

# Chicago Fed Letter

## Market structure, incentives, and fragility

by Carol L. Clark, senior policy advisor

The factors that have contributed to the adoption of high-speed trading and affected market structure in recent years include competition, technology, and regulation. The unexpected ways in which these dynamic forces are coming together raise a number of important policy issues.<sup>1</sup>

There have been profound changes in trading in recent years as the use of technology has taken on greater importance and introduced new risks. Trading speeds have increased from seconds to milli-

seconds (thousandth of a second) to micro-seconds (millionth of a second) and are migrating to nano-seconds (billionth of a second). Such high-speed trading (HST), which includes automated, algorithmic, and high-frequency trading, has received considerable media attention, largely due to high-profile market events that have been characterized by the coding or deployment of trading algorithms, market breakdowns,

and market manipulation.

Certainly, HST poses operational risks to the market due to the rate at which large, unintended positions can accumulate. There is also the possibility HST may result in positive or negative feedback loops caused by a runaway algorithm triggering other algorithms or by numerous HST firms utilizing trading models that do not accurately assess and respond to changing market conditions. The myriad of

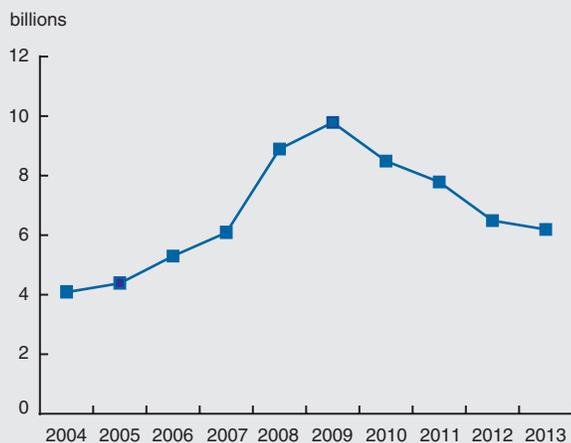
technologies that support HST also result in “systems that are robust yet fragile.”<sup>2</sup> Failure in one of many parts may have unexpected knock-on effects in others.

At the same time, institutional investors who often complained of being *front run*<sup>3</sup> by their trade intermediaries in a floor-based trading environment have welcomed the anonymity electronic trading provides. Various studies also indicate HST has brought substantial benefits, including lower costs, reduced volatility, and narrower bid-offer spreads. Some challenge these studies, however, because many were conducted by HST firms, exchanges that have HST customers, or academics sponsored by HST firms or exchanges.<sup>4</sup>

One may also argue that the movement toward HST is part of a natural, evolutionary outcome within financial markets, not unlike the adoption of automated or computer-based systems in every other major industry. Nevertheless, it is difficult to find examples of firms in other industries that were rapidly brought to the brink of bankruptcy due to technological malfunctions like the 40 minutes it took Knight Capital to lose \$460 million.<sup>5</sup>

As we look at the profound changes that have occurred in trading and in market structure in recent years, we need to examine some of the dynamic forces that have influenced this transformation and brought about the current HST environment. These include *regulatory*

1. U.S. equities average daily share volume (in billions)



SOURCE: TABB Group.

*initiatives* in some markets, *competition for order flow*, and new ways *technology* is used in that competition, all of which may be coming together in unexpected ways and raising a number of public policy questions. Some of these relate to operational risk, pricing, and manipulation.

At times, problems associated with HST can be resolved without undue market disruption. One example is the successful bailout of Knight Capital by a group of investors whose interest in the firm

This failure was substantially smaller than that of Knight Capital. The event is noteworthy, however, because it could happen in any jurisdiction if a failing firm does not have assets that are of interest to potential buyers and losses have to be covered by the reserve fund. Moreover, we cannot anticipate in advance how large a loss may be if operational risk controls are inadequate.

