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High-Frequency Trading: Background, Concerns, and Regulatory Developments

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June 19, 2014

Congressional Research Service

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R43608

Summary

High-frequency trading (HFT) is a broad term without a precise legal or regulatory definition. It is used to describe what many characterize as a subset of algorithmic trading that involves very rapid placement of orders, in the realm of tiny fractions of a second. Regulators have been scrutinizing HFT practices for years, but public concern about this form of trading intensified following the April 2014 publication of a book by author Michael Lewis. The Federal Bureau of Investigation (FBI), Department of Justice (DOJ), Securities and Exchange Commission (SEC), Commodity Futures Trading Commission (CFTC), Office of the New York Attorney General, and Massachusetts Secretary of Commerce have begun HFT-related probes.

Critics of HFT have raised several concerns about its impact. One criticism relates to its generation of so-called phantom liquidity, in which market liquidity that appears to be provided by HFT may be fleeting and transient due to the posting and then almost immediate cancellation of trading orders. Another concern is that HFT firms may engage in manipulative strategies that involve the use of quote cancellations. In addition, some observers allege that HFT firms are often involved in front-running whereby the firms trade ahead of a large order to buy or sell stocks based on nonpublic market information about an imminent trade. Another criticism is that HFT has increased the level of potential market systemic risk whereby shocks to a small number of active HFT traders could then detrimentally affect the entire market. A related concern is whether HFT could exacerbate market volatility. These concerns have percolated since the “Flash Crash” of May 6, 2010, when the Dow Jones Industrial Average (DJIA) fell by roughly 1,000 points in intraday trading—the largest one-day decline in the history of the DJIA. The crash was analyzed in an investigative report by the SEC and CFTC which, among other factors, looked at the role HFT may have played. The report determined that HFT was not the cause but may have exacerbated the crash. Another area of criticism is that HFT often involves two-tiered markets in which HFT firms pay extra for the right to access data feeds or to collocate their servers within exchanges’ servers—all of which is designed to give some traders an advantage over others.

HFT’s supporters argue that the increased trading provided by HFT adds market liquidity and reduces market volatility. They contend that HFT is a technological innovation that is the latest evolutionary stage in a long history of securities market making and assert that HFT has reduced the bid-ask spreads in stock trading, thereby lowering trading costs.

Congressional interest in HFT and the Flash Crash has manifested itself in the 113th Congress both legislatively and in the congressional oversight of the SEC and CFTC. Legislatively, S. 410 (Harkin), H.R. 880 (DeFazio), and H.R. 1579 (Ellison) would levy taxes on various financial trades, including trades conducted by HFT traders. H.R. 2292 (Markey) would require the CFTC to provide a regulatory definition of HFT in the derivatives markets it oversees and require those who do HFT to register with the CFTC.

In June 2014, SEC Chairman Mary Jo White announced that in response to concerns over “aggressive, destabilizing trading strategies in vulnerable market conditions,” the agency was pursuing several HFT-related reform proposals, including requiring unregistered HFT firms to register with the SEC.

This report provides an overview of HFT in the equities and derivatives markets regulated by the SEC and CFTC. It also examines the Flash Crash of 2010 and the role that HFT may have played as well as recent regulatory developments.

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Introduction

On May 6, 2010, the Dow Jones Industrial Average (DJIA), a broad stock index, fell by nearly 1,000 points over the course of several minutes and then quickly rebounded. This was one of the largest intraday declines in the history of the DJIA and was described by one commentator as “one of those eye-opening events that exposed many flaws in the structure of the market.”¹ Dubbed the *Flash Crash*, the event led to several analytical studies and reports and to greater scrutiny of a broad trading protocol known as high-frequency trading (HFT), a form of algorithmic securities trading, which has no formal consensus definition.²

In addition to the heightened scrutiny it received after the Flash Crash, HFT, which accounts for a large share of total domestic securities trades, has raised other public policy concerns. Among them are whether (1) HFT plays a role in exacerbating market fragility; (2) it may heighten the market’s systemic risk; (3) it enhances or harms the quality of the securities market; (4) certain kinds of HFT may constitute an illegal form of front-running; (5) HFT helps foster a system of two-tiered trading markets that benefits certain traders at the expense of others due to their access to faster trading data and advantageous trade infrastructure; and (6) the presence of HFT has been to the detriment of non-HFT investors and investor confidence in the securities market.

As in earlier major market disruptions, such as the October 1987 market crash (when the DJIA lost almost 22% in a single day, setting off a global stock market decline), congressional interest in the Flash Crash derives in part from Congress’s decades-old legislative mandate that, among other things, delegated to the Securities and Exchange Commission (SEC) responsibility for investor protection (through a regime of mandatory disclosure) and maintaining fair and orderly markets.

In the 113th Congress, congressional interest in HFT has been reflected in legislation that would levy securities transaction taxes on securities trades, presumably raising the cost and thus reducing the incidence of conducting HFT. Specifically, in the 113th Congress, S. 410 (Harkin), H.R. 880 (DeFazio), and H.R. 1579 (Ellison) would levy taxes on various financial trades, including trades conducted by HFT traders. H.R. 2292 (Markey) would require the Commodity Futures Trading Commission (CFTC) to provide a regulatory definition of HFT in the derivatives markets that the agency oversees. It would also require high-frequency traders in derivatives to register with the CFTC, submit semiannual reports to the agency, and conform to business conduct requirements that the CFTC may issue. H.R. 2292 would also grant the CFTC the authority to impose civil penalties under the Commodity Exchange Act for violations of a HFT regulation. The amount of the fine would be based on the duration of the violation. In addition, in exercising congressional oversight authority over the SEC and the CFTC, a number of committee and subcommittee hearings have touched on the subjects of HFT and the Flash Crash.³

¹ “Flash Crash, Four Years Later, Still Haunts Wall Street,” *Wall Street Journal*, May 6, 2014, available at <http://blogs.wsj.com/moneybeat/2014/05/06/flash-crash-four-years-later-still-haunts-wall-street/>.

² These are trading systems that employ advanced mathematical models for making transaction decisions in the financial markets.

³ For example, see “House Financial Services Committee Holds Hearing on Oversight of the Securities and Exchange Commission,” *Political Transcript Wire*, April 29, 2014, available at <http://search.proquest.com/docview/1519661206?accountid=12084>; “House Financial Services Subcommittee on Capital Markets and Government Sponsored Enterprises Holds Hearing on Equity Market Structure,” *CQ Congressional Transcripts*, February 28, 2014, available (continued...)

Meanwhile, the CFTC and the SEC, which respectively regulate derivatives and equities, have both issued studies that provide far-reaching explorations of HFT. The studies also pose a number of questions about the value of HFT and propose several ways to further regulate it or intervene to mitigate consequences of HFT that some consider to be problematic.

Interest in HFT has also been heightened by the release of the book *Flash Boys* by Michael Lewis and its offshoots, including an interview with the author on *60 Minutes* and an adaptation of the book in the *New York Times*. Among other things, a former securities trader at the Canadian brokerage firm RBC charges that the HFT firms on which Lewis reports have significantly relied on a form of “legalized front-running” and observes that many major institutional investors, including various mutual funds, appear to have been unaware of the existence of such behavior, which could allegedly be costly to them.⁴

The Department of Justice (DOJ), Federal Bureau of Investigation (FBI), CFTC, SEC, New York Attorney General, and Massachusetts Secretary of Commerce are variously conducting investigations and probes into specific HFT firms, certain HFT strategies, and HFT in general.

Specifically, Attorney General Eric Holder has announced that the DOJ is “investigating [HFT] ... to determine whether it violates insider trading laws.”⁵ In addition, the FBI is reportedly probing (1) whether HFT firms are trading ahead of other investors based on information that other market participants cannot see, a possible form of front-running, a type of illegal insider trading;⁶ (2) practices in which a HFT trader submits trade orders and then cancels them to foster

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at <http://www.cq.com/doc/congressionaltranscripts-4431399?wr=Nng4dW84NzhVdzJDZ0JleXk2RktJUQ>; “House Financial Services Committee Holds Hearing on Oversight of the Securities and Exchange Commission,” *CQ Congressional Transcripts*, May 16, 2013, available at <http://www.cq.com/doc/congressionaltranscripts-4277174?wr=Nng4dW84NzhVdzFvOHpoOG5BZFAYZw>; “House Agriculture Subcommittee on General Farm Commodities and Risk Management Holds Hearing on the Outlook for the Commodity Futures Trading Commission, Perspectives from End-Users,” *CQ Congressional Transcripts*, July 24, 2013, available at <http://www.cq.com/doc/congressionaltranscripts-4322599?wr=Nng4dW84NzhVdzJ2VDNhMGhCUlhGQQ>; “House Appropriations Subcommittee on Agriculture, Rural Development, FDA, and Related Agencies Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Commodity Futures Trading Commission,” *CQ Congressional Transcripts*, March 6, 2014, available at <http://www.cq.com/doc/congressionaltranscripts-4436311?wr=Nng4dW84NzhVdzJ2VDNhMGhCUlhGQQ>; and “House Appropriations Subcommittee on Financial Services and General Government Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Securities and Exchange Commission,” *CQ Congressional Transcripts*, April 1, 2014.

⁴ See Michael Lewis, *The Flash Boys*, New York, W. W. Norton & Company, 2014; Michael Lewis, “The Wolf Hunters of Wall Street,” *New York Times*, March 31, 2014, available at http://www.nytimes.com/2014/04/06/magazine/flash-boys-michael-lewis.html?_r=0; and “Is the U.S. Stock Market Rigged?” *CBS 60 Minutes*, March 30, 2014, available at <http://www.cbsnews.com/news/is-the-us-stock-market-rigged/>. A book that preceded *Flash Boys* by a couple of years and that also examines high-frequency trading and other related market structure development issues is Scott Patterson’s *Dark Pools: The Rise of the Machine Traders and the Rigging of the U.S. Stock Market*, which was published by Crown in 2012.

⁵ See the comments of U.S. Attorney General Eric Holder, Jr. in: “House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Justice Department,” *CQ Congressional Transcripts*, April 4, 2014, available at <http://www.cq.com/doc/congressionaltranscripts-4453431?wr=RDlYtIRja3lSajZKMhByWlZQS3dzZw>.

⁶ CRS Report RS21127, *Federal Securities Law: Insider Trading*, by (name redacted), observed, “Insider trading in securities may occur when a person in possession of material nonpublic information about a company trades in the company’s securities and makes a profit or avoids a loss. The Securities Exchange Act of 1934 and the Insider Trading Sanctions Act of 1984 have provisions which forbid insider trading. One provision of the 1934 Act requires the disgorgement of short-swing profits by named insiders. The 1934 Act’s general antifraud provision has been used many times to sanction insider trading.” Under the SEC’s regulatory ambit, FINRA is the frontline regulator that regulates (continued...)

the illusion of market activity, a possible form of market manipulation that may prompt others to respond to illusory trade orders; and (3) the use of HFT to place orders to hide transactions that may be based on an illegal tip.⁷ To facilitate these probes, the agency has reportedly openly solicited traders and stock-exchange workers to divulge any evidence suggesting front-running and manipulation. These inquiries reportedly derive from a multiyear agency probe of illegal insider trading, an effort that reportedly has led to at least 79 convictions of hedge-fund traders and others.⁸

The New York Attorney General is responsible for enforcing the state's Martin Act, a securities law that dates back to the 19th century, which gives the Attorney General statutory powers "to conduct investigations of suspected fraud in the offer, sale or purchase of securities [and] [w]here appropriate... [to] commence civil and criminal prosecutions ... to protect investors."⁹ Under the act's auspices, New York Attorney General Eric Schneiderman has opened an investigation into whether stock exchanges provide HFT firms with improper advantages, including accepting payment to locate HFT firm computer servers within an exchange's data center. The Attorney General has also struck deals with several entities, including Business Wire and Marketwired, that for a fee provided potentially market moving news releases to HFT traders in advance of public release. The entities agreed to suspend the advance news feeds.¹⁰ Reports also indicate that the Attorney General has subpoenaed several HFT firms as he investigates whether certain traders have an unfair advantage over others.¹¹

In the class action civil case *City of Providence, Rhode Island v. BATS Global Markets Incorporated et al.* (U.S. District Court, Southern District of New York, No. 14-2811), the city of Providence is suing BATS Global Markets Incorporated, the Chicago Board Options Exchange,

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and drafts regulations for SEC-registered broker-dealers. On September 4, 2012, the SEC approved FINRA's proposal to adopt NASD IM-2110-3, with the changes discussed below, as FINRA Rule 5270 in the Consolidated FINRA Rulebook. In defining illegal front-running, Rule 5270 provides that no member or person associated with a member shall cause to be executed an order to buy or sell a security or a related financial instrument when the member or person associated with the member causing the order to be executed has material, nonpublic market information concerning an imminent block transaction in that security, a related financial instrument, or a security underlying the related financial instrument prior to the time information concerning the block transaction has been made publicly available or has otherwise become stale or obsolete. The rule applies to orders caused to be executed for (1) any account in which the member or person associated with the member has an interest, (2) any account with respect to which the member or person associated with the member exercises investment discretion, and (3) any account of customers or affiliates of the member when the customer or affiliate has been provided such material, nonpublic market information by the member or any person associated with the member. "Front Running SEC Approves Consolidated Front Running Rule Effective Date," *FINRA*, June 1, 2013, available at <http://www.finra.org/web/groups/industry/@ip/@reg/@notice/documents/notices/p197391.pdf>.

⁷ Scott Patterson and Michael Rothfeld "FBI Investigates High-Speed Trading," *Wall Street Journal*, March 31, 2014, available at <http://online.wsj.com/news/articles/SB10001424052702304886904579473874181722310>.

⁸ Keri Geiger and Patricia Hurtado, "FBI Seeks Help From High-Frequency Traders to Find Abuses," *Bloomberg*, April 1, 2014, available at <http://www.bloomberg.com/news/2014-03-31/fbi-said-to-probe-high-speed-traders-over-abuse-of-information.html>.

⁹ "The Investor Protections Bureau," *New York Attorney General's Office*, available at <http://www.ag.ny.gov/bureau/investor-protection-bureau>.

¹⁰ "Remarks on High Frequency Trading & Insider Trading 2.0 at the New York Law School Panel on 'Insider Trading 2.0 A New Initiative to Crack Down on Predatory Practices'" March 8, 2014, available at http://www.ag.ny.gov/pdfs/HFT_and_market_structure.pdf.

¹¹ Kara Scannell and Arash Massoudi, "NY Attorney-General Subpoenas High-Frequency Traders," *Reuters*, April 16, 2014, available at <http://www.ft.com/intl/cms/s/0/e03a199a-c5b3-11e3-97e4-00144feabdc0.html#axzz2zuiKFkKW>.

