MEMORANDUM

TO: File No. S7-02-10

FROM: Theodore S. Venuti
Division of Trading and Markets

DATE: June 17, 2010

RE: Staff Meeting with Tradeworx, Inc.

On June 16, 2010, representatives of Tradeworx, Inc. (Manoj Narang, Arzhang Kamarei, Danielle Cassano, and Kelly Roy) met with Commission staff from the Division of Trading and Markets, Division of Risk, Strategy, and Financial Innovation, and the Office of Compliance Inspections and Examinations. The discussion included, among other things, the Commission's Concept Release on Equity Market Structure.

CANCELLATION RATES, MESSAGE TRAFFIC, AND HFT

by Manoj Narang Tradeworx, Inc.

Lately, a number of HFT detractors have begun complaining that the rate at which HFTs cancel their orders is excessively high. Furthermore, these purportedly high cancellation rates have been proffered as "evidence" of gaming or manipulation on the part of HFTs, or as "proof" that the liquidity they claim to provide is of inferior quality. Below, I undertake a critical examination of these claims, and show that the phenomenon of high cancellation rates is a red herring (i.e. a false issue). I also investigate the merits of various remedies that have been proposed to mitigate this supposed problem.

THE REASONS FOR HIGH CANCELLATION RATES

Cancellation rates in excess of 90% are natural, and arise for a number of very legitimate reasons in a healthy market:

- **Pegging**: Pegging is a common and perfectly legitimate passive-trading technique widely used by buy-side algorithms and HFT's alike. A trader who wishes to regularly participate at the NBBO must cancel his extant orders whenever the NBBO moves away from his order, so that a new order may be placed at the new NBBO. The lower bound for cancellation rate is generally around 50% for a pegging strategy, because if the market ticks up, the current bid must be cancelled and replaced with a higher priced bid, and if the market ticks down, the current offer must be cancelled and replaced with a lower priced offer. However, in practice, most players who post orders are not making two-sided markets. Most players will bid if they think the stock is going up, or offer if they think the stock is going down. This results in significantly lower fill rates than 50%, and by extension, significantly higher cancellation rates than the lower bound of 50%.
- **Competition for Time Priority**: Most electronic markets observe strict price-time priority. In such markets, time priority at a fixed price is extremely important, because it determines the extent to which the order is likely to experience "adverse selection" when filled. Thus, when a new price is formed, liquidity providers rush to submit orders to secure their place in line at the new price. Participants who wind up at the end of a very large queue will be more inclined to cancel their orders, to avoid adverse selection. However, preventing such players from cancelling their orders will deter them from trying to compete for time priority, which will result in far less competition among market makers to participate in the formation of prices.
- **Hedging**: Cross-sectional mean-reversion (i.e. mean reversion of *spreads* between stocks) is the among the oldest and most widely practiced of all quantitative strategies. A common technique for executing a mean-reverting spread trade is to post a bid on a stock you believe is "cheap", and then attempt to actively hedge yourself by hitting the bid on a stock you consider to be "rich". The success of such an approach depends on the inter-temporal availability of shares on the bid of the stock used as a hedge. If shares on the bid of the hedging instrument disappear (because the hedge ticked down), then the trader will seek to cancel his bid on passive leg of his trade, since the effective spread between the rich and cheap stocks will have changed. These sorts of strategies can have extremely high cancellation rates, yet are nonetheless very valuable to the market because they serve as effective mechanisms to transfer liquidity from stocks where it is abundant to those where it is in short supply.
- **Fair Pricing**: If a trader has posted an offer on a high-beta stock that has a penny spread, and the broad market starts rising (for instance, if SPY or S&P 500 E-Mini futures tick up), then the implied fair price for the stock has changed and the market maker will seek to cancel his offer and move it a penny higher. Anyone who complains about such behavior is effectively asserting the right to "pick off" the market-maker at an unfairly low price.

Other factors, which are not directly in the control of market participants, can also significantly impact cancellation rates:

- **Reg NMS Side-Effects**: A trader who is attempting to take an existing offer and establish a new bid at that price will often be hindered by Reg NMS, unless he is using ISO orders to trade. In such cases, his order may be involuntarily modified by an exchange in order to comply with Reg NMS – for instance an exchange may unilaterally convert a visible order into a hidden order in this situation. In such an instance, the trader will likely cancel the "repriced" or "modified" order, because it is not the order he asked for. For instance, a hidden order automatically loses time priority to all visible orders at the same price, which may defeat the trader's objective in sending the order in the first place. This is a very common occurrence and is an entirely legitimate reason to cancel an order.
- **Volatility**: The effects described above are exacerbated during periods of high volatility, simply by virtue of the fact the number of changes in the NBBO is higher. Thus, charts that show purport to show that cancellation rates are increasing over a certain timeframe, when in fact volatility is also increasing over the same timeframe, are misleading and uninformative.
- **Minimum Quoting Increment**: When the minimum quoting increment goes down, the number of NBBO changes increases (obviously), and the amount of "two-way flow" at any given NBBO decreases. This exacerbates all the above effects. Thus, studies that compare contemporary cancellation rates to those that prevailed prior to the advent of decimal pricing are deliberately misleading.
- **Fragmentation**: There are over a dozen exchanges that are "protected" by Reg NMS. Typically, a passive trader will post orders on multiple venues, since it is impossible to predict where he will get filled. The total amount posted often significantly exceeds the amount he is interested in trading. Thus, when his target size is filled, he must cancel all open orders at the remaining venues. This often compounds the issue of large cancellation rates, but is perfectly legitimate nonetheless.

