OMERS and BMO:
Field Testing Changes in Market Microstructure
by Rob Gouley and Eric Stockland

Market microstructure today

Competition compels exchanges and ATSs to innovate in novel ways just to maintain, let alone grow, their market share. Recent competition has shifted its focus to execution quality, with many examples live in today's marketplace: Nasdaq's Midpoint Extended Life Order (M-ELO), Intelligent Cross's AI powered matching, CBOE's Quote Depletion Mechanism, Level's VWAP Cross, and IEX's Discretionary Limit order.[1]

A methodic plan for experimentation

At BMO, we test venue and order type innovations with small-scale experiments, permutating our order routing to incorporate these new offerings and measure results. It's a prudent balance of risk and reward for these new trading tactics, but that prudence can also make discerning an aggregate effect on performance difficult.

While early stage tests are useful in measuring the marginal impact of a new order type or venue, effects can be diluted by the existing venues and order types in an algorithm. One way to speed up the learning cycle is to run a more concentrated and focused experiment, but that works best with support and collaboration from an asset manager.

Case study overview

In the spring of 2021, BMO upgraded its technology infrastructure to support the novel workflow associated with IEX's D-Limit order type and its restatement mechanism.[2] We teamed up with OMERS[3], one of the world's largest defined benefit pension plans, to explore the impact of IEX's D-Limit order type. OMERS Capital Markets team is a global investor responsible for the direct management of over $50 billion in net assets across a range of public market portfolios and strategies, including tens of billions of dollars of US and Canadian listed equities. OMERS is an industry thought-leader and is proactive in experimenting with new technologies to uncover incremental performance for its members. At OMERS, best execution is recognized as a process, not just a result, and thoughtful experimentation is integral to the best execution process. After a discussion with OMERS's Equity Trading Principal Rob Gouley, we were given the green light to run a joint experiment with an algorithm that would help us isolate and evaluate the impact of D-Limit.
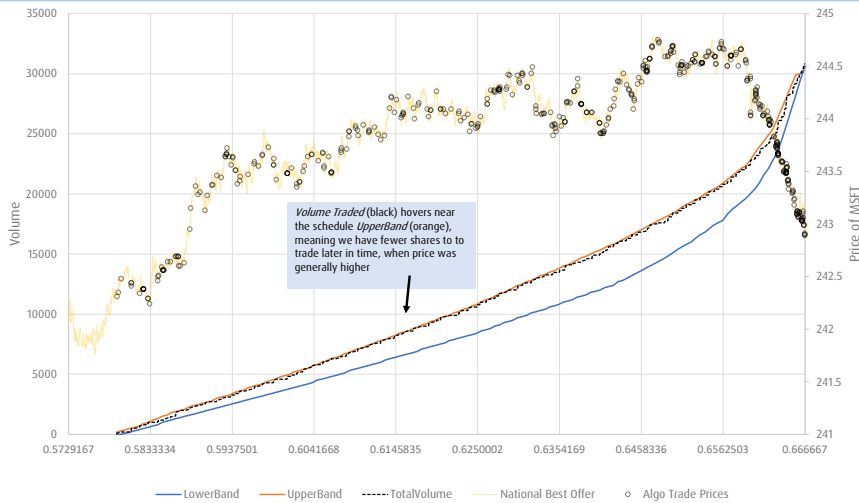
Approach

Our idea was to build a VWAP algorithm that leverages IEX's D-Limit order type when posting passively and utilizes IEX's non-displayed Primary Peg order for reserve shares. Both D-Limit and Primary Peg are designed to limit adverse selection by employing IEX's speed bump and Crumbling Quote signal.[4] We designed the algorithm to only escalate to more aggressive tactics at the NBBO mid if it falls behind schedule.