NASDAQ OMX Group, the New York Stock Exchange, and others for engaging in fraud designed to manipulate the markets. The suit alleges that the fraud was conducted in conjunction with several brokerage firms and several HFT firms and that it resulted in the diversion of “billions of dollars annually from buyers and sellers of securities to themselves.” The suit is being brought by the city of Providence on behalf of investors that acquired securities in the United States after April 2009.¹²

The civil case’s allegation that HFT has resulted in the diversion of billions of dollars from investors to a collective of market centers, brokerage firms, and HFT firms is not unlike a commonly heard characterization that HFT “is not trading—it is skimming ... [or] legalized theft [that constitutes] ... a tax on investors.”¹³

Media reports also indicate that William F. Galvin, the Massachusetts Secretary of Commerce, has sent inquiries to investment advisers and private equity and hedge-fund firms in which he requested answers to a number of questions related to their HFT practices, including their use of direct data feeds from exchanges and whether they have a computer server located within an exchange’s data center. Spokespersons have reportedly said that the inquiries are a way to learn about “the extent of the [HFT] practices.”¹⁴

SEC officials report that the agency is involved in “a number of ongoing investigations regarding various market integrity and structure issues, including high-frequency traders and automated trading.”¹⁵

In June 2014, SEC Chair Mary Jo White made what was arguably the first explicit agency discussion of prospective HFT-related regulatory initiatives. In the speech, which included a number of potential market structure regulatory reforms, White praised the benefits brought by algorithmic trading and electronic trading, such as the reduction of investor trading costs. Referencing HFT, however, she said she had concerns with “aggressive, destabilizing trading strategies in vulnerable market conditions.”¹⁶ Such concerns over HFT, she indicated, had prompted her to direct SEC staff to

- develop recommendations for “an anti-disruptive trading rule” that would “apply to active proprietary traders in short time periods when liquidity is most vulnerable and the risk of price disruption caused by aggressive short-term trading strategies is highest”;

¹² The suit is available at http://www.rgrdlaw.com/media/cases/279_complaint.pdf. Other defendants include Direct Edge ECN, the Chicago Board Options Exchange, the National Stock Exchange, the Chicago Stock Exchange, Scottrade, Ameritrade, Quantlab Financial, Credit Suisse, Bank of America, and Hudson River Trading.

¹³ Barry Ritholtz, “High Frequency Trading Runs over a Rigged Market,” *Investment News*, March 31, 2014, available at <http://www.investmentnews.com/article/20140331/BLOG09/140339993#>.

¹⁴ Margaret Collins, “Massachusetts Surveys Investment Firms on High-Frequency Trading,” *Bloomberg Business Week*, April 2, 2014, available at <http://www.businessweek.com/news/2014-04-02/massachusetts-surveys-investment-firms-on-high-frequency-trading>.

¹⁵ See the comments of SEC Chair Mary Jo White in: “House Appropriations Subcommittee on Financial Services and General Government Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Securities and Exchange Commission,” *CQ Congressional Transcripts*, April 1, 2014.

¹⁶ “Enhancing Our Equity Market Structure.” Speech by SEC Chair Mary Jo White before Sandler O’Neill & Partners, L.P. Global Exchange and Brokerage Conference, June 5, 2014, available at <http://www.sec.gov/News/Speech/Detail/Speech/1370542004312#.U5hzaihCw40>.

- clarify “the status of unregistered active proprietary traders to subject them to... [SEC] rules as dealers” and look into crafting “a rule eliminating an exception from ... [Financial Industry Regulatory Authority] membership requirements for dealers that trade in off-exchange venue”; and
- prepare recommendations for the SEC “to improve firms’ risk management of trading algorithms and to enhance regulatory oversight over their use.”

The SEC Chair also stated that the agency needed to explore whether “low-latency tools ... tend to advantage certain types of proprietary trading strategies that may detract from the interests of investors.”¹⁷

At present, the CFTC appears to be deliberating whether additional regulatory intervention has merit and, if so, what form that intervention might take. CFTC officials have reportedly said the agency is responding to concerns brought to it about certain potentially abusive HFT practices and investigating whether these practices meet the definition of market manipulation under the federal securities laws that the CFTC enforces.¹⁸

This report provides an overview of equities HFT and its potential economic and regulatory implications. It examines (1) recent developments regarding probes and investigations of HFT, (2) what equities HFT is, (3) the nature of the general equities HFT landscape, (4) how equities HFT works and who conducts it, (5) equity HFT’s perceived benefits and disadvantages, (6) the Flash Crash of 2010 and the alleged role of HFT, (7) SEC programmatic and regulation-related initiatives to potentially monitor HFT and address its potentially negative market impact, (8) European Union HFT regulatory developments,; and (9) various domestic HFT regulatory ideas under discussion. This report principally focuses on equities HFT. However, because the performance of many SEC-regulated equity products is interconnected with those of various CFTC-regulated derivative products, the report also provides a brief overview of HFT in CFTC-regulated derivatives and key HFT-related regulatory developments at the CFTC.

What is High-Frequency Trading?

Defining High-Frequency Trading

HFT is an imprecise “catchall” term that currently has no legal or regulatory definition. It is used to describe what many characterize as a subset of algorithmic trading (AT) largely associated with the sell side of the financial industry. AT is the use of computer algorithms to automatically make certain securities trading decisions, submit securities trades, and manage those securities orders after their submission.

¹⁷ “Enhancing Our Equity Market Structure.” Speech by SEC Chair Mary Jo White before Sandler O’Neill & Partners, L.P. Global Exchange and Brokerage Conference.

¹⁸ Douwe Miedema, “U.S. Futures Regulator CFTC Probing Speed Traders,” *Reuters*, April 3, 2014, available at <http://www.reuters.com/article/2014/04/03/us-hedgefunds-speed-trading-cftc-idUSBREA321QU20140403>.

The Buy Side and the Sell Side

The buy side of the financial industry is composed of investing institutions, including mutual funds, pension funds, and insurance firms, that tend to buy large amounts of securities for money-management purposes. The buy side is dependent on the sell side of the financial industry, which undertakes the creation, promotion, analysis, and sale of securities and often involves investment banks in those roles.

A detailed description of HFT comes from a 2010 SEC concept release on market structure:

One of the most significant market structure developments in recent years is high frequency trading. The term is relatively new and is not yet clearly defined. It typically is used to refer to professional traders acting in a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis.... Other characteristics often attributed to proprietary firms engaged in HFT are: (1) the use of extraordinarily high-speed and sophisticated computer programs for generating, routing, and executing orders; (2) use of colocation services and individual data feeds offered by exchanges and others to minimize network and other types of latencies; (3) very short time-frames for establishing and liquidating positions; (4) the submission of numerous orders that are cancelled shortly after submission; and (5) ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions over-night).¹⁹

The CFTC created the Technology Advisory Committee (TAC) to advise it on the impact and potential legislative and regulatory implications of technological innovations on financial services and the futures markets. Members include representatives of futures exchanges, self-regulatory organizations, financial intermediaries, market participants, and traders. In late 2011, a TAC working group said the attributes of HFT include

- algorithms for decision making, order initiation, generation, routing, or execution for each individual transaction without human direction;
- low-latency technology that is designed to minimize response times, including proximity and colocation services;
- high-speed connections to markets for order entry; and
- recurring high-message rates (orders, quotes, or cancellations) determined using one or more objective forms of measurement, including cancel-to-fill ratios;

¹⁹ “SEC Concept Release on Equity Market Structure: Securities and Exchange Commission,” *SEC*, January 14, 2010, available at <https://www.sec.gov/rules/concept/2010/34-61358.pdf>. In this context, proprietary trading refers to when a bank, a bank holding company, or brokerage or other financial institution trades on its own account rather than on behalf of a customer. Some foreign governments have promulgated specific statutory definitions. For example, the German parliament approved legislation on high-frequency trading. See Edzard Busemann, “German Upper House Approves Rules to Clamp Down on High Frequency Trading,” *Reuters*, March 22, 2013, available at <http://uk.reuters.com/article/2013/03/22/uk>. German authorities reportedly define HFT as “the sale or purchase of financial instruments for own account as direct or indirect participant in a domestic organized market or multilateral trading facility by means of a high frequency algorithmic trading technique which is characterized by (1) the usage of infrastructures to minimize latency times, (2) the decision of the system regarding the commencement, creation, transmission or execution of an order without human intervention for single transactions or orders, and (3) a high intraday messaging volume in the form of orders, quotes or cancellations.” See “High Frequency Trading: New Rules for Trading Participants,” *BaFin HFT Act Materials*, March 26, 2013, available at http://www.bafin.de/SharedDocs/Veroeffentlichungen/EN/Meldung/2013/meldung_130322_hft-gesetz_en.html?nn=2821494.

participant-to-market message ratios; or participant-to-market trade volume ratios.²⁰

Some securities regulators have argued that the absence of a clear definition of HFT has hurt their efforts to fully understand securities market structure issues.²¹ From a regulatory standpoint, the CFTC has also asked whether a formal definition of HFT should be adopted and, if so, what form it should take.²² Others, however, balk at the idea of crafting a definition of HFT for regulatory purposes, arguing that it is impossible to make a “clear distinction” between HFT and automated trading. They note that although HFT is generically defined as “a subset of automated trading,” it “should not be used interchangeably with the term automated trading or as a way of arbitrarily identifying a type of market participant.”²³ Others say that promulgating a useable and objective definition would require “selecting arbitrary [performance] thresholds”—which some researchers have said would require the measurement and collection of data at a scale that would be “exceedingly complicated.”²⁴

Some of the potential challenges in defining and differentiating HFT are illuminated in this discussion by the SEC staff:

[I]n the absence of trading account data, the use of general proxies for HFT that can be calculated with publicly available, market-wide data may capture a great deal of algorithmic and computer-assisted trading that should not be classified as HFT. Examples of such HFT proxies derived from market-wide data include high message rates, bursts of order cancellations and modifications, high order-to-trade ratios, small trade sizes, and increases in trading speed. These market-wide proxies are associated with the broader phenomena of algorithmic trading and computer-assisted trading in all their forms.... HFT represents a large subset, but by no means all, of algorithmic and computer-assisted trading.... In addition, other types of computer-assisted trading tools are common in today’s markets that may generate market activity that is difficult to distinguish from HFT, at least in the absence of datasets that can tie market activity to particular trading accounts. These tools include smart order routing systems that are designed to deal with the large number of trading venues in the fragmented U.S. equity market structure. They also include trading systems with automated functionalities that, while perhaps not falling within the definition of an algorithm (and therefore not appropriately classified as HFT), nevertheless enable orders to be submitted to the marketplace in ways that are far beyond the manual capacities of a human trader.”²⁵

²⁰ “TAC Subcommittee on Automated and High Frequency Trading, Working Group 1, Presentation to the TAC,” October 30, 2012), available at http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/tac103012_wg1.pdf.

²¹ SEC Concept Release on Equity Market Structure: Securities and Exchange Commission.

²² “Concept Release on Risk Controls and System Safeguards for Automated Trading Environments,” *Commodity Futures Trading Commission*, September 12, 2013, available at <http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/federalregister090913.pdf>.

²³ For example, see “FIA Principal Traders Group Comments at the CFTC’s Technology Advisory Committee Meeting,” *FIA*, February 10, 2014, available at http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/tac021014_fia_ptg.pdf. “The FIA is a trade organization for the futures, options and over-the-counter cleared swaps markets.” The FIA Principal Traders Group is a subsection of the FIA that describes itself as “firms that trade their own capital on the exchange-traded markets.”

²⁴ Rob Daily, “Can High Frequency Trading Be Defined?” *Sell-Side Technology*, December 16, 2011, available at <http://www.waterstechnology.com/sell-side-technology/opinion/2133536/frequency-trading-defined>.

²⁵ “Equity Market Structure Literature Review Part II: High Frequency Trading Staff of the SEC Division of Trading and Markets,” *SEC*, March 14, 2014, available at <https://www.sec.gov/marketstructure/research/> (continued...)

HFT Firms: Alternative Trading Systems, Electronic Communication Networks, and Dark Pools

Alternative trading systems (ATSs) are integral parts of the securities market landscape in which HFT takes place, and HFT often interacts with them. ATSs can be subdivided into electronic communication networks (ECNs) and dark pools. This section provides a basic overview of those components of the securities market.

ATSs are broker-dealer firms that match the orders of multiple buyers and sellers according to established, nondiscretionary methods and have been around since the late 1960s. They grew in popularity in the mid-1990s as technological developments made it easier for broker-dealers to match buy and sell orders. In 1998, the SEC adopted a new regulatory framework, Regulation ATS, that sought to reduce barriers to entry for such systems while also promoting competition and innovation and regulating the exchange functions they performed.²⁶ In 2013, 35 broker-dealers reportedly operated 44 ATSs that actively traded exchange-listed stocks.²⁷

One type of ATS, known as an ECN, chooses to publicly display its best orders in the consolidated quote stream as exchanges, as the New York Stock Exchange (NYSE) and Nasdaq do, and allow its stock trade offers, known as quotes, to be accessed by investors. ECNs are widely perceived to have benefited the equity market over the last decade or so through such features as faster trading technologies, innovative pricing strategies, and robust inter-market linkages.

Two of the best known independent ECNs are INET and Archipelago. Other ECNs have merged with registered securities exchanges (of which there are 13) or have themselves become exchanges, as have BATS and Direct Edge, which are major exchanges that compete with the NYSE and Nasdaq. The ATSs, including the ECNs, have gained growing equity trading market shares through the years. By various accounts, the competitive pressure from the ATSs has led to legacy exchanges like the NYSE adopting various innovations designed to enhance the customer trading experience.²⁸

Another type of ATS is called a dark pool. An ATS that performs as a dark pool does not provide quotes into the public quote stream. This attribute of trade quote opacity has attracted institutional investors that want to anonymously trade blocks of shares without triggering potentially unfavorable price movements. Currently, 40 or so dark pools exist in the market. Categorically, dark pools have been divided into subgroups that include

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²⁶ “Release No. 34-40760; File No. S7-12-98, Regulation of Exchanges and Alternative Trading Systems,” *Securities and Exchange Commission*, December 8, 1998, available at <http://www.sec.gov/rules/final/34-40760.txt>.

²⁷ Laura Tuttle, “Alternative Trading Systems: Description of ATS Trading in National Market System Stocks,” *SEC Division of Economic and Risk Analysis*, 2013, available at http://www.sec.gov/marketstructure/research/ats_data_paper_october_2013.pdf.

²⁸ For example, see “Testimony Concerning Dark Pools, Flash Orders, High Frequency Trading, and Other Market Structure Issues,” Testimony of James A. Brigagliano, Co-Acting Director, Division of Trading and Markets U.S. Securities and Exchange Commission before the Senate Banking Subcommittee on Securities, Insurance, and Investment, October 28, 2009, available at <http://www.sec.gov/news/testimony/2009/ts102809jab.htm>.

- **Broker-dealer owned.** Some dark pools have been created by large broker-dealers for their clients and at times for the benefit of their own proprietary traders. These dark pools reportedly derive their share prices from the broker-dealer's order flow. As a consequence, they are said to provide some price discovery. Examples reportedly include Credit Suisse's CrossFinder, Goldman Sachs' Sigma X, and Morgan Stanley's MS Pool.²⁹
- **Agency broker or exchange-owned.** These dark pools act as agents, not principals. The trades they conduct are based on the securities prices that derive from the exchanges. As such, they have no price discovery function. Examples of agency broker dark pools include Liquidnet and ITG Posit. Exchange-owned dark pools include those offered by BATS and the NYSE.³⁰
- **Electronic market maker.** These dark pools are affiliated with independent securities operators like Getco and Knight, which operate as principals for their own accounts. Like the aforementioned broker-dealer-owned dark pools, the transaction prices overseen by these pools are not calculated from the national best bid and offer (NBBO).³¹ As such, the dark pools do not provide price discovery.³²

Under Regulation ATS, dark pools are required to register either as exchanges with the SEC or as broker-dealers with Financial Industry Regulatory Authority (FINRA), the frontline regulator of SEC-registered broker-dealers that the SEC oversees. As such, dark pools are subject to the same rules that govern trading on an exchange or by a broker-dealer.

