



## **Virtu Financial, Inc.**

### **Study of Federal Reserve Announcement**

**September 18<sup>th</sup>, 2013**

Nanex recently released a study called “The Great Fed Robbery” which suggested that certain embargoed news of the Federal Reserve decision regarding tapering was released or “leaked” early. After analyzing the Nanex study, the data used in the Nanex study and our own sources of market data, we have concluded that the Nanex study is severely flawed. The following is our conclusions based on clear facts associated with the events of September 18<sup>th</sup>, 2013.

#### **What market data should be used for this analysis?**

First, when analyzing time stamps of events with microsecond granularity, you have to examine the accuracy of the source of the data and the time stamps appended to that data. For our source of data, we look at the equities exchanges in New York (technically operating out of data centers in New Jersey). It is important to observe the market data that is released directly from the exchanges. These feeds are the most direct and accurate feeds to replay actual market activity. The exchanges also pool all of their best prices together in a separate market data feed known as the “SIP” which is used for broad, public dissemination and regulatory purposes. The SIP is a consolidator of the direct market data feeds and as a result of this consolidation process it is not reliable for discerning millisecond differences in trades. Unfortunately, it appears that the Nanex study relies entirely on the inaccurate SIP market data time stamps.

#### **How should timestamps be reviewed?**

Our system records two timestamps on every market data message that we receive: (1) the time of receipt of each market data message at microsecond granularity; and (2) the timestamps embedded in the market data message from the venues themselves at millisecond granularity. More importantly, our system receives the market data in the data center in which it is being sent from the exchange. As a result, our timestamps don’t reflect travel time latencies from data being sent from data center to data center.

#### **When could trading have occurred in New York and Chicago?**

The straight line distance from Washington, D.C. to New York is approximately 204 miles. The straight line distance from Washington, D.C. to Chicago is approximately 595 miles. Any signal

leaving Washington, D.C. will arrive in Chicago at least 2.1 milliseconds after arriving in New York since that is the time it takes light to travel the additional 391 miles to Chicago.

In addition, some participants communicate with radio networks rather than through optical fiber between these cities (e.g., From Washington, DC to Chicago). Radio network times are over 30% faster than traditional fiber routes.

### **What time did equity trading actually begin after the Fed announcement?**

Relying on our two sources of market data timestamps, our records show that the first trade immediately following the Fed release at 2 PM in SPY occurred at 2:00:00.000397 on the BATS Exchange (100 shares at \$170.82). The timestamp embedded in the message by BATS was 2:00:00.000 (meaning it could have been between 0 and 999us after 2 PM). BATS can likely confirm the exact time. The Nanex study indicates that the first trade in SPY occurred at 2:00:00.001 on Nasdaq BX (referred to in the Nanex charts as “Bost” because it was formerly the Boston Stock Exchange). This Nanex data claims the first BATS trade in SPY occurred 2:00:00.011. The Nanex data is clearly wrong because it is reflecting timestamps after the consolidation process has been completed by the SIP.

With respect to GLD, our records show that the first trade immediately following the Fed release at 2 PM occurred at 2:00:00.000331 on the BATS Exchange (200 shares at \$126.83). The timestamp embedded in the message by BATS was 2:00:00.000 (due to rounding). This compares to the Nanex data which reflects the first trade in GLD occurring at 2:00:00.001 on Nasdaq and NYSE Arca.

### **What time did futures trading actually begin after the Fed announcement?**

For evaluating the time of the first trade in futures on the CME in Chicago, we rely on the direct data feed from the CME. Again, the timestamps we rely on include (1) the time of our receipt of each market data message at microsecond granularity; and (2) the timestamps embedded in the market data message from the CME at millisecond granularity. Our receipt time is in Chicago in the CME’s data center and does not involve travel times.

The first trade for the December 2013 S&P500 contract on CME was recorded by our system at 2:00:00.002130. The record of the CME's embedded timestamp is 2:00:00.002. These times are consistent with the timestamps used by Nanex. We believe Nanex is simply using the CME’s embedded timestamp of 2:00:00.002 found on the CME data feed.

The first trade for the December 2013 Gold Future contract on CME was recorded by our system at 2:00:00.002034. The record of the CME's embedded timestamp is 2:00:00.001. The CME time is consistent with the timestamps used by Nanex.

### **What does the data reveal?**

So, when using accurate market data and proper timestamping (which is supported by the exchange’s timestamps), there is no evidence of a “leak” of the Fed news regarding tapering.

The timestamp values almost line up perfectly with the minimal 2.1 millisecond figure for the difference in travel time between DC to Chicago and DC to NY.

There are a few sources of variation that cannot be accounted for. First, the distances quoted are between city centers and not between the physical location of the exchanges and the Fed announcement location. Second, participant reaction time in New York and Chicago can be different. Third, the CME and BATS can take different amounts of time to process and notify the market about trades. And finally, the 2.1 millisecond figure assumes perfect *straight line* travel at the speed of light. In reality the relative difference will vary with the actual path taken, and it is possible that the path from Washington, D.C. to New York is not as close to straight as the Chicago route is.

In fact, the data seems to indicate that the signal left Washington, D.C. some time before 2 PM. But it clearly shows that the trading in New York and Chicago is consistent with both locations receiving the same signal originating from Washington, D.C.

### **Why is Nanex wrong?**

Nanex unfortunately relies on the embedded timestamps of the SIP. These timestamps are SIP times (based on a clock operated by the SIP) and can be flawed as a result of (1) travel times from the exchanges to the SIP data center (The SIP for SPY is NYSE located in Mahwah); (2) the SIPs clock being skewed; and (3) the randomness of the SIPs processing capacity and timestamping. This is especially revealing in the Nanex charts where you see the SIP processing groupings of trades from each exchange rather than processing trades from various exchanges in random orders.

More importantly, our clocks in New York and Chicago are synchronized automatically to the same GPS antenna which ensures that the two clocks are synchronized to each other. The Nanex study relies on a clock operated by the CME in Chicago and a clock operated by the SIP in New Jersey. These two clocks would likely suffer from a lack of synchronization.