Columbia Business School

Elizabeth M. Murphy
Secretary
Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549-1090
Date 4/20/10

RE: FILE NO. S7-02-10, "CONCEPT RELEASE ON EQUITY MARKET STRUCTURE"

Ciamac C. Moallemi
Assistant Professor
Graduate School of Business
Columbia University
Uris 416
3022 Broadway
New York, NY 10027 USA
T +1-857-222-0285
O +1-212-854-0570
F +1-212-316-9180
ciamac@gsb.columbia.edu
http://moallemi.gsb.columbia.edu

Dear Ms. Murphy,

I am writing to offer comments in response to the recent concept release as follows:

1. QUANTITATIVE MEASUREMENT OF THE COST OF LATENCY

In the past decade, electronic markets have become pervasive. Technological advances in these markets have led to dramatic improvements in latency, defined here as the delay between a trading decision and the resulting trade execution. In a matter of years, latency has gone from seconds to milliseconds – "low latency" in a contemporary electronic market is qualified as under 10 milliseconds, "ultra low latency" as under 1 millisecond.

The much of the demand for low latency trading has come from a particular class of investors, so-called "high-frequency" traders. These traders expend significant resources in order to develop algorithms and computer systems that are able to trade quickly, and co-locate these systems at significant expense. There has been much discussion of the importance of latency among various market participants, regulators, and academics. Despite the significant amount of recent interest, however, latency remains poorly understood from a theoretical perspective.

The costs imposed by high latency may occur for many different reasons and, in general, may vary from investor to investor. In recent work,[1] we have developed a mathematical model to assess one fundamental role of latency in financial markets: the impact of latency on execution costs. The model considers the problem of a trader who wishes to trade an asset by placing orders in an electronic limit order book. Latency prevents the trader from maintaining continuous access to the market to adjust his orders in response to changing conditions, and thus imposes a market friction.

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[1] C. C. Moallemi and M. Sağlam, "The cost of latency." Working paper DRO-2010-02, Graduate School of Business, Columbia University, November 2009. Available at http://moallemi.gsb.columbia.edu/papers/latency-2009.pdf.

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We define the "latency cost" as the component of execution costs that are due to latency, as a fraction of the overall execution costs. Via a careful mathematical analysis, latency cost is determined as a function of common, easily estimated asset properties such as the asset's volatility and bid-offer spread. Hence, the latency cost that we derive provides a concrete measurement of the importance of latency. To my knowledge, this is the first and only model that is able to *quantitatively* access the impact of latency.

Some of the conclusions of our analysis are that:

- Latency cost is an increasing function of the asset's volatility, i.e., latency is most important when trading highly volatile assets.
- Latency cost is an increasing function of the asset's bid-offer spread, i.e., latency is most important when trading highly liquid assets.
- In the past 15 years, latency costs (again, measured as a fraction of overall transaction costs) for US equities have risen dramatically, i.e., the ability to trade with low latency is much more valuable now to investors than it has been in the past.
- Latency is important to *all* investors whether they have short-time horizons (e.g., high-frequency traders) or long-time horizons (e.g., pension funds), in so much as those with the ability to trade with low latency will face reduced execution costs.

Issues surrounding latency and high-frequency trading have often been discussed in an ad hoc or anecdotal matter. My hope is that this model will useful as a tool to broadly aid regulators and policy makers in quantifying the costs and benefits of low latency trading.

To be sure, however, our model captures one aspect of the importance of latency and has limitations. It only considers the benefits of low latency to a single investor, holding the rest of the market fixed. It does not answer larger systemic questions of fairness or consider the strategic implications of low latency trading. For example, does the ability to trade with low latency lead to greater overall market efficiency, or does it benefit one class of market participants at the expense of another class of participants? There are many interesting issues here for future research.

2. DARK POOLS AND UNDISPLAYED LIQUIDITY

So-called "dark pools" and other venues for undisplayed liquidity have become popular among some institutional investors in recent years. The rational for these dark pools is that, by minimizing information leakage and temporally matching large buyers with large sellers, they offer a way to execute large trades with minimal market impact. However, there are many reasons why dark pools might *not* be efficient venues for trade execution, for example:

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- *Adverse selection.* Even if there is lower price impact in dark pools than in displayed markets, it may be the case that there are significant costs due to adverse selection. For example, if an investor seeks to buy a stock in a dark pool and experiences a higher fill rate prior to periods when the prices are falling than when prices are rising, they may ultimately pay a higher price in a dark pool than in a displayed market even in the absence of *any* price impact.
- *Gaming of displayed prices.* Manipulation of the underlying reference price in the displayed market may result in higher execution costs.
- *Information leakage.* Even though orders in dark pools are not visible, they might be inferred through "pinging" orders.

Based on my discussions with practitioners, I think these mechanisms are not well understood. Indeed, anecdotally, the most sophisticated investors seem the most skeptical of dark pools. To know whether there is in fact cause for concern, however, it is important to move beyond anecdotes and analyze empirical data. In order to make such assessments, one would need a large quantity of historical data on orders in dark pools (whether executed or not) to cross-reference with existing public data from displayed markets. Unfortunately, by their very nature, dark pools are opaque entities. The only people with access to large volumes of historical order data are the dark pool operators themselves. They are clearly not in a position to offer a disinterested and objective analysis from the investor's perspective.

In order to more clearly understand the trade-offs that investors face in displayed versus undisplayed markets, I think it is important to enforce detailed historical transparency on all public markets, whether displayed or undisplayed. The same way that, for example, detailed Level 2 historical data is commonly available for electronic limit order books, dark pool operators should be required to publish anonymous historical order data. In order to protect investors trading in dark pools, this data could be delayed some interval of time (e.g., one month). However, without some sort of timely dissemination of detailed order data, it does not seem possible for investors, academics, policy makers, and others to analyze the relative benefits and costs of dark pools as an execution venue.

Sincerely yours,

Ciamac C. Moallemi

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Graduate School of Business
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