By isolating the effect of D-Limit, we hoped to maximize the order type's impact to benchmark performance. For example, consider the following: We want to sell 200 shares and the NBBO is $10.10 x $10.11. An algorithm places an order to sell 100 shares at $10.11 on a maker taker exchange and 100 shares on IEX D-Limit. If the NBBO ticks up to $10.11 x $10.12, the maker taker exchange order would be filled at $10.11. If, however, IEX correctly predicted the "Crumbling Quote," we would avoid a fill at $10.11 on IEX, leaving 100 shares open at $10.12. If those remaining shares trade at $10.12, we'd have an average price of $10.115, but if we had worked 200 on D-Limit we could have an average price of $10.12.[5] The key is that the potential value of a new order type can be diluted by the concurrent tactics present in an algorithm.

Our joint efforts and analysis cover many orders, however, we wanted to share a detailed example with our peers in industry to contribute to the public discourse on one of the more controversial market structure topics in recent years. We acknowledge that a reader cannot extrapolate expectations for benchmark performance from a single order; we can, however, dig into an individual order to learn how microstructure can benefit child-level executions. Presumably, as child order execution quality improves, the performance gains should accrue towards improving parent level benchmarks.

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VWAP Order Analysis: Sell 30,800 MSFT at MKT 5/13/2021

Volume Traded (black) hovers near the schedule *UpperBand* (orange), meaning we have fewer shares to trade later in time, when price was generally higher

Legend: LowerBand — UpperBand — TotalVolume ····· National Best Offer ○ Algo Trade Prices

As a seller into a rallying market, passive executions should be easier to come by and we'd generally expect volume traded to be at the limits of the schedule, which is what we see in the chart at left. What this means in practice, and with the benefit of hindsight, is that the algo had fewer shares to trade later in the day when prices were better. However, in this limited example, the parent order ended up narrowly beating interval VWAP by ⅓ of a basis point or ¾ of a penny. How?
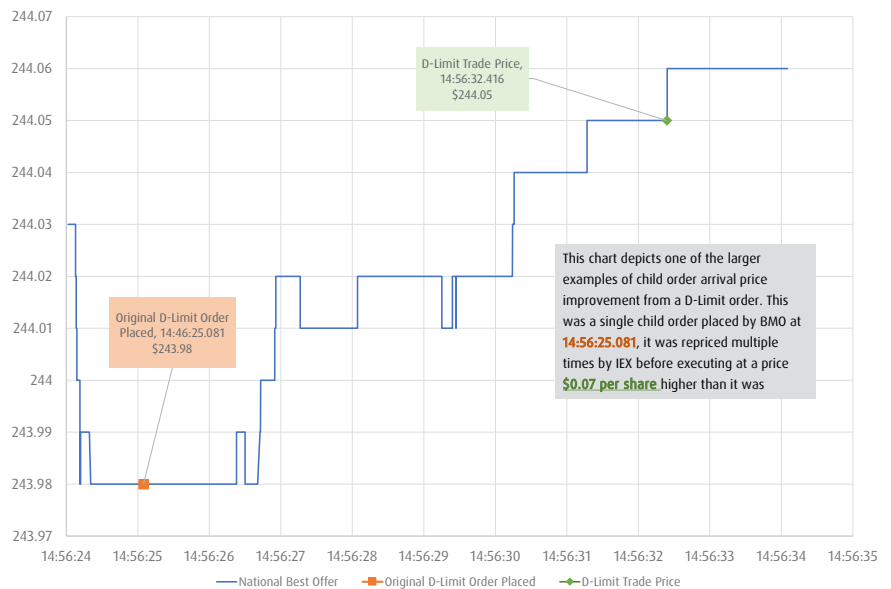
The interval VWAP was driven by child orders trading at prices that were on average $0.0168 per share *better*[6] than their limit prices.[7] For a displayed and protected limit order, this is a radical new concept. We will examine this concept with a specific example, and then describe the aggregate impact.

Example

We placed a D-Limit order to sell with a limit price of $243.98 at 14:56:25.081. That order was repriced by IEX in multiple Crumbling Quotes prior to it executing at $244.05, for a savings of $0.07 per share. The magnitude of this child order arrival price improvement is a more extreme example to illustrate the potential savings, but price improvement is not a rare occurrence.