COMPLAINT: CANELLATION RATES ARE TOO HIGH

This is a commonly expressed complaint, but is often ill-posed: too high for what, exactly? Detractors often fail to specify a concrete undesirable effect that arises due to high cancellation rates – rather, the very existence of high cancellation rates is often proffered as the undesirable effect in and of itself. Furthermore, detractors often fail to specify any material grounds for determining how high is "too high." On what basis is the threshold for reasonableness decided, and who gets to decide? By contrast, the previous page describes a very partial list of legitimate and compelling reasons for high cancellation rates, some of which arise from the natural operation of valuable liquidity-providing strategies, and others which arise from elements of the market structure itself.

COMPLAINT: HIGH CANCELLATION RATES ARE INDICATIVE OF POOR QUALITY OFLIQUIDITY

As is the case with many of the assertions levelled by HFTs detractors, this contention is the exact opposite of reality. As is amply demonstrated on the previous page, high cancellation rates are indicative of a robust competition among a large group of market makers and arbitrageurs, and are exhibited by a diverse set of strategies which provide high-quality liquidity to the markets, such as cross-sectional mean-reversion.

COMPLAINT: HIGH MESSAGE TRAFFIC IS INDICATIVE OF INSTABILITY OF THE NBBO

This complaint is best exemplified by a recent blog post from the anti-HFT site zerohedge.com. This post asserts that since 100,000 to 200,000 NBBO quotes per day are received on average for Dow Jones stocks in 2010 (according to Credit Suisse), that the quote changes 600+ times each minute, preventing any "true investor" from ascertaining "what is real". The post further claims that the average "quote duration" has thus gone from well over a second in 2004, to 0.1 seconds or less in 2010. Both of these contentions are sheer nonsense.

The first problem with this analysis is that it neglects to mention that the market is far more fragmented in 2010 than in 2004. Since Reg NMS went into effect in 2007, he NBBO is now comprised of protected quotes at over a dozen venues, meaning that changes at any one of them affect the NBBO. This naturally has led to an explosion of order volume as a result. This fact has nothing to do with HFT. The chart offered by the author shows a sharp spike in quote volume in 2007, after Reg NMS went into effect. Since 2007, the level of the chart has almost perfectly followed the trajectory of volatility, which is a reflection of the fact that daily quote changes are proportional to daily volatility. The chart purports to show the effect of HFT, but does nothing of the sort. It is sheer duplicity, designed to take advantage of ill-informed readers.

Equally vexing is the author's devious usage of the word "quote," which perfectly demonstrates the kinds of verbal sleights-of-hand that HFT detractors often engage in to delude pliable audiences. The Credit Suisse article is using "quote" to refer to an order – in other words, 100,000 to 200,000 orders at the NBBO arrive each day for DJIA stocks. The author then changes the meaning of the word "quote" to refer to the NBBO quotation, leading the reader to believe that the NBBO changes 600+ times per minute. Unfortunately, the two concepts have nothing to do with each other, and the conclusion is false. For all of 2010, the average NBBO on the most rapidly traded stock in the world (SPY) had an average duration of over 3 seconds. Stocks in the DJIA, which are considerably less liquid than SPY and generally lower-priced, have far longer mean NBBO durations than SPY.

REMEDY: HFTS SHOULD PAY A PENALTY FOR EXCESS CANCELLATIONS OR MESSAGE TRAFFIC

The premise for this remedy is that HFTs generate the lions share of message traffic to the exchanges, far in excess of their share of volume traded, and should therefore pay a "tax" for clogging up the exchanges and slowing everyone else down. There are two main fallacies for this argument. First, there is no empirical evidence that the day-to-day cancellation rates on exchanges have any role in "slowing them down." The exchanges themselves are best positioned to understand the impact of cancellation rates and message traffic on their matching engines, and are not among the people making such claims.

More importantly, the complaint is moot because the the exchanges already tax participants on the basis of their message traffic. To connect to an exchange, such as Nasdaq or BATS, you must connect to it through a "port," which is effectively a participant's private queue of messages to the exchange. If you send multiple messages into a port, they queue up in the port and are processed sequentially. The next message in the queue is not processed until the first one has received an acknowledgement. These exchanges use a round-robin system to process messages from the myriad inbound ports used by all the clients connected to the exchange. Because of this architecture, a large volume of messages on any one port has absolutely no bearing on the exchange's ability to function at its normal rate. In other words, if you send too many messages, you will clog up yourself, but not the exchange. The only way a participant can increase his message throughput to the exchange by purchasing more ports – which are billed at a per-month rate per port.

In other words, the fee that the detractors wish to impose already exists. How, then, to explain the criticism? Either the detractors are blissfully unaware of the finer details of how the market actually works (such as the existence of ports to throttle and constrain traffic), or they are cynically taking advantage of the lack of knowledge of market structure on the part of the public or policy makers, in order to promote their own self-interested agendas.

REMEDY: THERE SHOULD BE A MINIMUM TIME-IN-FORCE FOR ORDERS BEFORE ALLOWING CANCELS

A significant share of HFT activity (rebate-capture, cross-ecn-arb, futures leading stocks) exists only because of inefficiencies or asymmetries imposed by regulation. Policy-makers fail to comprehend that they can not win a battle of wits with HFTs. The more regulations they attempt to place on the market structure, the more arbitrage opportunities they will create for HFT's to exploit. The proposal to enforce a minimum lifespan on orders is a case in point -- if enforced, it will lead inexorably to a proliferation of riskless arbitrage opportunities as a by-product. Every time the e-mini futures contract ticks up in value, a trader will be able to lock in a riskless payoff by shorting the futures and lifting the frozen offer on SPY. Similar arbs will arise in highly but imperfectly related stocks, and between stocks vs options. In order to avoid getting picked off, market-makers will have no choice but to widen out their spreads.