ERIC BUDISH

Professor of Economics and Richard N. Rosett and David G. Booth Faculty Fellow

The University of Chicago Booth School of Business

5807 South Woodlawn Avenue Chicago, Illinois 60637

Phone: ▮▮▮▮▮▮▮▮ Email: ▮▮▮▮▮▮▮▮▮▮▮▮

April 14, 2016

Brent J. Fields
Secretary
US Securities and Exchange Commission
100 F Street, N.E.
Washington, D.C. 20549-0609

> Re: <u>Proposed Commission Interpretation Regarding Automated Quotations Under Regulation
> NMS (Release No. 34-77407; File No. S7-03-16)</u>

Dear Mr. Fields:

I appreciate the opportunity to comment on the Commission's proposed rule interpretation regarding
the definition of Automated Quotations under Regulation NMS. I am an economics professor at the
University of Chicago Booth School of Business who researches market design. I write independently,
without any financial involvement with any of the participants in the market structure debate.

The proposed interpretation of 1 millisecond as "de minimis" clarifies the meaning of "immediate" for
the purpose of order protection under Reg NMS. "Immediate" now means less than one millisecond.
Under this interpretation, IEX's market design is in compliance with the order protection rule of Reg
NMS since its quotations are both automatically and "immediately" accessible. More significantly, the
clarification of "immediate" now provides all exchanges, not just IEX, the opportunity to innovate on
market design to address latency arbitrage and reduce the outsized importance of speed in today's
trading environment. I applaud the Commission for enhancing exchanges' flexibility to innovate.
However, I have two concerns, one of which is significant, that I will explain below.

Interpreting delays of less than one millisecond as de minimis opens the door to several alternative
market designs aimed at addressing latency arbitrage and the outsized importance of speed. These
include not just IEX's proposed design but also (i) discrete-time batch process trading (i.e., frequent
batch auctions) [1], if the batch interval is less than one millisecond; (ii) the continuous limit order book
with asymmetric delay,[2] if the delay is less than one millisecond; and (iii) the continuous limit order book
with random delay, if the delay is less than one millisecond. Discussion of the economic impact of each
of these alternate market designs can be found in my recent research paper published in the *Quarterly*

---

[1] Frequent batch auctions may sound like a significant departure from the continuous limit order book but there
are really only two differences: (i) time is treated as discrete rather than continuous, and (ii) orders are batch
processed after each discrete time interval using a uniform price auction instead of serially in order of receipt. For
a full description of frequent batch auctions, see Section VII of Eric Budish, Peter Cramton and John Shim, "The
High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response," *Quarterly Journal of
Economics*, Vol. 130(4), November 2015, pgs. 1547-1621. Available under Open Access license at:
http://faculty.chicagobooth.edu/eric.budish/research/HFT-FrequentBatchAuctions.pdf.
[2] The delay is asymmetric in the sense that only marketable orders are delayed.

Journal of Economics, a leading peer-reviewed economics journal.[3] All three examples listed here seemingly comply with the order protection rule of Reg NMS under the proposed rule interpretation since all three market designs process orders automatically and "immediately" (within one millisecond).[4]

As I interpret the spirit of the proposed rule interpretation, the definition of 1 millisecond as de minimis is partly analogous to the minimum tick size of $0.01. The sub-penny rule of Reg NMS (Rule 612) establishes a minimum price increment of $0.01 to address "the practice of 'stepping ahead' of displayed limit orders by trivial amounts" of money. The interpretation of 1 millisecond as de minimis would allow for exchanges to process orders in a manner that addresses the practice of racing ahead of other orders by trivial amounts of time. (A difference is that Rule 612 mandates a minimum tick size, whereas this proposed interpretation would allow for but not require exchanges to modify how they treat time).

I have two concerns with the proposed rule interpretation that I encourage the Commission to address. The first concern is that the Commission should clarify where the choice of one millisecond comes from – why 0.001 seconds as opposed to 0.0001 seconds, 0.01 seconds, etc.? If a specific number must be hard-coded into regulation then it is important that the rationale behind the specific number is clarified. This could help guide future practice in the likely event that either speed technology or the geography of stock exchanges changes significantly.

