to many participants.
- Pre-CTS (prior to 9:30 am).
- Post-CTS (following 4:00 pm), excluding TSX MOC session.
Table 10: Volume by Trading Session

<table>
<thead>
<tr>
<th>Trading Activity Category</th>
<th>Pre 9:30</th>
<th>9:30 to 4:00 (Including Opening and MOC Session)</th>
<th>Post 4:00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT</td>
<td>0.06%</td>
<td>99.79%</td>
<td>0.15%</td>
<td>100.00%</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.22%</td>
<td>98.68%</td>
<td>1.11%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 11: Value by Trading Session

<table>
<thead>
<tr>
<th>Trading Activity Category</th>
<th>Pre 9:30</th>
<th>9:30 to 4:00 (Including Opening and MOC Session)</th>
<th>Post 4:00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT</td>
<td>0.08%</td>
<td>99.70%</td>
<td>0.22%</td>
<td>100.00%</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.10%</td>
<td>97.89%</td>
<td>2.01%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Table 12: Number of Trades by Trading Session

<table>
<thead>
<tr>
<th>Trading Activity Category</th>
<th>Pre 9:30</th>
<th>9:30 to 4:00 (Including Opening and MOC Session)</th>
<th>Post 4:00</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOT</td>
<td>0.02%</td>
<td>99.97%</td>
<td>0.01%</td>
<td>100.00%</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.02%</td>
<td>99.95%</td>
<td>0.03%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Tables 10, 11 and 12 show that greater than 97% of all trading, whether measured by volume traded, value traded or trades executed, for both HOT and OTHER, took place in the Common Trading Session.
When are HOT User IDs Trading: By Half Hour Increments

When measured by volume, value or number of trades within the Common Trading Session a saddle shape is seen, with more activity at the beginning and end of the day, with a relative lull in activity mid-day.

Figure 105: Average Daily Volume by Half Hour Increment in Common Trading Session

The percentage average volume traded by HOT User IDs peaks between 10:00 and 10:30, and between 3:30 and 4:00; there is relatively little participation in the TSX MOC session.

Figure 106: Average Daily Value by Half Hour Increment in Common Trading Session
The percentage average value traded by HOT User IDs peaks between 10:00 and 10:30, and between 3:30 and 4:00; there is relatively little participation in the TSX MOC session.

*Figure 107: Average Daily Number of Trades by Half Hour Increment in Common Trading Session*

The percentage average volume traded by HOT User IDs peaks between 10:00 and 10:30, and between 2:00 and 2:30 and 3:30 and 4:00; there is relatively little participation in the TSX MOC session.

In summary, the percentage of trading by all measures by HOT User IDs is fairly constant throughout the Common Trading Session, with slight peaks seen, including one in the last half hour of trading. HOT User IDs do not form a large percentage of the MOC trading session on TSX.

**When are HOT User IDs Trading: Open and Close of Common Trading Session**

Please note the following:

- The bar marked OT encompasses trading during the opening session on TSX and TSXV, and also includes any single opening trade on any marketplace between 9:30 and 10:00
Figure 108: Average Daily Volume by 5 Minute Increment at Open and Close of Common Trading Session

Figure 109: Average Daily Value by 5 Minute Increment at Open and Close of Common Trading Session
In summary, when the first and last half of trading is reviewed in 5-minute increments, breaking out the Opening Trades and TSX MOC into their own categories, we note:

- HOT User IDs do not form a large percentage of the opening trades, when measured by volume, value or number of trades;
- HOT User IDs do not form a large percentage of the TSX MOC session, when measured by volume, value or number of trades;
- The volume, value and number of trades by all market participants in the last 5 minutes of the common trading session is markedly higher than in the preceding 5 minutes time periods of the closing half hour; and
- The percentage of volume and value traded by HOT User IDs in the last 5 minutes of the Common Trading Session is slightly higher than in the preceding 5 minute time periods of the closing half hour.