Think again about the hypothetical example of posting on a maker taker exchange concurrently with D-Limit orders and in the context of the price action charted at right. You would expect the sell orders on maker taker exchanges to have traded on each tick of the offer, potentially exhausting the algo's sell interest at worse prices, well before the sale on IEX at $244.05.[8] A large part of the value realization in D-Limit is what BMO and OMERS are not doing, e.g. not placing child orders on venues with higher adverse selection. An analogy would be trying to lose weight by adding exercise to your daily routine, but if you don't stop eating junk food the potential value of adding exercise is mitigated by poor food choices. You are probably still better off exercising and eating junk food, but if you want to see faster and larger results, you need to both start exercising and stop eating junk food.[9]

Example of D-Limit Child Order Arrival Price Improvement

D-Limit Trade Price, 14:56:32.416 $244.05

Original D-Limit Order Placed, 14:46:25.081 $243.98

This chart depicts one of the larger examples of child order arrival price improvement from a D-Limit order. This was a single child order placed by BMO at **14:56:25.081**, it was repriced multiple times by IEX before executing at a price **$0.07 per share** higher than it was

Legend: National Best Offer ■ Original D-Limit Order Placed ◆ D-Limit Trade Price

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Continued

Results

For this single parent order, total child order arrival price improvement it was $518.05. Averaged over all shares executed, that amounts to $.0168 per share in savings.[10]

If you recall our interval VWAP beat was approximately $.0075; the difference here in beating interval VWAP in a tough market and missing VWAP is child order arrival price improvement.

At right is a histogram depicting the frequency and magnitude of child orders that executed at prices better than arrival, including both Primary Peg and D-Limit orders.[11]

In our example, the price of MSFT generally rallied over the life of the order, and one might presume child orders were price improved because they were on the opposite side of a trending market. Interestingly, that's not strictly the case; child order arrival price improvement also happened in periods where share prices were gyrating. In the chart below, we plot the price of MSFT and the cumulative child order arrival price improvement from 14:45 to 15:14 from both D-Limit and Primary Peg orders. This example shows that child orders can perform well in high tick volatility times when the price direction is not trending.

Magnitude & Frequency of Child Order Arrival Price Improvement
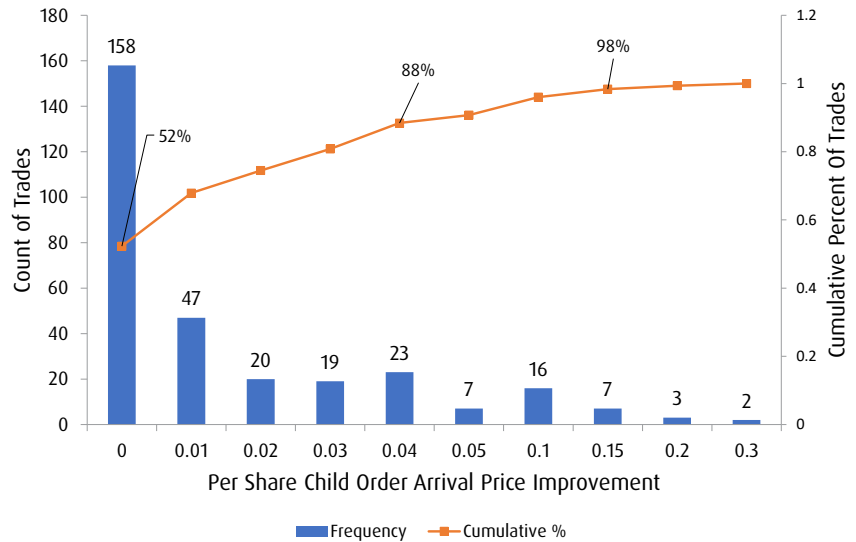
Child Order Arrival Price Improvement in a Gyrating Market
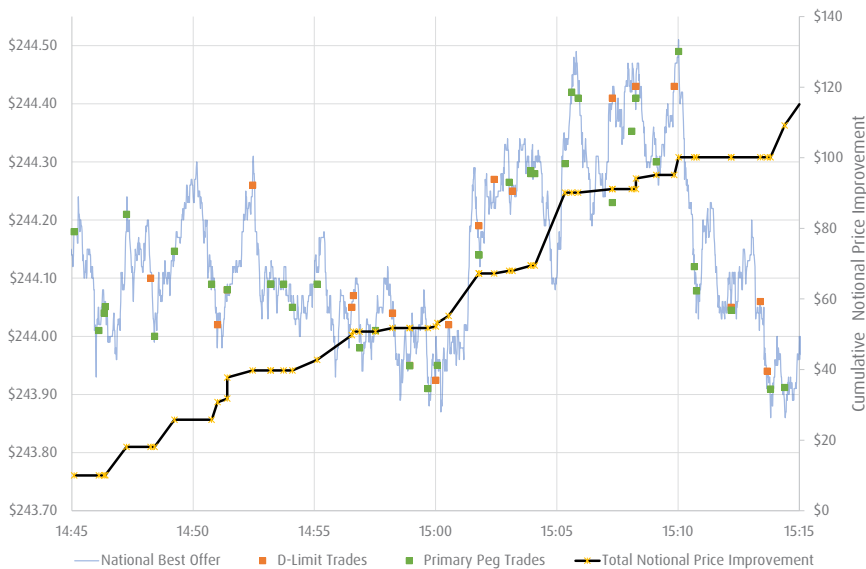
Conclusion