Importantly, regulators have made strides in addressing operational risks. Early

Order flow is critical to a trading venue's profitability because most have revenue models that are based, in part, on the number, and sometimes the value, of executed trades. Competition for order flow among trading venues in U.S. equities markets has likely increased over the past few years due to decreased trade volumes. Even though the number of U.S. equities trades increased dramatically (60%) during the recent financial crisis from 6.1 billion in 2007 to a peak of 9.8 billion in 2009 (see figure 1), current trade volumes are closer to pre-crisis levels (6.2 billion in 2013). This means trading venues are competing for fewer transactions at the same time that exchanges are losing volumes to off-exchange trading in broker-dealer internalizers and dark pools,<sup>11</sup> where an estimated 38% of all trades now take place.<sup>12</sup>

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was likely related to Knight's valuable business as a wholesaler for retail order flow for firms like Fidelity, TD Ameritrade, Scottrade, and E\*TRADE. Wholesalers pay retail broker-dealers to route orders to them and then match these orders against each other or against orders from the wholesaler's proprietary trading desk. Such orders are referred to as uninformed order flow because retail investors generally hold a longer-term view of the markets and are not concerned with exploiting intraday, short-term price swings. The profits wholesalers make on trading against uninformed order flow exceed the fees they have to pay to retail broker-dealers because they are able to capture the spread between buy and sell orders and save on transaction costs that would have to be paid to trading venues if orders were routed there. One of the investors in the bailout, the HST firm GETCO, later merged with Knight.<sup>6</sup>

In contrast, the recent failure of a brokerage firm on the Korea Exchange (KRX) ended less satisfactorily for market participants. After erroneously placing automated buy and sell options orders, HanMag Securities lost \$43.8 million, which exceeded the firm's capital of \$18.8 million.<sup>7</sup> One report indicates KRX had to use cash from an emergency reserve fund set up by the exchange's brokerage firms to cover the loss.<sup>8</sup> If HanMag files for bankruptcy and doesn't find a buyer, the exchange's brokers will be required to replenish the money used from the fund.

in 2013, the Securities and Exchange Commission (SEC) issued a proposal to require key market participants to have comprehensive policies and procedures in place for their technological systems. In September 2013, the chair of the SEC met with the heads of the major U.S. exchanges to develop an action plan to address recent technology outages.<sup>9</sup> The Commodity Futures Trading Commission (CFTC) issued a "Concept Release on Risk Controls and System Safeguards for Automated Trading Environments" in September.<sup>10</sup>

### **Regulation, competition, and technology intersect**

In U.S. markets, stocks trade simultaneously at numerous trading venues. One way the SEC promotes fairness and competition among these trading venues is through the Regulation National Market System (Reg NMS), which was fully implemented in 2007. Among other things, Reg NMS prohibits one trading venue from executing a trade at an inferior price to another.

New trading venues began to enter the market following the implementation of Reg NMS in order to capture order flow from liquidity providers, who post buy and sell orders in the order book for a specific stock at a specific price. The more buy and sell orders in the order book, the more liquid the trading venue and the more likely it is that other market participants will find a price they are willing to trade against.

Revenue models based on the values and volumes of trades provide trading venues with an incentive to attract HST firms, which bring large numbers of orders. Trading venues use a variety of strategies to do this, including pricing structures, order-matching algorithms, order types, and technology products and services. Some of these provide HST firms with time, place, or informational advantages.

### **Pricing structures**

BATS, a trading venue that entered the market following the implementation of Reg NMS, doubled its market share in NYSE-listed stocks by offering a fast execution platform and a "maker-taker" pricing structure to attract order flow.<sup>13</sup> Maker-taker pricing structures pay liquidity providers a rebate to post buy and sell orders to the order book and charge other market participants (including retail and institutional investors) to execute against these resting orders. Such a design encourages liquidity providers to send orders to the trading venue with the highest rebates.

Conversely, "taker-maker" pricing structures pay brokers for retail and institutional orders that remove liquidity and charge liquidity providers to execute against those orders. If two or more trading venues have the same price, this pricing structure encourages brokers to route orders to the trading venue offering the highest rebate.