**When are HOT User IDs Trading: Percentage Active and Passive**

The following figures explore the percentage of passive and active trading by HOT UserIDs in time increments over the common trading session. Because HOT User IDs on average trade a smaller portion in the opening and in the MOC session, this trading activity has not been included. Trading was divided into the following time categories:

- One minute increments between 9:30 and 9:35 (opening trades excluded)
- Five minute increments between 9:35 and 10:00
- Half hour increments between 10:00 and 3:30
- Five minute increments between 3:30 and 3:55
- One minute increments between 3:55 and 4:00

**Figure 111: Average Daily Volume and Percentage of Active and Passive Volume by HOT User IDs by Time Increments**

Figure 111 shows that by volume, HOT User IDs are most active and least passive in the first half hour and last minute of trading.

**Figure 112: Average Daily Value and Percentage of Active and Passive Volume by HOT User IDs by Time Increments**

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The HOT Study - Appendix B
Figure 112 shows that by value, HOT User IDs are most active and least passive in the first five minutes of trading.

**Figure 113: Average Daily Number of Trades and Percentage of Active and Passive Volume by HOT User IDs by Time Increments**

Figure 113 shows that by number of trades, HOT User IDs are most active and least passive in the first four minutes and last minute of trading.

*When are HOT User IDs Trading: Order-to-trade Ratio*

The following figure explores the average number of new and amended orders and the order-to-trade ratio by HOT User IDs by half hour increments during the common trading session. These charts compare trading by HOT User IDs and the trading by all remaining User IDs.
Figure 114: Average Daily Number of New and Amended Orders and Order-to-trade Ratio by Half Hour Increment in Common Trading Session

Figure 114 reveals that the number of new and amended orders form a saddle shape similar to that identified for the volume, value and number of trades by half hour (Figures 105, 106 and 107).

The order-to-trade ratio for the HOT User IDs takes the opposite shape with a lower order-to-trade ratio early in the day and late in the day, cresting in the middle of the day.

It would appear that the order-to-trade ratio for the HOT User IDs has an inverse relationship to the saddle shape of the total number of orders (noting that volume, value and number of trades also have this saddle shape). In other words, it appears that HOT User IDs enter more orders relative to their number of trades during periods of lower market activity. Analysis was conducted to explore this potential relationship to see if it could be statistically verified.
Figure 115 shows the relationship between the number of trades by all market participants (HOT and OTHER User IDs) in a half hour increment in the common trading session plotted against the order-to-trade ratio for HOT User IDs in the same time period. The line of best fit was determined, and the R-squared value was calculated. The R-squared value measures how well the trend line predicts the relationship between the two variables. An R-squared value of 1 would indicate that all the observations fell on the line. It would appear that there is a weak inverse relationship between the total trades and the HOT order-to-trade ratio in a half hour increment.
V. Table of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
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<tbody>
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<td>Market Share by Volume Traded over Study Period</td>
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<td>Market Share by Value Traded over Study Period</td>
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<td>Market Share by Trades Executed over Study Period</td>
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<td>Frequency of De-trended Log Orders</td>
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<td>Orders vs. Trades – HOT &amp; OTHER</td>
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<td>Number of HOT User IDs by Month</td>
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<td>Number of HOT User IDs</td>
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<td>Volume of Trading by HOT User IDs</td>
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<td>Value of Trading by HOT User IDs</td>
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<td>Number of Trades by HOT User IDs</td>
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<td>Number of New and Amended Orders by HOT User IDs</td>
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<td>18</td>
<td>Additional Comparisons between HOT and OTHER</td>
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<td>Number of HOT User IDs by DMA and Non-DMA Account Type</td>
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<td>Number of Trades by HOT User IDs by DMA and Non-DMA Account Type</td>
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<td>Order-to-trade Ratio of HOT User IDs by DMA and Non-DMA Account Type</td>
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<td>Order-to-trade Ratio of HOT User IDs by DMA and Non-DMA Account Type in selected Security Types</td>
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<td>Percentage of Volume Traded by HOT User IDs by DMA and NDMA in Selected Security Types</td>
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<td>Percentage of Value Traded by HOT User IDs by DMA and NDMA in Selected Security Types</td>
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<td>27</td>
<td>Percentage of Trades Executed by HOT User IDs by DMA and NDMA in Selected Security Types</td>
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<td>28</td>
<td>Example of Double Counting Volume</td>
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<tr>
<td>29</td>
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