Strange things have been happening on Wall Street, and some of them are related to the increasing role of computers in stock trading. Earlier this year (May 18) was the much-discussed Facebook IPO (initial public offering) on the NASDAQ exchange. After technical difficulties delayed the offering, a huge influx of orders to buy, sell and cancel overwhelmed NASDAQ’s software, causing a 17-second blackout in trading.

Suspicion immediately fell on “high-frequency trading” (HFT) — a catch-all term for the practice of using high-powered computers to execute trades at very fast speeds, thousands or millions per second. Since the U.S. Securities and Exchange Commission (SEC) authorized electronic trades in 1998, trading firms have developed the speed and sophistication of HFT, and over the last few years, it has come to dominate the market. With HFT, profits accrue in fractions of a penny. A stock might, for instance, momentarily be priced slightly lower in New York than London, and with an algorithm in charge, an HFT trader can almost instantaneously buy and sell for risk-free profit. With HFT, traders typically move in and out of positions quickly and liquidate their entire portfolios daily. They compete on the basis of speed.

In June, The Wall Street Journal reported that trading had entered the nanosecond age. A London firm, for instance, momentarily priced slightly lower in New York than London, and with an algorithm in charge, an HFT trader can almost instantaneously buy and sell for risk-free profit. With HFT, traders typically move in and out of positions quickly and liquidate their entire portfolios daily. They compete on the basis of speed.

Many questions arise about fairness and things that can go wrong (such as computer glitches) to the detriment of the market. One of the first problems researchers face, however, is with HFT the amount of data has exploded almost beyond the means to study it — a problem highlighted by the “flash crash” of May 6, 2010. The Dow Jones Industrial Average dropped nearly 1,000 points, 9 percent of its value, in about 20 minutes, the biggest one-day drop in its history. Analysis eventually revealed HFT-related glitches as the culprit, but it took the SEC five months to analyze the data and arrive at answers.

“Fifteen years ago, trade was done by humans,” says Mao Ye, assistant professor of finance at the University of Illinois, Urbana-Champaign (UIUC), “and you didn’t need supercomputing to understand and regulate the markets. Now the players in the trading game are superfast computers. To study them you need the same power. The size of trading data has increased exponentially, and the raw data of a day can be as large as ten gigabytes.”
Because of this XSEDE-supported research, the Financial Industry Regulatory Authority is reconsidering the policy of excluding odd-lot trades from the consolidated tape.

On August 30, 2011, about three million orders were submitted to the NASDAQ exchange to trade the stock SPDR S&P 500 Trust (ticker symbol SPY). This image shows that 18.3 percent of the orders were cancelled within one second and 31.4 percent of orders had a lifespan of less than 50 milliseconds, less time than it takes to transfer a signal between New York and California. More than 40 percent of orders, in other words, disappeared before a trader in California could react.

Many odd-lot trades, their analysis showed, are the result of informed traders splitting orders. Suppose you want to trade 10,000 shares, but you slice it — through HFT — into 200 trades of 50 shares. “If you trade in large lots,” explains Ye, “people will guess something has happened and they can follow you. If you trade quietly through slicing into small lots, it looks to other people like no trade has happened.”

Regulation has suggested a minimum quote life or cancellation fee, which could be based on the average number of order cancellations to transactions.

Processing data files that contain the order instructions for stocks, Ye and colleagues did an “event-study” — analyzing order messages that covered two periods during 2010, a total of 35 trading days from March 19 to June 2, when trading speed rapidly increased. Both these periods, which the researchers term “technology shocks,” occurred on weekends, when — the researchers note — “it is more convenient for exchanges or traders to test their technology enhancement.”

Their paper, the researchers write, is “the first paper to explore the impact of high frequency trading in a nanosecond environment.” They found that as trading frequency increased from microseconds to nanoseconds the order cancellation/excision ratio increased dramatically from 26.1 to 32.1. Their analysis found no impact on liquidity, price efficiency and trading volume, but found evidence consistent with quote stuffing — a high volume of trade aimed at congesting the market.

The increase in speed from seconds to milliseconds, say the researchers, may have social benefit by creating new trading opportunities, but they doubt whether such benefit will continue as speed goes from micro to nanoseconds, or possibly, to picoseconds. Their analysis gives justification for regulatory changes, such as a speed limit on orders or a fee for order cancellations. “While it is naive to eliminate high frequency traders,” they write, “it is equally naive to let the arms race of speed proceed without any restriction.”

More info: www.psc.edu/science/2012/trading/