At a House Financial Services Subcommittee on Capital Markets and Government Sponsored Enterprises hearing on February 28, 2014, some subcommittee members expressed concerns that the presence of dark pools might contribute to market uncertainty, potentially harming small investors. However, Roel Campos, a former SEC commissioner, testified at the hearing that although the pools may have a "sinister" connotation, the rules that govern them are very explicit, and the pools must "reflect the last, best price" for a given security.³³ In *Flash Boys*, Michael Lewis discusses various large broker-dealers that owned dark pools to which they would channel customer orders for execution. Although all customer orders are supposed to fetch the best prevailing buy or sell price, the book notes that due to the pools' opacity, evidence of whether this has happened is essentially unavailable. According to an article by Sullivan and Russello in the *New York Law Journal*, there are "several ways in which dark pools can be used to further

²⁹ Elvis Picardo, "An Introduction To Dark Pools," *Investopedia*, May 6, 2014, available at <http://www.investopedia.com/articles/markets/050614/introduction-dark-pools.asp>.

³⁰ *Ibid.*

³¹ The NBBO is updated throughout the day to show the highest and lowest offers for a security among all exchanges and market makers. The lowest ask price and the highest bid price displayed in the NBBO do not have to come from the same exchange. The best bid and ask prices from a single exchange or market maker are known as the "best bid and offer." Traders interested in executing orders larger than those available through the NBBO may want to know other potential bid and ask prices at which they can execute their orders. These can be found in an exchange or market maker's "depth of book" data. The Consolidated Quotation System gives the NBBO for securities listed on the NYSE, while the Unlisted Trading Privileges Quote Data Feed gives the NBBO for securities listed on the Nasdaq. "National Best Bid and Offer – NBBO," *Investopedia*, available at <http://www.investopedia.com/terms/n/nbbo.asp>.

³² Elvis Picardo, "An Introduction To Dark Pools."

³³ "House Financial Service Subcommittee on Capital Markets and Government Sponsored Enterprises Holds a Hearing on Equity Market Structure," *Political Transcript Wire*, February 28, 2014, available at <http://search.proquest.com/docview/1503127210?accountid=12084>.

potentially improper trading motives.” The authors cite as one such example an insider trading case complaint filed by the DOJ and the SEC against a former fund manager at SAC Capital Advisors.³⁴ According to the SEC’s complaint, the manager’s emails showed that allegedly unlawful trades were “executed quietly and efficiently over a four day period through algorithms and dark pools and booked into two firm accounts with very limited viewing access.” The authors then argue that the case illustrates the possibility that a dark pool’s “promise of confidentiality could entice traders to employ those systems for unlawful purposes.” Relatedly, in April 2014, SEC Chair Mary Jo White noted that the agency has “a number of ongoing investigations as to practices” by dark pools. Another major policy concern over dark pools is whether having a significant portion of a security’s trade volume executed in the pools harms the overall price discovery process in the security. Effective May 2014, FINRA rules require ATS to publicly report weekly trading volume information, specifically the number of securities trades (both equity and debt) within the ATS. FINRA has said the rules should enhance transparency in the dark pools by improving available information concerning specific stock prices and liquidity.³⁵

HFT Technology: Trader Strategies

HFT is conducted through supercomputers that give firms the capability to execute trades within microseconds or milliseconds (or, in the technical jargon, with “extremely low latency”). In practice, depending on the particulars of the trade, trading opportunities can last from milliseconds to a few hours.

Generally, the traders that employ HFT strategies are attempting to earn small amounts of profit per trade. Some arbitrage strategies can reportedly earn profits close to 100% of the time, but many HFT strategies are based on the law of averages. Reports indicate such strategies might make money on only 51% of the trades, but because the trades are conducted hundreds or thousands of times per day, the strategies may still be profitable.³⁶

HFT traders employ a diverse range of trading strategies that may also be used in combination with each other. Some analysis broadly categorizes these strategies into passive and aggressive trading strategies. Passive strategies involve the provision of limit orders, offers to buy or sell certain amounts of securities when certain designated share prices thresholds are met that have not yet been executed. Providing limit orders injects liquidity into the markets, which is considered an integral part of market quality. An example of this is the market making strategy described below. Aggressive HFT involves the provision of market orders or marketable (immediately executable) limit orders, which do not put liquidity into the markets and are said to result in the removal of liquidity-producing limit orders. Such strategies are said to include momentum ignition trading, described below.

³⁴ Neal E. Sullivan and Gerald J. Russello, “Dark Pool’ Trading Is Not Shielded From Regulatory Spotlight,” *New York Law Journal*, January 31, 2013, available at <http://www.newyorklawjournal.com/id=1202586322320/%27Dark-Pool%27-Trading-Is-Not-Shielded-From-Regulatory-Spotlight?slreturn=20140510172105>.

³⁵ “SEC Approves New Requirements for Alternative Trading Systems,” *FINRA*, February 2014, available at <http://www.finra.org/Industry/Regulation/Notices/2014/P446085>.

³⁶ Charles M. Jones, “What Do We Know About High-Frequency Trading?” *Columbia Business School*, March 20, 2013, available at http://www.futuresindustry.org/ptg/downloads/HFT-Study_CMJones.pdf.

A number of observers say the aggressive form of HFT should be the central focus of public policy concerns over HFT because the passive form tends to result in price and liquidity improvements to HFT counterparties.³⁷

A micro-market structure study of passive and aggressive HFT found that “a majority of HFTs consistently specialize either in ... aggressive HFTs or ... passive HFT [and that] [a]ggressive HFTs earn substantially higher returns than [p]assive HFTs—the average [a]ggressive HFTs earns an annualized alpha of 90.67%, while the average passive firm earns 23.22%—suggesting that there is a stronger profit motive for liquidity taking compared to liquidity provision.”³⁸

HFT strategies include

- *Market making*, which involves a firm providing liquidity by matching buyer and seller orders or by buying and selling through its own securities inventories if a market maker cannot immediately match buyers and sellers. Market makers earn a profit on the difference between the bid prices buyers are willing to pay for a security and the ask prices sellers are willing to accept. Some of this kind of HFT market making is reportedly driven by the HFT firm’s receipt of so-called liquidity rebates (usually a fraction of a penny a share) provided by ECNs and exchanges for the limit orders that they post to those trading centers. Some argue that the subsidies help to ensure sustained market participation regardless of market conditions.³⁹
- *Arbitrage trading*, which involves profiting from price differentials for the same stocks that are traded on different market centers, such as the London Stock Exchange and the NYSE, or the same stock and its derivatives, such as stock options. Within this context, various HFT firms employ something called slow market arbitrage wherein the firms attempt to arbitrage minute price differences for stocks between various exchanges resulting from infinitesimal time differences in the trading prices that they report on the same securities, a practice described in *Flash Boys*.⁴⁰

³⁷ For example, see Anton Golub, “Overview of High Frequency Trading,” *Manchester Business School*, April 15, 2011, available at https://fp7.portals.mbs.ac.uk/Portals/59/docs/MC%20deliverables/WP27%20A%20Golub%20paper%201_IntroHFT.pdf.

³⁸ Matthew Baron, Jonathan Brogaard, and Andrei Kirilenko, “Risk and Return in High Frequency Trading,” *Social Science Research Network*, April 2014, available at <http://dx.doi.org/10.2139/ssrn.2433118>. Alpha is a measure of performance on a risk-adjusted basis. Alpha takes the volatility (price risk) of an asset and compares its risk-adjusted performance to a benchmark index. The excess return of the fund relative to the return of the benchmark index is the alpha.

³⁹ The rebates are one side of a “maker-taker model” for subsidizing the provision of stock liquidity employed by various market centers such as the NYSE, Nasdaq, and BATS. In this model, investors and traders that put in limit orders typically receive a small rebate from the exchange upon execution of their orders because they are regarded as having contributed to liquidity in the stock (i.e., they are liquidity “makers”). Conversely, those that put in market orders are regarded as “takers” of liquidity and charged a modest fee by the exchange for their orders. While the rebates are typically fractions of a cent per share, they can add up to significant amounts over the millions of shares traded daily by high-frequency traders. Many HFT firms employ trading strategies specifically designed to capture as much of the liquidity rebates as possible.

⁴⁰ Elvis Picardo, “You’d Better Know Your High-Frequency Trading Terminology,” *Investopedia*, April 25, 2014, available at <http://www.investopedia.com/articles/active-trading/042414/you-d-better-know-your-high-frequency-trading-terminology.asp>. The article also provides an illustration of this kind of arbitrage: Assume that a fictitious company named UVW is trading at \$20.00/\$20.01 on all exchanges, but because of sudden large-scale buying on the Nasdaq, jumps to \$20.03/\$20.04 on that exchange. HFT firms would use their superior speed to buy large numbers of (continued...)

- *Pair arbitrage trading*, which involves exploiting relative price discrepancies between closely related companies (like Home Depot and Lowes, for example).
- *Momentum ignition strategies*, which involve a proprietary trading firm initiating a series of orders or trades aimed at causing rapid up or down securities price movements. By establishing an early position, the proprietary trading firm is attempting to profit when it subsequently liquidates the position if it has succeeded at sparking the aforementioned price movements.
- *Liquidity detection trading*, which involves the use of computer algorithms to identify large institutional orders that sit in dark pools or other stock order trading venues. HFT traders may repeatedly submit small-sized exploratory trading orders intended to detect orders from large institutional investors. The process can provide the HFT trader with valuable intelligence on the existence of hidden large investor liquidity, which may enable the trader to trade ahead of the large order under the assumption that the large order will ultimately move the market's pricing of the security to the benefit of the HFT firm. *Flash Boys* describes the phenomenon in which the broker-dealer owners of dark pools, such as Credit Suisse and Morgan Stanley, sold access to HFT firms to trade against orders in dark pools. The book asks "Why would anyone pay for access to the customers' orders inside a Wall Street bank's dark pool?" It then answers the question: "[A] customer's stock market order, inside a dark pool, was fat and juicy prey. The order was typically large, and its movements were especially predictable: Each Wall Street bank had its own detectable pattern for handling orders. The order was also slow, because of the time it was forced to spend inside the dark pool before accessing the wider market."⁴¹

Flash Boys also described a variation on this liquidity detection strategy called ping-pong. This involves HFT firms placing buy and sell offers in 100-share lots for every listed stock (the minimum order needed to get them to the front of the trading queue). They may then receive a ping or a series of pings, which means the order or orders have been executed. The pings alert the HFT firm to the presence of a large buy side investor's order. A HFT trader would then act to be the buy side order's counterparty at the first exchange, which part of the order arrived at. Milliseconds later when other parts of a buy side order reach other trading venues, the HFT firm is described as having outmaneuvered the buy side, thus reportedly enabling it to profitably take advantage of the buy side order.⁴² Some market participants have likened this ping-pong to a form of baiting in which institutional investors are enticed into divulging the intent behind their orders. However, there are some indications that may at least in part challenge this characterization of "predatory" liquidity detection HFT as being an aggressive strategy aimed at vulnerable buy side trading. For example, citing market data the agency has been receiving, SEC officials report evidence that the more traditional

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UVW shares at \$20.01 from the other exchanges and sell them a fraction of a second later at \$20.03 on the Nasdaq. This arbitrage would push up the price of UVW on the other exchanges and drive it lower on the Nasdaq, resulting in a new equalized price of, say, \$20.02/\$20.03.

⁴¹ Michael Lewis, *Flash Boys*, p. 92.

⁴² *Ibid.*, p. 72.

buy side was becoming at least as complex in trading patterns as the sell side firms that are involved in HFT.⁴³ In addition, Blackrock, an asset manager and the nation's largest buy side firm, observed that "for institutional investors, there is risk that transaction costs may be inflated due to predatory HFT activity" but also noted that Blackrock "employs various strategies to mitigate predatory HFT activity wherever possible, leveraging *technology, trading tactics and transaction cost analysis*."⁴⁴

Major types of HFT practitioners include

- *Traditional broker-dealers* and now bank holding companies, such as Goldman Sachs, Morgan Stanley, and Deutsche Bank, that have conducted HFT strategies through their proprietary trading desks (outside of their client businesses),⁴⁵
- *Independent proprietary trading firms* like Getco, Tradebot, QuantLab, and Virtu; and
- *Hedge funds* such as Citadel, D.E. Shaw, SAC Global Advisors, and Renaissance Technologies.

Analysis

The Current Equities HFT Landscape

HFT takes place among several types of securities classes, including equities, options, derivatives, fixed income securities, and foreign currencies. In the domestic equities arena, the volume of HFT appears to have leveled off in recent years. Estimates from Rosenblatt Securities

⁴³ "What Drives the Complexity and Speed of our Markets? Speech by Gregg E. Berman, Associate Director, Office of Analytics and Research Division of Trading and Markets U.S. Securities and Exchange Commission," April 15, 2014, available at <http://www.sec.gov/News/Speech/Detail/Speech/1370541505819#.U13Hq1fDUwc>.

⁴⁴ "US Equity Market Structure: An Investor Perspective."

⁴⁵ According to CRS Legal Sidebar, "Final Volcker Rule—In Time for the Holidays and 18 Months for Compliance," by (name redacted) and David Carpenter: "On December 10, 2013, more than two years after the statutory-mandated deadline, five federal financial regulators, the Office of the Comptroller of the Currency; the Treasury Department; the Board of Governors of the Federal Reserve System; the Federal Deposit Insurance Corporation; and the Securities and Exchange Commission] published final regulations implementing what is known as the Volcker Rule, i.e., section 619 of the Dodd-Frank Wall Street Reform and Consumer Protection Act, which restricts proprietary trading and hedge fund investments and relationships by banking institutions. The same day, the Federal Reserve Board (FRB) set the date when conformance with the rule is required as July 21, 2015, although that date could be extended an additional two years." On the issue of high-frequency trading, the implementation rules said, "Algorithmic trading strategies that only trade when market factors are favorable to the strategy's objectives or that otherwise frequently exit the market would not be considered to be standing ready to purchase or sell a type of financial instrument throughout market cycles and, thus, would not qualify for the market-making exemption. The agencies believe this addresses commenters' concerns about high-frequency trading activities that are only active in the market when it is believed to be profitable, rather than to facilitate customers.... The Agencies are not, however, prohibiting all high-frequency trading activities under the final rule or otherwise limiting high-frequency trading by banking entities by imposing a resting period on their orders, as requested by certain commenters." "Prohibitions and Restrictions on Proprietary Trading and Certain Interests In, and Relationships With, Hedge Funds and Private Equity Funds," *Office of the Comptroller of the Currency, Department of the Treasury, Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation; and the Securities and Exchange Commission*, December 10, 2013, available at <http://www.sec.gov/rules/final/2013/bhca-1.pdf>.

indicate that although as much as two-thirds of all domestic stock trades between 2008 and 2011 were executed by HFT firms, this share may have declined to about one-half. In addition, Rosenblatt estimates that whereas HFT firms accounted for a trading volume of about 3.25 billion shares a day in 2009, that figure had fallen to about 1.6 billion shares in daily volume by 2012. HFT profits also appear to be in decline. Rosenblatt estimates that HFT firms' average profits have fallen from about a tenth of a penny per share traded to a twentieth of a penny.⁴⁶ The TABB Group, a securities market research firm that has done extensive research on HFT, estimates that domestic HFT revenues fell from approximately \$7.2 billion in 2009 to about \$1.3 billion in 2014.⁴⁷

Commenting on this changing HFT landscape, Mark Gorton, founder of Tower Research Capital, a large HFT firm, observed: "Profits have collapsed. The easy money's gone. We're doing more things better than ever before and making less money doing it." As a number of HFT firms went out of business in 2012, Raj Fernando, chief executive officer and founder of Chopper Trading, a large Chicago-based firm that employs HFT strategies, reportedly observed, "The margins on trades have gotten to the point where it's not even paying the bills for a lot of firms. No one's laughing while running to the bank now, that's for sure."⁴⁸ A number of factors have been cited for the diminishing profits, including the assertion that "the rest of the market has rushed to catch up technologically using smart order routers and other tools" and the claim that securities exchanges began charging HFT firms substantially more for the right to be connected to the exchange's data servers.⁴⁹ Another explanation is that a few years ago, the promise of outsized profits resulted in HFT firms "flood[ing] the market," only to find later that "it became harder to make money—especially since trading volumes were steadily declining as investors pulled out of stocks and poured their money into bonds ... [as they were] competing for shrinking profits against hundreds of other speed traders who were just as fast and just as smart" as HFT firms.⁵⁰

Some researchers have found that "trading profits persistently and disproportionately accumulate to a handful" of HFT firms and that there is evidence that is "consistent with a winner-takes-all industry structure." In such an environment, they say the HFT practitioners that are the first to identify and exploit profitable trading opportunities are able to capture virtually all of the gains. As such, some research also found that new firms that attempt to begin HFT "earn substantially fewer profits and are more likely to exit" HFT.⁵¹ One researcher observed that the HFT industry appeared to be "dominated by a small number of fast" HFT firms.⁵²

⁴⁶ Matthew Philips, "How the Robots Lost: High-Frequency Trading's Rise and Fall," *Bloomberg BusinessWeek*, June 6, 2013, available at <http://www.businessweek.com/articles/2013-06-06/how-the-robots-lost-high-frequency-tradings-rise-and-fall>.