Casting aside the market structure debate, D-Limit represents an execution alternative for asset managers that are all too often adversely selected in the current latency obsessed market microstructure. The benefits of this order type accrue directly to the asset manager and asset owner, and, hopefully, the asset management community will see more choices like it in the years ahead.

Considerations for scale, for the opportunity cost of not trading, and for the risk of potential information leakage are all challenges for market participants to study and compete on. What is certain is that D-Limit and order types like it represent a new frontier for performance and incentivize participation in the public price discovery process which our industry depends upon.

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[1] Co-author Eric Stockland worked at IEX from July 2016 through October 2020, is listed as an inventor on IEX's D-Limit patent application (https://patents.justia.com/patent/20200167866) and owns an illiquid equity position in the IEX Exchange Group.

[2] As a matter of best practice, brokers should process the unsolicited restatement messages and incorporate logic to cope with false positive restatement messages. BMO integrated logic into our algorithms to intelligently cope with the unique messaging and features associated with IEX's Discretionary Limit order type.

[3] The Ontario Municipal Employees Retirement System ("OMERS") Primary Plan is a jointly sponsored, defined benefit pension plan, with 1,000 participating employers ranging from large cities to local agencies, and over half a million active, deferred and retired members across Ontario. OMERS members include union and non-union employees of municipalities, school boards, local boards, transit systems, electrical utilities, emergency services and children's aid societies.

[4] https://iextrading.com/trading/signal/

[5] This is an intentionally simple example. There are numerous variables to consider including false positives, opportunity costs, signaling, and the likelihood of being able to sell the stock at $10.12 or at even higher prices.

[6] We define D-Limit and P-Peg child order arrival price improvement as the difference between our execution price and the arrival near.

[7] Interval VWAP performance is also heavily influenced by divergence in actual volume vs forecasted. For this parent order, the actual volume curve was approximated well by the forecasted curve.

[8] The eventual sale at $244.05 might in isolation look like a 'bad' fill in markout space as the price moved higher post trade, but only with the context of the pre-trade child order arrival price improvement do we realize the quality of the execution. The execution price was $0.07 per share better than its original limit price. Markouts calculated from trade price don't factor in pre-trade child order arrival price improvement.

[9] There are venues other than IEX that help protect child orders from adverse selection. At the near touch in the US are segmented ATSs and Intelligent Cross's ASPEN, as well as TMX Alpha and Aequitas NEO in Canada. Additionally, CBOE's QDP mechanism, Nasdaq's MELO, IEX D-Peg and conditional orders mitigate the risk of immediate adverse selection at the midpoint. This list is not exhaustive.

[10] This average is not an indication of future performance, it varies by ticker and by day. The example was not cherry picked for its Price Improvement stats, rather it was selected for its size, duration, and age.

[11] Note that the bin $.10 includes all child orders price improved between $0.06 and $0.10 per share. The bin size covers 5 ticks whereas the preceding bins were all in $0.01 increments.