My second and more significant concern is that, in addition to clarifying the definition of "immediate", the Commission should more explicitly clarify that exchanges do indeed have the flexibility to innovate on market design beyond the confines of the continuous limit order book under Reg NMS. The reason for the need for explicit clarification is that the language of Reg NMS often seems to implicitly assume that all exchanges in the National Market System use the continuous limit order book, even though the language never explicitly mandates that all exchanges use this design.[5] The proposed rule interpretation document suggests that the Commission does not mean to mandate that exchanges use the continuous limit order book; ideally this flexibility should be made explicit and its limitations outlined. Do exchanges have complete flexibility to handle orders that arrive within the de minimis threshold in any way they deem best? Are they mandated to process messages serially in order-of-receipt, as in the continuous limit order book? Can they batch process? Can they process in a random order? Can they process in a

---

[3] On frequent batch auctions, see especially Section VII of Budish et al (2015). On asymmetric delays, see Section VIII.D of Budish et al (2015) and also Baldauf and Mollner (2014). On random delays see Section VIII.C of Budish et al (2015) and also Harris (2012).

[4] A frequent batch auction exchange stores (in, say, a buffer) all orders for a period of less than 1 millisecond and is thus "immediate", then automatically and electronically processes them in a batch using an auction. The continuous limit order book with random delays processes every order in less than 1 millisecond and is thus "immediate", and the assignment of random delays and processing of orders after each order's random delay is done electronically and is automatic. The continuous limit order book with asymmetric delays processes every order in less than 1 millisecond (marketable orders with some delay less than 1 millisecond, and other orders with no delay) and is thus "immediate", and the assignment of delays and processing of orders is done electronically and is automatic.

[5] One example of such an ambiguity is Rule 600(b)(3)(ii), which requires of an automated quotation that it "immediately and automatically executes an order marked as immediate-or-cancel against the displayed quotation up to its full size". This language could be interpreted as implicitly assuming serial process trading using the continuous limit order book market design.

pre-specified order that privileges some kinds of messages (e.g., cancels) over other kinds of messages (e.g., marketable orders)?

Chair White herself emphasized the importance of eliminating regulatory ambiguities obstructing market design innovations in her June 5, 2014 speech "Enhancing our Equity Market Structure":

> We must consider, for example, whether the increasingly expensive search for speed has passed the point of diminishing returns. I am personally wary of prescriptive regulation that attempts to identify an optimal trading speed, but I am receptive to more flexible, competitive solutions that could be adopted by trading venues. These could include frequent batch auctions or other mechanisms designed to minimize speed advantages. … A key question is whether trading venues have sufficient opportunity and flexibility to innovate successfully with initiatives that seek to deemphasize speed as a key to trading success in order to further serve the interests of investors. If not, we must reconsider the SEC rules and market practices that stand in the way. (emphasis added)

I want to echo Chair White and emphasize how important it is to allow for innovation in market design. My research shows that latency arbitrage is built in to the continuous limit order book market design.[6] Thus, the outsized importance of speed is also built in to the continuous limit order book market design. If the SEC mandates that all exchanges use the continuous limit order book, then it is mandating that latency arbitrage and the outsized importance of speed are an intrinsic feature of our market structure.

To conclude: I applaud the Commission for clarifying the meaning of "immediate" and thereby seemingly paving the way for innovative new market designs that address the issues of the continuous limit order book. I encourage the Commission to explicitly clarify that the continuous limit order book is not mandated by Reg NMS, ideally to allow and even encourage the implementation of other novel market designs and not just IEX's.

Better still would be to more comprehensively reform Reg NMS, as I called for in my IEX comment letter, both to allow for market design innovation and to reduce complexity. The approach outlined in a recent proposal of Stephane Tyc[7] – eliminate trade through protection, while simultaneously mandating significantly improved transparency and time-stamp accuracy – seems a sensible starting point.

I will be pleased to be of service to the SEC in these important matters in whatever way is helpful.

Kind regards,

 Eric Budish

---

[6] Please see Budish et al (2015), Section VI, as well as my comment letter on IEX's exchange application, available at https://www.sec.gov/comments/10-222/10222-371.pdf.

[7] Stephane Tyc, 2014, "A Technological Solution to Best Execution and Excessive Market Complexity." Available at http://www.quincy-data.com/wp-content/uploads/2014/12/20141002-Atechsolutiontobestexec.pdf?aad152.