⁴⁷ Larry Tabb, "No, Michael Lewis, the US Equities Market Is Not Rigged," *TABB Group*, March 31, 2014, available at http://tabbforum.com/opinions/no-michael-lewis-the-us-equities-market-is-not-rigged?print_preview=true&single=true. A criticism of Michael Lewis's book is that it ignores these reported declines in HFT's profits and its proportion of total market trades.

⁴⁸ *Ibid.*

⁴⁹ *Ibid.* Sarah N. Lynch, "SEC Official Calls for Review of 'Reg NMS' Equity Market Rules," *Reuters*, December 5, 2013, available at <http://www.reuters.com/article/2013/12/05/sec-aguilar-regnms-idUSL2N0JK11W20131205>. Amid these characterizations of recent HFT profit trends are reports that one HFT firm, Virtu Financial Incorporated, reported in filings with the SEC that it had earned money every day but one in the preceding five years. Sam Mamudi and Leslie Picker, "Virtu Filing Shines Light on High-Frequency Trading," *Bloomberg*, March 11, 2014, available at <http://www.bloomberg.com/news/2014-03-11/virtu-filing-shines-light-on-business-of-high-frequency-trading.html>.

⁵⁰ Matthew Philips, "How the Robots Lost: High-Frequency Trading's Rise and Fall."

⁵¹ See "Testimony of Andrei Kirilenko, Professor of the Practice of Finance Sloan School of Management (continued...)"

Key Factors Behind the Emergence of HFT

Technological and financial developments that have played roles in the emergence of HFT include

- technological advances in the speed and sophistication of securities trading-based computer technology and software and the falling costs of such technology,⁵³ and
- for-profit market trading centers like Nasdaq, the NYSE, and BATS that have responded to demand by HFT traders by selling faster access to their trading infrastructure and direct connections to their trade data transmissions.⁵⁴

In addition, several regulatory changes by the SEC have reportedly altered the securities market structure in ways that appear to have promoted the growth of HFT. Such SEC regulatory reforms include

- *Decimalization*. This protocol was adopted by the SEC in 2000 and directed stock exchanges to quote share prices in decimals instead of using the traditional fractions. This change reportedly made traditional market making less profitable, reduced the size of securities trades, and enhanced the demand for more sophisticated computerized trading devices.⁵⁵
- *Regulation Alternative Trading System*. This protocol was adopted by the SEC in 1998 and required alternative trading systems to comply with some of the regulatory obligations applicable to registered exchanges. The regulation appears to have contributed to the development and registration of ECNs. This helped to expand the number of trading centers for listed-stocks, further fragmenting the universe of market centers, a situation that appears to have aided certain HFT arbitrage strategies.⁵⁶
- *Regulation National Market System (Reg NMS)*. Adopted by the SEC in 2005, Reg NMS was a set of rules to improve domestic exchanges through improved price execution, quotes, and investor access to market data. Three key Reg NMS

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Massachusetts Institute of Technology before the Senate Committee on Agriculture, Nutrition & Forestry Hearing on High Frequency and Automated Trading in Futures Markets,” May 13, 2014.

⁵² “Testimony of Andrei Kirilenko, Professor of the Practice of Finance Sloan School of Management Massachusetts Institute of Technology before the Senate Committee on Agriculture, Nutrition & Forestry Hearing on High Frequency and Automated Trading in Futures Markets,” May 13, 2014.

⁵³ For example, one study reportedly found that the “game-changing technology” that helped foster the growth of HFT was bandwidth availability and the comparatively low cost of buying bandwidth. Nina Mehta, “High-Frequency Trading Is a Tough Game,” *Traders Magazine*, November 24, 2009, available at <http://www.tradersmagazine.com/news/high-frequency-trading-tough-game-104672-1.html>.

⁵⁴ For example, see Sorokin, Andrew Ross. “Fault Goes Deep in Ultrafast Trades.” *New York Times*, March 31, 2014. As an example, according to a news report, a firm conducting HFT can pay the NYSE and Nasdaq tens of thousands of dollars a month for a server “rackspace” right next to, or even at, either exchange. Jonathon M. Trugman, “How NYSE, NASDAQ Profit off ‘Flash Boys,’” *New York Post*, April 6, 2014, available at <http://nypost.com/2014/04/06/how-nyse-nasdaq-profit-off-flash-boys/>.

⁵⁵ See “Exchange Release No. 42360,” January 28, 2000, “Exchange Act Release No. 42685,” April 13, 2000, and “Exchange Act Release No. 42914,” June 8, 2000.

⁵⁶ See “Exchange Act Release No. 40760,” December 8, 1998, available at <http://www.sec.gov/rules/final/34-40760.txt>.

rules are (1) *the order protection rule*, which was aimed at ensuring investors receive the best buy or sell price when their order is executed by eliminating the ability to have orders *traded through* (executed at a worse price); (2) *the access rule*, which attempted to improve access to trade quotations from trading centers in the National Market System by requiring better market center linkages and lower access fees; and (3) *the market data rule*, which allocated revenue to self-regulatory-organizations (exchanges such as the NYSE) that promote and improve market data access by requiring market centers to route orders for execution to the market center that shows the best price, the NBBO. Various observers have asserted that Reg NMS contributed to today's fragmented trading marketplace, which includes 13 exchanges and about 40 dark pools that compete for business in listed stock trades.⁵⁷ HFT firms often exploit those fragmented markets by moving quickly between trading venues.

Perceived Costs and Benefits of HFT

Since HFT's emergence in the early and mid-2000s, academics, financial market participants, and other observers have vigorously debated its costs and benefits.

As discussed earlier, high-frequency traders use several distinct HFT strategies. Individual strategies may have markedly different effects on market quality and investors. According to one major asset manager from the buy side, which often finds itself in competition with HFT firms,

[H]igh frequency trading encompasses a wide variety of trading strategies and care must be taken to differentiate predatory practices from practices that benefit end-investors.... “[E]lectronic market making” is a type of HFT that brings tangible benefits to our clients through tighter spreads and by delivering intermediation in a fragmented trading landscape. Additionally, HFT is difficult to distinguish from computer-based trading tools such as algorithms or smart order routers which are used by market participants to execute orders for institutional and retail investors. All are characterized by low latency and infrastructures and automated order management. But, electronic market making and algorithmic trading are both activities which are legitimate elements of market structure and help asset managers to achieve best execution for clients.⁵⁸

Similarly, a SEC staff literature survey of academic research on HFT concluded,

Perhaps the most noteworthy finding of the HFT Dataset papers is that HFT is not a monolithic phenomenon, but rather encompasses a diverse range of trading strategies. In particular, HFT is not solely, or even primarily, characterized by passive market making strategies that employ liquidity providing orders that rest on order books and can be accessed by others.... [T]he level and nature of HFT activity can vary greatly across different types of stocks.⁵⁹

⁵⁷ For example, see Jacob Bunge, “A Suspect Emerges in Stock-Trade Hiccups: Regulation NMS,” *Wall Street Journal*, January 27, 2014, available at <http://online.wsj.com/news/articles/SB10001424052702303281504579219962494432336>.

⁵⁸ “U.S. Equity Market Structure: An Investor Perspective,” *Blackrock*, April 2014, available at <http://www.blackrock.com/corporate/en-us/literature/whitepaper/viewpoint-us-equity-market-structure-april-2014.pdf>.

⁵⁹ “Equity Market Structure Literature Review Part II: High Frequency Trading By Staff of the Division of Trading and Markets of the U.S. Securities and Exchange Commission,” *SEC*, March 18, 2014, available at https://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf.

Below are descriptions of arguments in support of, in defense of, and critical of HFT. As the reader goes through these, it is helpful to keep in mind the aforementioned caveats on the disparate range of HFT strategies and the limitations of HFT research. In addition, although the critical arguments outnumber the supportive arguments, one should not necessarily interpret this to mean that HFT criticism trumps supportive HFT arguments; individual supportive arguments such as market quality include several key market attributes that contribute to the overall quality of a securities market. In turn, the level of market quality can have significant monetary implications for investors.

Supportive Arguments for HFT

Arguments in support of HFT or that might mitigate criticism directed at it include the following:

Market Quality. The bid-ask spread of a security is essentially the difference between the price investors are willing to pay for it and the price other investors are willing to sell it for. Theoretically, lowered bid-ask spreads should reduce the costs of trading for all investors. Liquidity describes an investor's ability to promptly purchase or sell a security while having a minimal impact on its price. Price discovery is the process by which the value of a security is established through market supply and demand dynamics. Surveys of empirical research suggest that in both equity and foreign exchange markets, HFT appears to have narrowed bid-ask spreads, bolstered market liquidity, reduced some measures of price volatility, and improved the price discovery process.⁶⁰ Research indicates that some HFT can involve a price reversal strategy in which the trader rapidly buys securities after price declines and rapidly sells them after prices increase. This process could arguably help detect price anomalies and help stabilize prices.⁶¹ The aforementioned SEC HFT literature survey concluded that the research it examined generally found that primarily passive as opposed to aggressive HFT strategies appear to have had a beneficial impact on market quality metrics such as reducing bid-ask spreads.⁶² Correspondingly, various observers assert that HFT appears to have contributed to improvements in general market liquidity and bid-ask spreads over the past decade or so. However, correlation is not necessarily causation; various changes in the equity market structure, including developments such as decimalization, Regulation NMS, and the general expansion in computer technology during the period likely also contributed to these improvements, and it is hard to disentangle their individual roles.⁶³

⁶⁰ See "The Fast and the Furious; High-frequency Trading," *The Economist*, February 25, 2012. Terrence Hendershott, Charles M. Jones, and Albert Menkveld, "Does Algorithmic Trading Improve Liquidity?," *SSRN*, August 30, 2010, available at <http://pages.stern.nyu.edu/~jhasbrou/Teaching/2014%20Winter%20Markets/Readings/HFT0324.pdf>. Charles M. Jones, "What Do We Know About High-Frequency Trading?" *Columbia Business School*, March 20, 2013, available at http://www.futuresindustry.org/ptg/downloads/HFT-Study_CMJones.pdf.

⁶¹ "U.S. Department of the Treasury, Office of Financial Research 2013 Annual Report," December 2013, available at http://www.treasury.gov/initiatives/ofr/about/Documents/OFR_AnnualReport2013_FINAL_12-17-2013_Accessible.pdf.

⁶² "Equity Market Structure Literature Review Part II: High Frequency Trading by Staff of the Division of Trading and Markets," SEC, March 18, 2014, available at https://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf.

⁶³ For example, see Michael A. Goldstein, Pavitra Kumar and Frank C. Graves, "Computerized and High-Frequency Trading," *Social Science Research Network*, January 15, 2014, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2379842.

Volatility. Volatility refers to the frequency and magnitude of asset fluctuations. A major concern with heightened market volatility is that it fosters investor uncertainty and erodes market confidence. Noting that some HFT strategies are designed to profit from volatile markets, research found that there have been historical instances in which HFT appears to have helped reduce volatility when interacting with volatile markets. Such a dynamic was reportedly observed during the particularly volatile months of September and October 2008.⁶⁴ The aforementioned SEC HFT literature survey found that on average, passive as opposed to aggressive HFT strategies tended to reduce intraday volatility.⁶⁵ However, the SEC survey also referenced studies that found that HFT was associated with increased intraday volatility, but the research did not disaggregate the effects of aggressive and passive HFT.⁶⁶

HFT Has Not Been Proven to Foster Unduly Fast Markets. Concerns have been raised about the rapidity of trading in today's securities market and how such fast speeds may reduce market transparency for traders. Using data from a robust market-data feed system known as Midas, a staff official with the SEC's Office of Analytics and Research Division of Trading and Markets observed that HFT may not be pushing the securities market to move at a problematically fast rate. According to the official, the data suggest that investors are generally able to access even the most short-lived quotes.⁶⁷

Focusing on the Sell Side's Use of HFT-Related Strategies May Be Only a Part of the Picture. In a March 2014 speech, a SEC official with the Office of Analytics and Research Division of Trading and Markets spoke of some analysis of market data that the agency was receiving. Although the general tendency is to associate HFT-related strategies with the sell side, the analysis reportedly suggested to the SEC that the more traditional buy side was becoming at least as complex in trading patterns as the sell side firms involved in HFT. This provides a counterpoint to the narrative in *Flash Boys* and other observations that HFT significantly disadvantages institutional investors.⁶⁸ To the extent that some have suggested HFT can financially harm institutional investors, this could imply that at least some of them may be able to improve their ability to trade with HFT firms on more equal terms.

Concerns and Criticisms of HFT

By contrast, key concerns and criticisms of HFT include the following:

Lack of Dependable Liquidity. Some observers are concerned that overall market liquidity could deteriorate if HFT firms were to quickly and unexpectedly incur large losses. An attendant worry is that the liquidity provided by high-frequency trades is often not qualitatively comparable to the liquidity provided by traditional market makers. The high-frequency trades are said to

⁶⁴ Cristina McEachern Gibbs, "HFT Does Not Create Volatility," *Advanced Trading*, Aug. 26, 2009, available at <http://www.advancedtrading.com/algorithms/showArticle.jhtml?articleID=219500116>. Charles M. Jones, "What Do We Know About High-Frequency Trading?"

⁶⁵ "Equity Market Structure Literature Review Part II: High Frequency Trading by Staff of the Division of Trading and Markets."

⁶⁶ *Ibid.*

⁶⁷ "What Drives the Complexity and Speed of our Markets? Speech by Gregg E. Berman, Associate Director, Office of Analytics and Research Division of Trading and Markets U.S. Securities and Exchange Commission," *SEC*, April 15, 2014, available at <http://www.sec.gov/News/Speech/Detail/Speech/1370541505819#.U13Hq1fDUwc>.