While not every trading venue uses rebates, most have tiered pricing structures whereby firms that execute larger numbers, and sometimes larger values, of trades are charged lower fees than firms with smaller trading volumes and values.

### Order matching and special order types

Trading venues may use other means to attract liquidity, such as the way they match buy and sell orders. First-in-first-out (FIFO) matching algorithms compare buy and sell orders based on the best price and the time the order arrived in the queue, providing a competitive advantage to firms with the best prices and fastest systems. To level the playing field between high-speed and other traders, some trading venues have moved away from using FIFO algorithms.<sup>14</sup>

In addition, some trading venues may try to attract order flow by offering special order types. According to a *Wall Street Journal* report, one such order type offered by the exchange Direct Edge allowed some HST firms to trade ahead of other investors.<sup>15</sup>

### Technology products and services

Trading venues have also adjusted their technology and product offerings to draw HST firms. For example, many offer co-location services, which allow trading firms to place their computer servers within the same data center that houses the trading venue's servers, thereby ensuring the shortest transmission times between the systems. Co-location enables HST firms to access detailed price and other information, view buy and sell orders in the order book, and send their orders to the trading venue's matching engine ahead of firms that do not co-locate.

Other technology advantages offered by some trading venues include social media feeds HST firms can incorporate into their trading strategies and faster trading routes via fiber-optic cables and microwave technology. Technology products and services can provide time, place, or informational advantages to firms willing to pay for them.

### Time, place, informational advantages

Of course, traders have *always* sought time, place, and informational advantages. However, their means for doing

so have changed over time. In the past, traders physically jostled for a better position on the trading floor and used their voices to drown each other out. Placing a firm's telephone closer to the trading floor also provided an edge by shortening the distance a runner had to go to hand an order into the pit.

Going back to 1815, there is the account of Nathan Rothschild receiving advance news of the outcome of the Battle of Waterloo via carrier pigeon or boat.<sup>16</sup> Today, we might think of this as a technological edge or an early release of data. One version of the story says Rothschild made a fortune buying British government bonds based on the knowledge that Napoleon had been defeated. Another account claims that Rothschild was aware that other traders knew he had excellent communication systems so he started selling British bonds, which prompted others to sell. Rothschild then bought back the bonds at a cheaper price.<sup>17</sup>

We are able to recount the Rothschild tale because the identities of traders were known in a traditional trading environment. Such knowledge could facilitate retribution and may have prevented some, but by no means all, bad behaviors. In contrast, electronic markets, which have been lauded for their transparency, actually have an element of opacity because trading firms do not know each other's identity.

### Market manipulation and operational risk

While market manipulation has always been a concern in trading, it may be more difficult to detect today because HST firms trade correlated products across multiple asset classes and trading venues around the world. Moreover, trading venues may be monitored by different regulators using different technologies, such as the CFTC's Trade Surveillance System (TSS)<sup>18</sup> and the SEC's Market Information Data Analytics System (MIDAS).<sup>19</sup> In addition to concerns about the interoperability of these systems, it is questionable whether firm-level data can be easily exchanged among regulators because MIDAS does not provide attribution information about the brokers or customers behind the orders.<sup>20</sup>

A recent example of regulators and trading venues working together to discipline firms engaged in market manipulation is the case of the HST firm, Panther Energy Trading. In July 2013, the CFTC fined Panther for manipulating U.S. commodities markets and the United Kingdom's Financial Conduct Authority fined the owner of Panther for manipulating markets there.

### Public policy questions

Among the many questions HST raises for policymakers and regulators are the following:

- Are market participants underpricing the risks of HST?
- Do they have the real-time controls they need to manage these risks?
- Should trading venues evaluate alternative revenue models?
- Do regulators and trading venues have the proper incentives and tools to identify and control market manipulation? If not, why not?
- And since trading firms are trading across asset classes globally, who has the authority to implement an international approach to promptly monitor, respond to, and discipline firms for market manipulation?