⁶⁸ *Ibid.*

generally lack depth because of the relatively small size of HFT quotes (offers to buy or sell certain securities) and the fact that HFT firms have no affirmative market-making obligation.⁶⁹ In addition, a number of market participants contend that HFT firms tend to focus their trades and thus the provision of liquidity on the securities of companies with large capitalizations, often ignoring the stocks of smaller capitalized companies.⁷⁰ Among other things, HFT proponents, however, cite analysis that examined two months' worth of trading in the United Kingdom. The study found that HFT traders provide liquidity when spreads tend to be wide, demand liquidity when spreads tend to be narrow, and generally smooth out liquidity over the long run.⁷¹

Phantom Liquidity. A separate criticism of HFT is that the liquidity provided is often fleeting and has been alternatively dubbed “phantom liquidity” or “flickering quotes.” Several factors are said to underlie this, including the speed differences between trading venues and rapidly changing order book dynamics due to HFTs’ penchant for posting and then canceling orders. As a consequence, the available liquidity for given securities may often be less than what appears to be the case. Some institutional investors are said to have difficulties evaluating whether or not posted liquidity is transient. Such challenges have led to concerns that HFT may have helped increase the total trading costs of institutional investors.⁷²

Former SEC Chair Mary Schapiro noted that although there may be

justifiable explanations for many cancelled orders to reflect changing market conditions, the SEC and other regulators are looking carefully at certain practices in this area to assess whether they violate existing rules against fraudulent or other improper behavior [and that] we also must understand the impact this activity has on price discovery, capital formation and the capital markets more generally, and consider whether additional steps such as registration and trading requirements are needed to ensure that these and other practices are used only in ways that foster—not undermine—fair and orderly markets.⁷³

Others, however, argue that a significant number of the cancellations may reflect logical market responses in which a HFT firm pulls back submitted quotes that do not get “a favorable

⁶⁹ “U.S. Department of the Treasury, Office of Financial Research 2013 Annual Report,” December 2013, available at http://www.treasury.gov/initiatives/ofr/about/Documents/OFR_AnnualReport2013_FINAL_12-17-2013_Accessible.pdf. An affirmative obligation is the requirement imposed on certain exchange market makers that they must enter the market on a particular security by being willing to buy or sell a security when there is insufficient market demand and supply to efficiently match orders in the security.

⁷⁰ “High Frequency Trading: Is It A Dark Force Against Ordinary Human Traders And Investors?” *Forbes*, September 30, 2013, available at <http://www.forbes.com/sites/richardfinger/2013/09/30/high-frequency-trading-is-it-a-dark-force-against-ordinary-human-traders-and-investors/>.

⁷¹ “London Stock Exchange Group Response to CESR Call for Evidence on Micro-Structural Issues of the European Equity Markets,” *London Stock Exchange Group*, April 30, 2010, available at <http://modernmarketsinitiative.org/wp-content/uploads/2013/10/LondonStockExchange-HFT.pdf>.

⁷² “NBIM Discussion Note: High Frequency Trading – An Asset Manager’s Perspective,” *NBIM*, 2013, available at http://www.nbim.no/Global/Documents/Dicussion%20Paper/2013/DiscussionNote_1-13.pdf. In 2010, then SEC Chair Mary Schapiro observed that a HFT firm “that trades one million times per day may submit 90 million or more orders that are [subsequently] canceled.” “Speech by SEC Chairman: Strengthening Our Equity Market Structure by Chairman Mary L. Schapiro U.S. Securities and Exchange Commission Economic Club of New York,” September 7, 2010, available at <http://www.sec.gov/news/speech/2010/spch090710mls.htm>. The order submission and cancellation protocol is said to help HFT firms ascertain the market demand for the securities.

⁷³ “Speech by SEC Chairman: Strengthening Our Equity Market Structure. Chairman Mary L. Schapiro U.S. Securities and Exchange Commission Economic Club of New York New York,” September 7, 2010, available at <http://www.sec.gov/news/speech/2010/spch090710mls.htm>.

execution,” perhaps because “conditions didn’t move in ... [the firm’s] favor ... when [it] put the order in.”⁷⁴ A corollary perspective questions the notion that high cancellation rates are symptomatic of low-quality liquidity. It argues that elevated cancellation rates reflect robust competition between market makers, including HFT firms, that are simply vying for trade execution priority as part of the securities trade price determination process.⁷⁵

In April 2014, an official with the SEC’s Office of Analytics and Research spoke about the results of some analysis of 2013 market data. The analysis found that although about 39% of all canceled orders were initially active for one-half of one second or less, about 27% of executed trades were the result of another trader accessing posted orders within that window of time. The office also found that although 23% of all cancellations occurred within 50 milliseconds, approximately 19% of all the monitored trades took place within that time frame. After evaluating these findings, the official suggested there were several potential takeaways, including (1) the speed of canceled orders and the speed of executed trades have been relatively aligned, (2) the degree to which stock exchanges and non-dark pool ATSS have been dominated by HFT may have been overstated by some, and (3) regulation aimed at reducing high cancellation rates would also have to reduce the trading speeds of liquidity “takers.”⁷⁶

Front-Running. Front-running is a form of illegal insider trading. CRS Report RS21127, *Federal Securities Law: Insider Trading*, by (name redacted), observes that

insider trading in securities may occur when a person in possession of material nonpublic information about a company trades in the company’s securities and makes a profit or avoids a loss. The Securities Exchange Act of 1934 and the Insider Trading Sanctions Act of 1984 have provisions which forbid insider trading. One provision of the 1934 Act requires the disgorgement of short-swing profits by named insiders.⁷⁷ The 1934 Act’s general antifraud provision has been used many times to sanction insider trading.⁷⁸

FINRA, the frontline regulator of broker-dealers, describes its prohibition on illegal front-running:

[N]o member or person associated with a member shall cause to be executed an order to buy or sell a security or a related financial instrument when the member or person associated with the member causing the order to be executed has material, non-public market information concerning an imminent block transaction in that security, a related financial instrument or a security underlying the related financial instrument prior to the time information concerning the block transaction has been made publicly available or has otherwise become stale or obsolete.⁷⁹

⁷⁴ See the comments of former SEC Chief Economist Chester Spatt in: “Final Brookings Institution Holds Discussion on Trading Stocks in America: Key Policy Issues, Panel 1” *CCQ Newsmaker Transcripts*, January 30, 2014.

⁷⁵ Manoj Naring, “What’s All the Fuss About High-Frequency Trading Cancellation Rates?” *Institutional Investor*, June 24, 2010, available at <http://www.institutionalinvestor.com/Popups/PrintArticle.aspx?ArticleID=261756>.

⁷⁶ “What Drives the Complexity and Speed of our Markets? Speech by Gregg E. Berman, Associate Director, Office of Analytics and Research Division of Trading and Markets U.S. Securities and Exchange Commission,” *SEC*, April 15, 2014, available at <http://www.sec.gov/News/Speech/Detail/Speech/1370541505819#.U13Hq1fDUwc>.

⁷⁷ 15 U.S.C. §78p.

⁷⁸ 15 U.S.C. §78j(b).

⁷⁹ See FINRA Manual, “5720. Front Running of Block Transactions,” at http://finra.complanet.com/en/display/display.html?rbid=2403&record_id=14821&element_id=10860&highlight=front-running#r14821.

As reported earlier, the DOJ and the FBI are among a number of entities involved in examining whether HFT traders may have been engaged in front-running and insider trading.⁸⁰ Two divergent perspectives on whether HFT traders illegally front run follow:

[A] recent University of Michigan report claims “[b]y anticipating future NBBO, an HFT algorithm can capitalize on cross-market disparities before they are reflected in the public price quote, in effect jumping ahead of incoming orders.”... What’s actually happening behind the scenes may be frustratingly complicated, but it’s not ... illegal.... HFTs generally use direct connections to exchanges in order to post bids and offers and collect market data, rather than relying on the centralized SIP feed. This is because the SIP feed is unacceptably slow.... When an order is placed, it takes some time to be reflected in the NBBO. But that order is already in the market before the HFT can see it, even on the direct feed, by definition. HFTs never know what a customer’s order is before it’s in the market. HFTs have no customers. HFTs cannot front-run anyone.⁸¹

In April 2014, when asked of her views on whether HFT firms may be involved in illegal front-running, SEC Chair Mary Jo White said some may be erroneously conflating the ability of some HFT firms to conduct trades based on their quick reactions to “public information” with illegal front-running wherein traders have “early access to order information.”⁸²

If, however, federal prosecutors go forward with cases involving HFT front-running, an article in the *New York Times* spoke of the legal challenges they could encounter:

The cornerstone of insider trading law is identifying a misuse of confidential information that constitutes a breach of a fiduciary duty.... High-frequency traders get the best prices by stepping ahead of others in having their trades executed first, making the transactions of other investors a bit less profitable. This sounds like front-running, in which a broker buys or sells before execution of a client’s order to take advantage of a more favorable price.... One way in which high-frequency traders try to gather information about the flow of orders is by “pinging” different markets. That means a firm sends multiple orders out into the markets to determine whether any will be filled, which can give an indication of the direction of a stock.... Can this be the basis for pursuing charges against high-frequency trading firms? The problem with proving market manipulation is that the government must show intent to either artificially affect stock prices or to defraud others. High-frequency traders send out orders to learn the best price so they can trade ahead of others, not necessarily to drive the price up or down. In fact, they usually do not want the price to move until after they have traded. Proving intent to defraud requires purposeful or reckless conduct to deprive the victim of property. That standard would be difficult to prove when an algorithm makes the investment decision in the blink of an eye and the firms have no real interest in the underlying value of the companies whose shares they trade.⁸³

⁸⁰ Keri Geiger and Patricia Hurtado, “FBI Seeks Help From High-Frequency Traders to Find Abuses,” *Bloomberg*, April 1, 2014, available at <http://www.bloomberg.com/news/2014-03-31/fbi-said-to-probe-high-speed-traders-over-abuse-of-information.html>. See the comments of U.S. Attorney General, Eric Holder, Jr. in: “House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Justice Department,” *CQ Congressional Transcripts*, April 4, 2014.

⁸¹ Rishi K. Narang, “High-Frequency Traders Can’t Front-Run Anyone,” *CNBC.com*, April 3, 2014, available at <http://www.cnbc.com/id/101551570>.

⁸² “House Financial Services Committee Holds Hearing on President Obama’s Proposed Fiscal 2015 Budget Request for the Securities and Exchange Commission,” *CQ Congressional Transcripts*, April 29, 2014, available at <http://www.cq.com/doc/congressionaltranscripts-4465319?3>.

⁸³ Peter Henning, “High-Frequency Trading Falls in the Cracks of Criminal Law,” *New York Times*, April 7, 2014, (continued...)

Two-Tiered Markets Through Differential Access to Market Center Trading Infrastructure.

HFT firms often pay for the right to access two pieces of technology for market trading centers like the NYSE, Nasdaq, and BATS: (1) direct access to market center overall trade data and (2) being able to locate a trader's servers in close proximity to a market center's trade order dissemination servers, known as *colocation*. The direct data feeds give subscribers real-time market quote and trading data fractions of a second before the data reach other investors through the conventional aggregate real-time quote and trading data feeds provided by the Consolidated Tape Association/Securities Information Processor (CTA).⁸⁴

Getting early access to market data via direct feeds reportedly gives HFT firms an earlier peek at the CTA data, which relies on data from all market center securities and must be aggregated and then normalized and thus lags direct data feeds from individual trading centers. Colocation permits HFT traders to minimize transmission times through paying securities exchanges for the right to place their servers in the same data centers in which an exchange's or an ECN's market data systems are located. This is said to enable HFT firms to reduce the data transmission time between their own technology systems and the systems operated by the market centers. By some accounts, the pairing of direct access feeds with colocation can provide HFT traders with a fraction of a microsecond advantage over conventional traders that depend on the CTA feeds.⁸⁵

This has led to charges that HFT firms are unfairly advantaged vis-à-vis other traders that, it is said, are thus competitively disadvantaged. Some argue that an advance information advantage of just a fraction of a microsecond can be "enough to get a better price, even for a later-placed order."⁸⁶ Others, however, say securities markets have always been characterized by differential or tiered access to securities trades, going back to the time when floor traders had favored access to stock orders.⁸⁷ Moreover, they note that the benefits of direct feeds and colocation are available to anyone willing to pay for the services, albeit at prices that may be beyond the reach of many traders. Still others argue that "the cost-benefit tradeoff for investing in these tools and capabilities is likely to be much more favorable to organized, institutional, strongly capitalized high-frequency traders, given that the proportional increase in HFT profits from minute improvements in trading speed is potentially far greater across very large volumes of trades per day rather than for long-term, low-frequency investors."⁸⁸

Two-Tiered Markets Through Customized HFT Order Types. Market centers, including the NYSE, Nasdaq, BATS, and Direct Edge, are reportedly involved in customizing order types to fit the needs of their HFT firm clients. The order types give HFT traders different ways to interact with the securities market and, as one trader from an HFT firm reportedly said, such customized trading protocols "optimize the order type for a given trade.... [S]ometimes you'll want to pay the [liquidity provision] rebate and sometimes want to take [receive] it—but what's really essential is

(...continued)

available at <http://dealbook.nytimes.com/2014/04/07/high-frequency-trading-falls-in-the-cracks-of-criminal-laws/>.

⁸⁴ This is the entity that oversees the dissemination of real-time trade and quote information in the NYSE, BATS, NYSE Arca, NYSE MKT, and other regional exchanges' listed securities.

⁸⁵ Eliot Lauer, Jason Gottlieb, and Alyssa Astiz, "High-Frequency Trading: Are the Exchanges the Next Targets?" *BNA Securities Regulation & Law Report*, June 3, 2013, available at http://www.curtis.com/siteFiles/News/curtis_lauer_gottlieb_astiz_article.pdf.

⁸⁶ *Ibid.*

⁸⁷ Charles M. Jones, "What Do We Know About High-Frequency Trading?"

⁸⁸ Michael A. Goldstein, Pavitra Kumar, and Frank C. Graves, "Computerized and High-Frequency Trading."

to jump to the head of the queue.... You pay for it, but you jump to the head.”⁸⁹ Market centers say they do not favor one group of clients over others and such orders are available to all customers. A NYSE official, however, reportedly acknowledged that “we’re always competing for market share, so we try to create products that will attract more volume. We listen to clients and see how orders can help their execution strategy.”⁹⁰

Research published by Barclays Bank in early 2013 reportedly detailed 34 order types at the NYSE and 30 at BATS, for example. The order types are apparently often combined, so thousands of order types are said to effectively exist. In April 2013, Haim Bodek, a former HFT practitioner and now a critic of the order types, praised the industry for what he sees as moving in the right direction with respect to the order types. He observed that market centers “have been cleaning up their act, tweaking order types combinations to remove problems, and expected them to have eliminated all perverse orders by the end of 2014.”⁹¹ Meanwhile, the SEC has reportedly been reviewing the process of providing customized order types with respect to which order types are developed, approved, and monitored.⁹²

Market Manipulation. Another criticism is that HFT firms may engage in potentially manipulative strategies that involve the use of quote cancellations. FINRA, the frontline broker-dealer regulator, has observed that

although many HFT strategies are legitimate, some are not and may be used for manipulative purposes. Given the scale of the potential impact these practices may have, the surveillance of abusive algorithms remains a high priority for FINRA.... [A]reas of concern [include] ... the use of so-called “momentum ignition strategies” where a market participant attempts to induce others to trade at artificially high or low prices. Examples of this activity reportedly include layering and spoofing strategies.⁹³

Layering involves the placement of multiple, often large orders that are not meant to be executed and that are subsequently rapidly canceled. The aim is to create artificial levels of supply and demand that drive the price of stock up or down. After this, “genuine” orders are transacted that benefit from the artificially inflated or reduced securities prices.⁹⁴ In spoofing, a HFT firm places large limit orders to sell that are above the best asking price with the intention of quickly canceling them if the price moves upward so they will not be executed. HFT firms allegedly hope that during spoofing the size of the sell orders will scare other traders into selling at a low price, potentially enabling the HFT firm to profit from the bargain prices. The causes and effects of spoofing are said to be similar to certain human-based market manipulations such as pump-and-dump and bear raid schemes. The SEC and

⁸⁹ Laurie Carver, “Exchange Order Types Prompt Fears of HFT Conspiracy,” *Risk Magazine*, April 23, 2013, available at <http://www.risk.net/risk-magazine/feature/2261626/exchange-order-types-prompt-fears-of-hft-conspiracy>.

⁹⁰ *Ibid*

⁹¹ *Ibid*.

⁹² *Ibid*. In May 2014, the chief executive officer of Intercontinental Exchange (ICE), which owns the NYSE, announced that the NYSE would be eliminating a number of order types, saying that they added to the complexity of the markets. “ICE Seeks to Reduce Stock Order Types at NYSE CEO Says Big Board Will Petition Regulators in Bid to Reduce Market Complexity,” *Wall Street Journal*, May 8, 2014, available at <http://online.wsj.com/news/articles/SB10001424052702304885404579549372363787310>.

⁹³ “FINRA Annual Examination Priorities Letter,” *FINRA*, January 2, 2014, available at <http://www.finra.org/web/groups/industry/@ip/@reg/@guide/documents/industry/p419710.pdf>.

⁹⁴ “Wave of Action Against High-Frequency Traders Hits Home,” *Banking & Finance, Litigation & Dispute Resolution*, July 26, 2013, available at <https://www.taylorwessing.com/news-insights/details/wave-of-action-against-high-frequency-traders-hits-home-2013-07-26.html>.

the CFTC have reportedly prosecuted a number of alleged spoofing offenders. However, detecting spoofing is said to be both difficult and complicated.⁹⁵

Small Investors May Be Harmed by HFT. Among other things, *Flash Boys* alleges that HFT tends to profit at the expense of small investors:

The simple retail stock market order was, from the standpoint of high-frequency traders, easy kill.... High frequency traders sought to trade as often as possible with ordinary investors, who had slower connections ... because the investors themselves had only the faintest clue of what was happening to them, and also because the investors, even big, sophisticated ones, had no ability to control their own orders. When, say, Fidelity Investments sent a big stock market order to Bank of America, Bank of America treated that order as its own—and behaved as if it, not Fidelity, owned the information associated with that order. The same was true when an individual investor bought stock through an online broker [like] ... E*Trade or TD Ameritrade or Schwab. [T]he role of the big nine Wall Street banks that controlled 70 percent of all stock market orders was more complicated.... [They] controlled not only the orders, and the information value of those orders, but dark pools in which those orders might be executed.... All of them tended to send the orders first to their own dark pools before routing them out to the wider market. Inside the dark pool, the bank could trade against the orders themselves, or they could sell special access to the dark pool to high frequency traders.⁹⁶

With respect to empirical research on HFT and small investors, a micro market structure HFT analysis by Baron, Brogaard, and Kirilenko found that on the securities contract level, fundamental traders, which are likely to be institutional investors, incurred the least cost to HFT and small traders, which are likely to be retail investors, incurred the most.⁹⁷ Given that this analysis involved individual firms, it is unclear how HFT may affect small investors in the aggregate. Blackrock, the nation's largest buy side firm, spoke to that issue, stating that small or retail investors are generally not affected by HFT: “[F]or virtually all retail investors, we expect there should be no negative impact on their trades from HFT; small orders will under normal market conditions get filled immediately at the NBBO.”⁹⁸

Another argument is that the majority of retail orders do not go to stock exchanges where they could encounter HFT. Instead, the vast majority of such orders are said to be filled internally within large wholesalers, including UBS, Citadel, KCG (formerly Knight Capital Group), and Citigroup, in a process called *internalization*. Internalizers' algorithms are said to generally be in competition among themselves to capture those orders and then match them internally. The internalizers are thus able to avoid paying fees for sending the orders to exchanges, savings which are reportedly passed on to the retail investor.⁹⁹

In 2012, Canadian stock market regulators increased the fees on market messages sent by all broker-dealers, such as trades, order submissions, and cancellations. The fee had a

⁹⁵ Irene Aldridge, “The Risks of High-Frequency Trading,” *Huffington Post*, March 29, 2013, available at http://www.huffingtonpost.com/irene-aldrige/the-risks-of-highfrequenc_b_2966242.html.

⁹⁶ *Flash Boys*, pp. 180-181.

⁹⁷ Matthew Baron, Jonathan Brogaard, and Andrei Kirilenko, “Risk and Return in High Frequency Trading.”

⁹⁸ “US Equity Market Structure: An Investor Perspective.”

⁹⁹ Matthew Philips, “What Michael Lewis Gets Wrong About High-Frequency Trading,” *Businessweek*, April 1, 2014, available at <http://www.businessweek.com/articles/2014-04-01/what-michael-lewis-gets-wrong-about-high-frequency-trading>.

disproportionately large effect on the activity level of high-frequency traders because they transmit more messages than do other traders. On the Toronto Stock Exchange, researchers found that the number of messages fell by 30%. Average bid-ask spreads rose by about 10%. The study's authors concluded that retail investors saw their aggregate transaction costs remain unchanged, although their intraday trading losses grew with the presumed fall in HFT activity.¹⁰⁰ Retail investors that engage in day trading, which entails significant trading over the course of a trading day, may be more affected by HFT. By contrast, "buy and hold" investors that trade sparingly are less likely to be affected by HFT, according to this study.

However, it is important to note that many retail investors interact with the market via institutional investors such as pension and mutual funds. The extent to which retail purchasers in mutual funds and pension funds may be affected by HFT is addressed below during the discussion of the impact of HFT on institutional investors.¹⁰¹

HFT May Harm Institutional Investors. This report has discussed the use by HFT firms of liquidity detection strategies particularly aimed at buy side firms, tactics that some have described as predatory.¹⁰² There are indications that at least some on the buy side may be getting more adept at handling aggressive HFT. A micro market structure analysis of HFT by Baron, Brogaard, and Kirilenko identified four basic types of HFT trading counterparties: (1) fundamental traders, said to likely be large institutional investors; (2) non-HFT market makers; (3) small traders, said to likely be retail traders; and (4) opportunistic traders, said to likely be arbitrageurs, small asset managers, and hedge funds. Among other things, the study found that on a per contract basis, the fundamental traders incurred the least cost to HFT and small traders incurred the most.¹⁰³ The analysis is, however, limited to the micro realm of securities transaction and is not an aggregate analysis.

More broadly, institutional investors' exposures to HFT may vary, with index mutual funds likely among some of the least affected. Institutional investors' perceptions on how HFT affects them can also vary. For example, in 2014, the ConvergEx Group LLC, which provides brokerage and trading-related services, surveyed people who work for money managers such as mutual funds, hedge funds, broker-dealers, and banks with regard to their views of HFT. With 233 of the 357 total respondents working for the buy side's money managers and hedge funds, the survey found that just over 51% of the total respondents considered HFT to be either harmful or very harmful.¹⁰⁴ Officials at the Vanguard Group, one of the nation's largest mutual fund complexes, expressed a rather optimistic view of HFT, reportedly observing: "We believe the majority of 'high-frequency traders' play within the rules governing our current equity markets.... We believe a majority of 'high-frequency traders,' which is not a defined term, add value to our current structure by 'knitting' together today's fragmented market centers."

¹⁰⁰ Katya Malinova, Andreas Park, and Ryan Riordan, "Do Retail Traders Suffer from High Frequency Traders?" *SSRN*, 2013, available at Available at SSRN: <http://ssrn.com/abstract=2183806> or <http://dx.doi.org/10.2139/ssrn.2183806>.

¹⁰¹ Matthew Philips, "What Michael Lewis Gets Wrong About High-Frequency Trading."

¹⁰² For example, see Blackrock, "US Equity Market Structure: An Investor Perspective," at <http://www.blackrock.com/corporate/en-es/literature/whitepaper/viewpoint-us-equity-market-structure-april-2014.pdf>.

¹⁰³ Matthew Baron, Jonathan Brogaard, and Andrei Kirilenko, "Risk and Return in High Frequency Trading."

¹⁰⁴ Sam Mamudi, "Flash Boys Resonates as Survey Finds High-Frequency Worry," *Bloomberg*, April 24, 2014, available at <http://www.bloomberg.com/news/2014-04-23/-flash-boys-resonates-as-survey-finds-high-frequency-concerns.html>.

AQR Capital Management is an institutional investor that largely manages long-term investment strategies. Media sources report the views of officials at the buy side firm on the direct impact of HFT:

We think it helps us. It seems to have reduced our costs and may enable us to manage more investment dollars. We can't be 100% sure. Maybe something other than HFT is responsible for the reduction in costs we've seen since HFT has risen to prominence, like maybe even our own efforts to improve.... One of the biggest headline-grabbing worries about HFTs is how fast the trades are conducted. The speed sounds unnecessary, dangerous and possibly nefarious. "These guys care about the speed of light!" For the most part, though, HFTs don't need that super speed to get ahead of the little guy or even institutional traders, but to get ahead of other HFTs. Some of the loudest complaints about high-frequency trading come from the slower traders who used to win the races. While we like HFTs on balance for reducing our clients' trading costs, some may push the envelope at times. Some of them may negotiate advantages that might be bad for markets. Worse, these arrangements tend to be little understood by the broader range of market participants.¹⁰⁵

One of the challenges that buy side firms may have in ascertaining how HFT affects them is simply the complexity of the electronic markets. The nation's largest buy side company, asset manager Blackrock, observed,

HFT is difficult to distinguish from computer-based trading tools such as algorithms or smart order routers which are used by market participants to execute orders for institutional and retail investors. All are characterized by low latency and infrastructures and automated order management. But, electronic market making and algorithmic trading are both activities which are legitimate elements of market structure and help asset managers to achieve best execution for clients.¹⁰⁶

Having said that, Blackrock observed that it was

firmly opposed to predatory HFT practices which seek to manipulate the market or disadvantage end-investors. These practices constitute market abuse and should be treated as such in law. However, "high frequency trading" encompasses a wide variety of trading strategies and care must be taken to differentiate predatory practices from practices that benefit end-investors. For example, "electronic market making" is a type of HFT that brings tangible benefits to our clients through tighter spreads and by delivering intermediation in a fragmented trading landscape.¹⁰⁷

From an empirical standpoint, the aforementioned SEC HFT literature survey referenced two studies that suggested that some HFT firms may employ order anticipation and momentum ignition strategies. The survey then observed that such strategies can potentially exacerbate institutional investor transaction costs and contribute to extreme volatility events. As noted earlier, in the study that looked at the impact of the imposition of messaging fees on the Toronto Stock Exchange, the fees appear to have disproportionately curbed HFT. However, the study found that neither the aggregate transaction costs nor intraday returns of institutional traders were

¹⁰⁵ Clifford S. Asness and Michael Mendelson, "High-Frequency Hyperbole," *Wall Street Journal*, April 2, 2014, available at <http://online.wsj.com/news/articles/SB10001424052702303978304579475102237652362>.

¹⁰⁶ Blackrock, "US Equity Market Structure: An Investor Perspective," at <http://www.blackrock.com/corporate/en-es/literature/whitepaper/viewpoint-us-equity-market-structure-april-2014.pdf>.

¹⁰⁷ Ibid.

significantly impacted by the trading slowdown.¹⁰⁸ Another study found that more pronounced HFT activity on the Nasdaq was associated with higher trade implementation costs for institutional investors. However, it did not distinguish between the effects of aggressive and passive HFT.¹⁰⁹

Investor Confidence. HFT may diminish investors' confidence in the markets. Such concerns were illustrated in a letter released by officials at the Charles Schwab Corporation, a major securities brokerage firm, which described HFT as "undermining investor confidence in the fairness of the markets."¹¹⁰ Two article excerpts discuss the complicated issue of investor stock market exposure and confidence and the hard-to-quantify effect of HFT on these:

The Investment Company Institute has been polling investors every few years about their exposure to the stock market. This survey is a big one—responses from more than 4,000 households in the latest poll—and it doesn't take much to be counted as a stock-market participant. If one owns individual stocks, equity mutual funds or exchange-traded funds, hybrid funds or variable annuities, that person is grouped in the stock-ownership category. Yet equity ownership in the U.S. peaked more than a dozen years ago, in the aftermath of the tech-bubble collapse. The number of stock-owning households has dropped from 57 million back then to 54 million last year. More tellingly, the proportion of equity-owning households has tumbled from 53 percent to 44 percent, meaning investors clearly are in the minority. Many factors might explain this disconnect. One is that the population is graying and thus should be getting a bit more risk-averse. Also, some people likely have had to tap into their investment portfolios because of job losses or employment uncertainty. Others have focused on repairing their personal balance sheets by paying down debt.

A February [2014] survey of affluent investors by Wells Fargo Private Bank found widespread wariness even among this well-off group. One-fifth of the respondents indicated 'nothing would get them to add more stocks to their portfolio,' said Dean Junkans, chief investment officer for the private bank, in a statement. Only 15 percent of respondents said they 'trust' the stock market in a recent poll of consumer confidence by the University of Chicago and Northwestern University. People are two and half times more trusting of banks.... This skittishness provides a fertile backdrop for media reports that sometimes feed the fear. A case in point was the *60 Minutes* segment ... about the stock market being rigged by firms that practice ultra high-speed, high-frequency trading.... "Reports like this one provide an excuse some investors may use to justify avoiding the stock market.... The stock market arguably offers a more level playing field than ever before, with lower trading costs ... and access to more asset classes and investment vehicles," [observed Jeremy Kisner of Surevest Wealth Management].¹¹¹ The last few years can only be characterized as market chaos where market confidence has been mortally wounded. Along with the macroeconomic issues, what we saw was a market of intense volatility where Main Street investors, who number 90 million strong, pulled their money out of equities and either put it in their mattresses or into low-yielding instruments. While a number of factors were at play, the

¹⁰⁸ "Do Retail Traders Suffer from High Frequency Traders?"

¹⁰⁹ Lin Tong, "A Blessing or a Curse? The Impact of High Frequency Trading on Institutional Investors," November 13, 2013, *SSRN*, available at <http://ssrn.com/abstract=2330053> or <http://dx.doi.org/10.2139/ssrn.2330053>.

¹¹⁰ "Schwab Statement on High-Frequency Trading," April 3, 2014, available at <http://pressroom.aboutschwab.com/press-release/corporate-and-financial-news/schwab-statement-high-frequency-trading#sthash.eF0pbjFG.dpuf>.

¹¹¹ Russ Wiles, "Stocks' Popularity Wanes as Market Hits New Highs," *The Arizona Republic*, April 6, 2014, available at <http://www.azcentral.com/story/money/business/2014/04/05/stocks-popularity-wanes-despite-new-highs/7364695/>.

growing role of high-frequency trading and its ability to take advantage of the volatility and inefficiencies in the market cannot be dismissed.”¹¹²

Systemic Risk. Some research has concluded that algorithmic trades in general tend to be correlated, which suggests that some HFT strategies may not be as varied as those employed by human traders. A potential concern here is that because of this correlation, shocks that hit a small number of very active HFT traders could detrimentally affect the entire market. Another criticism is that independent HFT traders that are not part of larger conglomerates are often described as being lightly capitalized, a factor that could exacerbate their financial risk. Additional concern exists that the ability of many HFT traders to handle the corresponding counterparty risk in such scenarios could be challenged because these traders tend to turn over their positions many times a day and securities trade clearing systems tend to operate at a much slower rate. In combination, these aspects of HFT have led to concerns that under certain scenarios the firms could help generate systemic market disruptions.¹¹³ Similarly, the Treasury Department’s Office of Financial Research (OFR) has identified the “operational risk from automated trading systems, including high-frequency trading” as one of a number potential threats to financial stability that it is monitoring.¹¹⁴

HFT Alleged to Have Helped Foster “Rigged” Stock Markets. In *Flash Boys*, while exploring the significant role played by HFT, Brad Katsuyama, a securities trader and a principal figure in the book, claimed that “the stock market at bottom is rigged.” Fleshing out this theme of rigged markets, Michael Lewis wrote,

Financial intermediation is a tax on capital; it’s the toll paid by both the people who have it and the people who put it to productive use.... Technology should have led to a reduction in this tax.... [T]he ability of investors to find each other without the help of some human broker might have eliminated the tax altogether. Instead, this new beast [HFT] rose up ... and the tax increased by billions of dollars.¹¹⁵

The term “rigged” was not defined, but several financial market observers have responded to the characterization. According to the testimony of SEC Chair Mary Jo White, “The markets are not rigged. The markets—the U.S. markets are the strongest and most reliable in the world. That—you know, that’s not to say they’re perfect.”¹¹⁶

One nuanced non-regulator response to the “rigged” charge is

For individual traders (i.e., traders not dealing in amounts big enough to move market prices), HFT has proven to be beneficial through compressed bid-ask spreads along with reduced trade execution times. For larger traders, the effects are more ambiguous. They also

¹¹² Seth Merrin, “High-Frequency Trading,” *The Economist*, March 7, 2012, available at <http://www.economist.com/debate/days/view/816>.