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- <sup>2</sup> The term was coined by Andrew Haldane. See Andrew Haldane, 2013, “Why institutions matter (more than ever),” speech given at the Centre for Research on Socio-Cultural Change Annual Conference, University of London, School of Oriental and African Studies, London, September 4.
- <sup>3</sup> Front-running is an illegal practice, whereby a broker uses advance knowledge of customer orders to gain an unfair trading advantage. For example, if a customer has a large order to buy, the broker buys the same stock in advance of placing the customer’s large order. As a large order will naturally drive up the price of the stock, the broker then sells the shares at the higher price, generating a profit at the expense of the customer.
- <sup>4</sup> Dave Lauer, 2013, “2013 top stories: HFT—In search of the truth,” *TabbFORUM*, December 27.
- <sup>5</sup> Alexandra Stevenson, 2013, “Knight Capital to pay \$12 million fine on trading violations,” *New York Times DealBook*, October 16.
- <sup>6</sup> Sam Mamudi, 2013, “Getco posts loss as merger partner Knight’s trading improves,” *Bloomberg*, August 7.
- <sup>7</sup> Kanga Kong, 2013, “Trading error leaves Korean broker scrambling,” *Korea Real Time*, blog, *Wall Street Journal*, December 18, available at <http://blogs.wsj.com/korearealtime/2013/12/18/trading-error-leaves-korean-broker-scrambling/>.
- <sup>8</sup> Exchange clearing houses generally require clearing members to contribute to a loss-sharing pool that can be drawn upon in the event a member becomes insolvent. See Carol L. Clark, 2010, “Controlling risk in a lightning-speed trading environment,” *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 272, March.
- <sup>9</sup> Sarah N. Lynch and Herbert Lash, 2013, “U.S. exchanges to create kill switches following Nasdaq outage,” Reuters, September 12.
- <sup>10</sup> See [www.cftc.gov/PressRoom/PressReleases/pr6683-13](http://www.cftc.gov/PressRoom/PressReleases/pr6683-13).
- <sup>11</sup> Dark pools minimize the risk of large orders moving the market price by allowing buyers and sellers to submit orders anonymously and report price and size information only after the trade has been completed.
- <sup>12</sup> John McCrank and Sarah N. Lynch, 2013, “Exchange CEOs meet regulators on dark pools, internalizers,” Reuters, April 9.
- <sup>13</sup> Giovanni Petrella, 2010, “MiFID, Reg NMS and competition across trading venues in Europe and the USA,” *Journal of Financial Regulation and Compliance*, Vol. 18, No. 3, pp. 257–271.
- <sup>14</sup> Another common matching algorithm is pro rata, where orders for the same price are filled based on some percentage related to the size of the order.
- <sup>15</sup> Scott Patterson and Jenny Strasburg, 2012, “For superfast stock traders, a way to jump ahead in line,” *Wall Street Journal*, September 19, available at <http://online.wsj.com/news/articles/SB10000872396390443989204577599243693561670>.
- <sup>16</sup> See <http://trove.nla.gov.au/ndp/del/article/1401561>, p. 4.
- <sup>17</sup> John Kay, 2013, “Enduring lessons from the legend of Rothschild’s carrier pigeon,” *Financial Times*, May 28.
- <sup>18</sup> See [www.cftc.gov/IndustryOversight/MarketSurveillance/CFTCMarketSurveillanceProgram/tradepacticesurveillance](http://www.cftc.gov/IndustryOversight/MarketSurveillance/CFTCMarketSurveillanceProgram/tradepacticesurveillance).
- <sup>19</sup> See [www.sec.gov/marketstructure/midas.html](http://www.sec.gov/marketstructure/midas.html).
- <sup>20</sup> Dave Michaels and Sam Mamudi, 2013, “SEC once slowed by data gap to report high-speed trader research,” *Bloomberg*, October 1.