¹¹³ Cristina McEachern Gibbs, “HFT Does Not Create Volatility,” *Advanced Trading*, August 26, 2009, available at <http://www.advancedtrading.com/algorithms/showArticle.jhtml?articleID=219500116>. Charles M. Jones, “What Do We Know About High-Frequency Trading?”

¹¹⁴ “U.S. Department of the Treasury, Office of Financial Research 2013 Annual Report,” available at http://www.treasury.gov/initiatives/ofr/about/Documents/OFR_AnnualReport2013_FINAL_12-17-2013_Accessible.pdf.

¹¹⁵ Michael Lewis, *Flash Boys*, p. 109.

¹¹⁶ “Representative Jeb Hensarling Holds a Hearing on Securities and Exchange Commission Oversight,” Political Transcript Wire, April 29, 2014, available at <http://search.proquest.com/docview/1519661206?accountid=12084>.

benefit from smaller spreads, but they can be disadvantaged by the front running by HFT firms. Among these institutional investors are fund providers (such as mutual funds and exchange traded funds). To the extent that front running results in additional trading costs, this activity could cause a drag on fund returns, and thus small retail investors (those investing in those funds) can share in this pain as well. There has not been sufficient research on high-frequency trading to give a definitive answer to whether or not the benefits of smaller spreads outweigh (or are outweighed by) the costs of front running, so it is difficult to identify the net effect of HFT. However, calling markets “rigged” seems a bit extreme.¹¹⁷

Market Crashes

An additional area of focus with respect to HFT involves concerns that HFT may play a contributing role in extreme market movements. Such concerns intensified after the Flash Crash of 2010 and have continued with observations of ongoing mini-flash crashes.

The Flash Crash of 2010

By the afternoon of May 6, 2010, the Dow Jones Industrial Average (DJIA) had already fallen by more than 300 points on the day. It then began a precipitous decline of nearly 700 points in a few minutes, amounting to a roughly 1,000 point drop on the day at that point. Twenty minutes later, the market rebounded, regaining most of the 700 point drop on the DJIA. The earlier 1,000 point decline was historical, representing the largest one-day decline in the history of the DJIA. The whole event has been dubbed the *Flash Crash*.

On September 30, 2010, the SEC and the CFTC¹¹⁸ issued a joint report, *Findings Regarding the Market Events of May 6, 2010*,¹¹⁹ which identified the agencies’ consensus view on the chain of events that led up to the Flash Crash. The report described “a market so fragmented and fragile that a single large trade could send stocks into a sudden spiral.”

The report also detailed how an undisclosed large institutional trader executed that single trade, which consisted of a large sell order worth about \$4 billion through an automated execution algorithm (but not through HFT) at a time when the markets were already extremely stressed. The order of E-Mini S&P 500 (a stock market index futures contract traded on Globex, the Chicago Mercantile Exchange’s [CME’s] electronic platform)¹²⁰ contracts initially exhausted available buyers, including high-frequency traders, which began to aggressively sell them. The report, which largely focused on market structure and liquidity concerns, did not place blame on HFT for the crash. Rather, it raised questions about the ability of HFT to provide continuous market liquidity. The report also observed that HFT traders “in the equity markets, who normally both provide and take liquidity as part of their strategies, traded proportionally more as volume

¹¹⁷ Eric Lehr, “Are Markets Rigged? A Look at High-Frequency Trading and Market Microstructure,” *Empirical Papers*, April 30, 2014, available at <http://www.empirical.net/markets-rigged-look-high-frequency-trading-market-microstructure/>.

¹¹⁸ The trading that was alleged to have triggered the event involved a CFTC-regulated stock index future.

¹¹⁹ “Findings Regarding The Market Events of May 6, 2010: Report Of The Staffs Of The CFTC And SEC to the Joint Advisory Committee On Emerging Regulatory Issues, September 30, 2010, available at <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.

¹²⁰ The CME is a U.S.-based securities trading venue for various futures and options.

increased, and overall were net sellers in the rapidly declining broad market along with most other participants.” It nevertheless noted that there were some high-frequency traders that remained active traders throughout the event.¹²¹

At the official release of the report, Brooksley Born, a member of the committee that authored the Flash Crash report and a former chairman of the CFTC, observed, “Algorithmic trading, high-frequency trading poses some special problems in terms of orderly trading on the markets. The high percentage of order cancellations I think could well be considered a disruptive trading practice that should be looked at very carefully by the commissions.”¹²²

Baron, Brogaard, and Kirilenko conducted another examination of the crash to help determine the role played by HFT firms. That study found that HFT did not trigger the crash but that the firms’ responses to the abnormally large selling pressure exacerbated market volatility.¹²³

The CME Group conducted an additional study of the incident. That report criticized the joint SEC and CFTC report, saying that the alleged precipitating E-mini S&P 500 trade was a small part of the volume of related trades at the time and that traders thus paid little attention to it. Consequently, the CME Group report argued that the timing of the trade was at odds with the notion that it was the cause of the crash.¹²⁴

Mini-Flash Crashes

In the aftermath of the Flash Crash, several observers, including officials from the CFTC and Nanex, a market data provider, have said that so-called mini-crashes, significant and precipitous drops in the prices of individual securities that do not reach the level of the 2010 crash, appear to be fairly common and an ongoing feature of the market.¹²⁵

Observers have suggested that a contributing factor behind some of these mini-crashes is HFT. SEC officials have responded that those who “try to use instances of mini-flash crashes as clear and incontrovertible evidence of the problems with high-frequency trading, high-speed markets, fragility, and impending doom ... may be looking in the wrong places.” Instead, the officials

¹²¹ Nanex, a market data provider that has analyzed data from the Flash Crash, has reportedly suggested an alternative possible scenario: it hypothesized that high-speed traders could have been attempting to outsmart each other’s computers with massive amounts of buy and sell orders that were intended to actually be filled. Nanex speculated that these high-frequency traders might also have been trying to deliberately paralyze the exchanges with their orders to gain an advantage over rival traders. “Flash Crash Still Baffles,” *New York Times*, August 23, 2010, available at <http://dealbook.nytimes.com/2010/08/23/ominously-flash-crash-still-baffles/>.

¹²² Nina Mehta, Whitney Kisling, and Jesse Hamilton, “SEC May Risk Harming Investors With ‘Trade-At Rule’ for Stocks,” *Bloomberg*, February 19, 2011, available at <http://www.bloomberg.com/news/2011-02-18/stock-markets-require-limit-up-limit-down-system-sec-cftc-advisers-say.html>.

¹²³ Andrei Kirilenko, Albert Kyle, Mehrdad Samadi, and Tugkan Tuzun, “The Flash Crash: The Impact of High Frequency Trading on an Electronic Market, January 12, 2011, available at <http://ssrn.com/abstract=1686004>.

¹²⁴ “CME Group Statement on the Joint CFTC/SEC Report Regarding the Events of May 6,” *CME Group*, October 1, 2010, available at <http://cmegroup.mediaroom.com/index.php?s=43&item=3068>.

¹²⁵ Sheyna Steiner, “Does High-Frequency Trading Change Investing,?” *Bankrate.com*, January 29, 2014, available at <http://finance.yahoo.com/news/does-high-frequency-trading-change-100000463.html>. For example, in 2013, reports indicate that some active traders had observed “at least a dozen” such mini-crashes “a day.” Maureen Farrell, “There May Not Have Been any Major Market Malfunctions Recently, But Mini Flash Crashes Still Happen Nearly Every Day,” *CNNMoney*, March 20, 2013, available at <http://money.cnn.com/2013/03/20/investing/mini-flash-crash/>.

attribute such developments to various kinds of human errors, including inadequate risk management practices in which there has been a “lack of checks and balances.”¹²⁶

Regulatory Activity and Response

The 2010 SEC Equity Market Structure Concept Release

In 2010, the SEC released its first comprehensive exploration of the public policy implications of HFT. The document, *The SEC Concept Release on Equity Market Structure* (the release),¹²⁷ was essentially aimed at establishing the conceptual framework for a potentially wide-ranging review of the nation’s equity market structure. The release sought public comment on a range of issues that had arisen after SEC implementation of Regulation NMS. Among the key areas of discussion were the various implications of HFT. In the concept release, the SEC requests public comment on literally hundreds of questions on equity market structure performance (in particular for “long-term investors”), HFT that would provide a broad review of the equity market structure with respect to concerns such as the following:

- Is the current highly automated, high-speed market structure fundamentally fair for other investors?
- What types of strategies are used by high-frequency traders, and are the strategies beneficial or harmful to other investors?
- Are HFT trading strategies sufficiently harmful that the SEC should consider regulatory initiatives aimed at alleviating those damages?
- Does colocation give proprietary trading firms an unfair advantage over other investors and, if so, should the firms that use the services be subject to any specified trading obligations?
- Does colocation provide benefits to long-term investors as well as overall market quality?
- Does colocation enable liquidity providers to operate more efficiently and thereby increase the quality of liquidity?
- Does HFT pose a risk to the integrity of the equity market structure?
- Should all proprietary trading firms be required to register as broker-dealers and become members of FINRA so that their operations are subject to full regulatory oversight?

¹²⁶ For example, see “Transformational Technologies, Market Structure, and the SEC,” Speech by Gregg E. Berman, Associate Director, Office of Analytics and Research Division of Trading and Markets U.S. Securities and Exchange Commission at the SIFMA Tech Conference, June 18, 2013, available at <http://www.sec.gov/News/Speech/Detail/Speech/1365171575716#.Uw-zMla8jJY>.

¹²⁷ “SEC Concept Release on Equity Market Structure,” Federal Register, January 21, 2010, available at <http://www.gpo.gov/fdsys/pkg/FR-2010-01-21/html/2010-1045.htm>.

- Does the current regulatory regime sufficiently address various concerns related to the trading activity of proprietary trading firms and their trading strategies?¹²⁸

Recent SEC Regulatory and Programmatic Initiatives

In the aforementioned June 2014 speech, SEC Chair Mary Jo White spoke of several specific HFT-related prospective regulatory initiatives. Meanwhile, the SEC has already adopted a number of regulatory and programmatic initiatives intended to help fulfill the agency's statutory mandate to provide for investor protection and maintain fair, orderly, and efficient markets. These initiatives, which could also help monitor HFT developments that could have problematic market impacts or mitigate potentially troublesome and immediate market impacts of HFT, include

- **MIDAS.** In 2013, the SEC adopted MIDAS, the Market Information Data Analytics System. The trade monitoring system captures all orders posted on the national exchanges, all modifications and cancellations of those orders, all trade executions of those orders, and all off-exchange executions, providing the agency with what some officials called “an unprecedented aggregation of trading information data.” MIDAS will reportedly help the agency monitor and understand mini-flash crashes or ascertain potentially troublesome or illegal behavior, for example by alerting the agency to excessive order cancellations.¹²⁹
- **The Consolidated Audit Trail.** Adopted by the SEC in 2012, the Consolidated Audit Trail requires all domestic stock exchanges and other markets to create a uniform system for tracking the life cycle of all orders and trades. With the audit trail in place, the SEC is reportedly able to receive real-time access to most of the data needed to reconstruct a market dislocation such as a flash crash.¹³⁰
- **Regulation SCI.** In March 2013, the SEC proposed a new set of rules, Regulation Systems Compliance and Integrity (Regulation SCI), that would create new, enforceable standards for maintaining and testing the trading systems used by securities exchanges and brokers. The rules, which have not yet been adopted, would replace the existing, voluntary guidelines that pertain to such market trading technology.¹³¹
- **Large Trader Reporting Rule.** The Large Trader Reporting Rule was adopted by the SEC in 2011. It imposes certain SEC registration and reporting requirements on large traders, which it defines as entities that trade either 2 million shares or \$20 million during any calendar day or 20 million shares or \$200 million during any calendar month. The SEC has said that the reporting regime will help it to identify and obtain certain baseline trading information about traders that are involved in substantial amounts of trading activity. That information will then reportedly aid the agency in (1) assessing the impact of

¹²⁸ “SEC Concept Release on Equity Market Structure,” Federal Register, January 21, 2010, available at <http://www.gpo.gov/fdsys/pkg/FR-2010-01-21/html/2010-1045.htm>.

¹²⁹ “MIDAS Market Information Data Analytics System,” SEC, 2013, available at <http://www.sec.gov/marketstructure/midas.html#UwUENYa8jJY>.

¹³⁰ See “Current Regulatory Initiatives,” *Nasdaq*, 2013, available at <https://www.nasdaqtrader.com/trader.aspx?id=currentregulatory>.

¹³¹ *Ibid.*

large trader activity on the securities market, (2) reconstructing trading activity following periods of unusual market volatility, and (3) analyzing significant market events for regulatory purposes.¹³²

- **Naked Access.** Before the Flash Crash, many HFT firms gained special access to securities exchanges through “naked access,” a process through which SEC-registered brokers allowed the firms to basically piggyback on their direct access to securities markets. The arrangement enabled the firms to reduce their trade latency while avoiding the various risk checks and capital requirements with which they would have needed to comply had they been registered brokers. In 2010, the SEC adopted a new rule aimed at the registered brokers, Rule 15c3-5, which essentially prohibited HFT firms from receiving naked access.¹³³
- **New Circuit Breakers.** In 2012, the SEC adopted a “limit up-limit down” mechanism to replace the single-stock circuit breaker rules. Because single-stock circuit breakers are triggered after a trade occurs at or outside of the applicable percentage threshold, circuit breakers have been triggered by erroneous trades. The new limit up-limit down mechanism is intended to prevent trades in individual securities from occurring outside of a specified price band, which will be set as a percentage level above and below the average price of the stock over the immediately preceding five-minute trading period. The price limit bands are 5%, 10%, 20%, or the lesser of \$0.15 or 75%, depending on the price of the stock. The bands will be more generous during the often more volatile opening and closing periods of the trading day, during which they will double in size.¹³⁴

The European Union Proposes HFT Regulation

In April 2014, the European Parliament adopted the European Union’s (EU’s) first common HFT-related regulatory initiative. The development’s importance for domestic markets is twofold: the HFT-related regulatory initiatives may provide a model for U.S. regulators, and some assets that might be potentially affected by the EU regulations, such as foreign exchange securities, might also be traded in the United States.

The Markets in Financial Instruments Directive (MiFiD) has been in force since 2008 and is the framework for the regulation of the EU’s financial markets. The EU is now involved in implementing an updated MiFiD known as MiFiD II, which EU officials say is aimed at establishing “a safer, sounder, more transparent and more responsible financial system.” On April 15, 2014, the EU Parliament adopted various parts of MiFiD II, including a regulatory framework aimed at increasing transparency in equity, bond, and derivatives markets and a regulatory framework aimed at improving conditions for competition in the trading and clearing of financial instruments. MiFiD II also defines HFT as *algorithmic trading that relies on computer programs to determine the timing, prices, or quantities of orders in fractions of a second*, and it included the first ever EU-based regulatory curbs on such activities. Under the MiFiD II regulatory frameworks adopted by the European Parliament, “any investment firm engaging in such trading will have to have effective systems and controls in place, such as ‘circuit breakers’ to stop trading

¹³² Ibid.

¹³³ Ibid.

¹³⁴ Ibid.

process if price volatility gets too high [and] to minimize systemic risk, the algorithms used will have to be tested on venues and authorized by regulators.... [In addition, the] records of all placed orders and cancellations of orders would have to be stored and made available to the competent authority upon request.”¹³⁵

Explaining the reasoning behind the HFT regulations, European Commissioner for Internal Markets and Services Michel Barnier said, “The dramatic increase in the speed and volumes of order flows can pose systemic risks. The new rules ensure safe and orderly markets and financial stability through the introduction of trading controls, an appropriate liquidity provision obligation for high-frequency traders pursuing market-making strategies, and by regulating the provision of direct electronic market access.”¹³⁶

As stated earlier, the prospective HFT regulations are part of MiFID II, which is an EU Directive. EU Directives need to be adopted separately by the individual EU members, a process that could take some time. In addition, the individual country versions of MiFID II may ultimately vary from that which was adopted at the EU level.

Ideas and Proposals for Regulating Equities HFT

Below is a discussion of a number of the potential HFT regulatory ideas that have become part of the public policy discourse on the trading.

Order Cancellation Fees. Some observers argue that by imposing penalty charges for excessive order cancellations, HFT traders would be discouraged from posting orders they do not intend to execute or using cancellations as part of manipulative strategies like spoofing. Others respond that order cancellation fees would likely reduce the provision of liquidity, thus reducing market depth.¹³⁷ Nasdaq currently imposes such fees, a levy that is primarily described as a means of preventing an overload of exchanges’ computer systems and reportedly discouraging only the most blatant use of excessive cancellations.¹³⁸ Some observers say it is probably too early to gauge the Nasdaq fee’s impact.¹³⁹

Minimum Order Exposure Times. Under this scheme, submitted securities orders could not be canceled for some minimum duration, for example 50 milliseconds. Some argue that such a requirement, an idea proffered by SEC Chair Mary Jo White,¹⁴⁰ would be another means of curbing what many perceive to be the problematic and excessive use of canceled orders by HFT firms. Detractors, however, argue that such a protocol would have an asymmetric impact, affecting liquidity providers but having no effect on liquidity demanders. A major concern here derives from the premise that much of the alleged benefits from HFT are due to the fact that the

¹³⁵ “MEPs Vote Laws to Regulate Financial Markets and Curb High-Frequency Trading,” *European Parliament / Liaison Office with U.S. Congress*, April 15, 2014, available at http://www.europarl.europa.eu/us/en/news_events/news/news_2014/news_apr_2014/high_frequency_trading.html?jsessionid=4E7B19FF8552061B1799D7A1F962596F.

¹³⁶ Marina Daras, “EU Introduces First Rule on HFT,” *Sell-Side Technology*, April 16, 2014, available at <http://www.waterstechnology.com/sell-side-technology/analysis/2340311/eu-introduces-first-rule-on-hft>.

¹³⁷ Charles M. Jones, “What Do We Know About High-Frequency Trading?”

¹³⁸ Matt Prewitt, “High-Frequency Trading: Should Regulators Do More?”

¹³⁹ Charles M. Jones, “What Do We Know About High-Frequency Trading?”

¹⁴⁰ Mary Jo White, “Enhancing Our Equity Market Structure.”

firms are efficient providers of liquidity. As a consequence, it has been argued that the introduction of a minimum exposure time protocol would have an adverse market impact.¹⁴¹

Batch Auctions. One concern of HFT detractors is that conventional providers of market liquidity, including various trading firms, may suffer when securities prices fluctuate excessively due to the presence of HFT. Moreover, they argue that the status quo tends to reward HFT traders that continuously flood the securities market with orders because the emphasis is on speed over securities pricing. As a result, they argue that quotes of conventional liquidity providers may often not get matched, resulting in potential losses to such liquidity providers. Some theorize that to accommodate those losses, such liquidity providers may tend to widen their bid-ask spreads, which would cause investors to pay more to trade. Orders to buy or sell securities at certain prices are governed by price-time priority, in which the best prices are executed first. When two identical offers arrive, as tracked by a continuous limit order book, the first order to arrive is the first to be executed. However, some researchers claim to have evidence that continuous limit order books do not always work in continuous time. Normal pricing relationships between related securities that exist for what they call “human time intervals” of a second, minute, or hour may reportedly collapse when trading is done at the millisecond trading speeds of HFT.

To remedy this situation, there is a proposal that exchanges run what are called batch auctions at frequent intervals, such as once per second. Under this protocol, exchanges would collect and aggregate orders to trade securities and then execute them at the price at which the most bids and offers match, reconciling demand and supply. Proponents assert that many exchanges already run batch auctions when they open their trading day. More importantly, the idea’s proponents argue that “if multiple traders observe the same information at the same time, they are forced to compete on price instead of speed.”¹⁴²

Such a reform, which has been praised by New York Attorney General Eric T. Schneiderman, could arguably produce markets with narrower bid-ask spreads, improved market liquidity, greater stability, and significant investor savings.¹⁴³ Critics, however, counter that exchanges are unlikely to embrace changes such as batch auctions that would curb the volume of orders (both filled and not filled) that they process because exchanges profit from such order volumes. Others believe HFT firms would find work-arounds in which they would “wait until that last brief period before the auction happens to place their orders.”¹⁴⁴ An additional criticism is that batch auctions would be at odds with the continuous trading protocol that prevails in most trading systems worldwide.

¹⁴¹ Ibid.

¹⁴² Eric Budish, “An Alternative to High-Frequency Trading,” *Tabb Forum*, October 17, 2013, available at <http://tabbforum.com/opinions/an-alternative-to-high-frequency-trading>.

¹⁴³ Remarks on High-Frequency Trading & Insider Trading 2.0 by New York Attorney General Eric T. Schneiderman at the New York Law School Panel on “Insider Trading 2.0 – A New Initiative to Crack Down on Predatory Practices,” March 18, 2014, available at http://www.ag.ny.gov/pdfs/HFT_and_market_structure.pdf.

¹⁴⁴ Linette Lopez, “New York Attorney General Endorses A Radical Change To The Way The World Trades Stocks,” *Business Insider*, March 18, 2014, available at <http://www.businessinsider.com/schneiderman-endorses-batch-auctions-2014-3>.

A Transaction Tax. Some critics of HFT have proposed a transaction tax on HFT trades as a way of limiting that kind of trading and its perceived negative consequences. As observed in CRS Report R41192, *A Securities Transaction Tax: Financial Markets and Revenue Effects*,¹⁴⁵

A tax on securities transactions has precedents in the United States. At the federal level there was a stock transfer excise tax (sometimes called documentary stamp tax) on the issuance and subsequent transfers of securities from 1914 to 1966. The tax rates on these transactions were 0.1% and 0.04%, respectively. The tax was repealed as part of the Excise Tax Reduction Act of 1965 (P.L. 89-44), which also repealed a number of other excise taxes, many of which were imposed to deal with the emergencies during the Great Depression or wartime. The purpose of the act was to remove unnecessary impediments to economic growth and consumer and business spending in the context of improving federal fiscal positions. Proposals for an STT [securities transaction tax] have been made in ... [various] Congresses and by previous Administrations ... [including] proposals by Presidents George H. W. Bush and Bill Clinton, as well as former Speaker of the House James Wright, to introduce some sort of an STT in the United States. Some of these proposals were targeted to narrow segments of financial markets, such as trades in derivatives, while others were broader and covered most financial transactions. No proposal was ever enacted into law.¹⁴⁶

In 2013, Italy imposed a tax on trades on Italian financial markets that are generated by a computer algorithm that automatically determines the decisions related to relevant orders or metrics, their changes or cancellation. The tax rate is 0.02% and applies to any portion of changed or canceled daily orders in which the ratio of the changed or canceled orders less than half a second in duration exceeds 60% of the total number of submitted orders. It does not apply to market makers.¹⁴⁷ The tax was reportedly introduced due to concerns that the growth of HFT in Italy could potentially have an adverse impact on the integrity and quality of Italian financial markets, particularly with regard to volatility and liquidity.¹⁴⁸ Prior to its adoption, Italian banks and some other traders warned that the tax would have a detrimental effect on the provision of liquidity in the nation's market.¹⁴⁹

In the 113th Congress, S. 410 (Harkin) and H.R. 880 (DeFazio) propose instituting a 0.03% tax on all financial transactions. Proponents of these legislative proposals say such a levy could help reduce the budget deficit or pay for needed public spending without unduly burdening individual investors and could also curb high-frequency trading and reduce market volatility.¹⁵⁰ H.R. 1579 (Ellison) would levy a 0.5% tax on stock trades, a 0.1% tax on bond trades, and a 0.005% tax on trades of derivatives and other investments. The bill's supporters say it would both raise revenue and help slow down financial markets that have become faster and more volatile due to HFT.¹⁵¹

¹⁴⁵ CRS Report R41192, *A Securities Transaction Tax: Financial Markets and Revenue Effects*, by (name redacted) (out of print; available from the author).

¹⁴⁶ Ibid.

¹⁴⁷ "Italy Introduces a Financial Transaction Tax," *Cleary and Gottlieb*, December 26, 2012, available at http://www.cgsh.com/italy_introduces_a_financial_transaction_tax_as_of_2013/.

¹⁴⁸ Cheryl Jones, "Italy's FTT on HFT: Catching up with High-Frequency Trading," *Lexisweb.com*, October 28, 2013, available at <http://lexisweb.co.uk/blog/fs/italys-ftt-on-hft-catching-up-with-high-frequency-trading/>.

¹⁴⁹ Tyler Durden, "First Ever High Frequency Trading Transaction Tax Introduced In Italy," *Zero Hedge*, October 2, 2013, available at <http://www.zerohedge.com/news/2013-09-02/first-ever-high-frequency-trading-transaction-tax-introduced-italy>.

¹⁵⁰ For example, see "Beware the Transaction Tax Proposal," *Investment News*, May 5, 2013, available at <http://www.investmentnews.com/article/20130505/REG/305059984>.

¹⁵¹ Travis Waldron, "Democratic Rep. Introduces Legislation To Tax Risky Financial Transactions," *Think Progress*, (continued...)

On the idea of imposing taxes to curb HFT, CRS Report R41192, *A Securities Transaction Tax: Financial Markets and Revenue Effects*,¹⁵² concluded,

If the objective of policymakers is to improve financial market operations, then it is not clear that an STT would be the most effective tool, or effective at all. The analysis in the body of this report suggests that the tax's effects on financial market efficiency are uncertain. Thus, improving financial market operations may be better handled via some other mechanism such as reforming the regulatory environment within which derivatives and high-frequency traders operate, for example. If policymakers do proceed with an STT as a means for improving financial market operations, one option would be to begin with a low tax rate, perhaps lower than 0.25%, and increase it only if additional research supports such a move.¹⁵³

Affirmative Trade Obligations. Some suggest that consideration be given to imposing certain affirmative trade obligations on HFT firms that are not registered broker-dealers and thus are not legally obligated to step in and provide needed liquidity, particularly during market disruptions similar to the Flash Crash.¹⁵⁴ Supporters of HFT could argue that such regulations change the business model of some HFT firms and could reduce profits. Critics of HFT affirmative trade obligations cite the examples of other severe market disruptions when SEC-registered market makers refused to conduct their market making activity. The stock market crash of October 1987, when Nasdaq market makers and others did not answer their phones or provide liquidity-enhancing market-making activity, has been identified as such a case.¹⁵⁵

A Kill Switch. A kill switch would permit the suspension of an individual firm's trades following erroneous trades or excessive trading volume. Some regulators have argued in favor of such a protocol as a way of thwarting large-scale market events in which HFT has played a role. At a SEC technology roundtable in 2012, there appeared to be widespread agreement that a kill switch could be useful but that it would require multiple layers and thresholds to ensure that it would not be used at inappropriate times. There were, however, concerns over how and when such mechanisms would be implemented, whether market stakeholders would be willing to "pull the trigger" during market disruptions, and that the switches might tend to be mere "after the fact" interventions on the heels of major market disruptions.¹⁵⁶

(...continued)

April 17, 2013, available at <http://thinkprogress.org/economy/2013/04/17/1879801/ellison-financial-transactions-tax/>.

¹⁵² CRS Report R41192, *A Securities Transaction Tax: Financial Markets and Revenue Effects*, by (name redacted) (out of print; available from the author).

¹⁵³ CRS Report R41192, *A Securities Transaction Tax: Financial Markets and Revenue Effects*, by (name redacted) (out of print; available from the author).

¹⁵⁴ For example, see "Speech by SEC Chairman Mary L. Schapiro: Strengthening Our Equity Market Structure at Economic Club of New York New," September 7, 2010, available at <http://www.sec.gov/news/speech/2010/spch090710mls.htm>.

¹⁵⁵ Charles M. Jones, "What Do We Know About High-Frequency Trading?"

¹⁵⁶ For example, see various view in: "Transcript for the SEC Roundtable on Technology and Trading: Promoting Stability in Today's Markets," SEC October 2, 2012, available at <http://www.sec.gov/news/otherwebcasts/2012/ttr100212-transcript.pdf>.

HFT in Futures Markets and the CFTC

As indicated earlier, in addition to equities markets HFT takes place in certain derivatives markets, such as in the futures markets, which are regulated by the CFTC. Such trading has attracted attention somewhat later than equities HFT but has subsequently grown to become a large portion of market volume. By 2012, the TABB Group, a financial market consulting firm, reportedly estimated that HFT comprised over 60% of all futures volume in 2012 on U.S. futures exchanges.¹⁵⁷ A 2013 CFTC concept release on automated trading reported that by 2012, about 92% of exchange-trading futures volume in the United States were executed electronically.¹⁵⁸ By 2010, Automated Trading Systems (ATS) trading accounted for over 50% of trading volume in a number of significant futures exchange products, the CFTC reported.¹⁵⁹

By various accounts, the proportion of trades on the futures exchanges attributable to HFT has grown briskly during the last few years.¹⁶⁰ As in the equities markets, proponents of HFT in the futures markets have argued that the rise of HFT has tended to increase market liquidity and narrow bid-ask spreads,¹⁶¹ thereby reducing transaction costs.¹⁶² Similar concerns have been raised in futures markets about fairness in trading and market stability more generally. For instance, do hedge funds and large investment banks, which can afford the latest technology, have an advantage over small investors in futures as well as equities markets? Do institutions that serve small investors, such as mutual funds or pension funds, pay more (or receive less) for futures contracts as well as stocks because HFT traders may interpose themselves between ultimate buyers and sellers? Such concerns have percolated in the press and among market participants and regulators.¹⁶³

Regulators at the CFTC have expressed concerns over the possible use of HFT to flood a market with *wash trades*, which are bids and offers launched essentially by the same market participant to create the impression of greater market activity even though the participant incurs no actual market risk.¹⁶⁴ The Commodity Exchange Act prohibits wash trades.¹⁶⁵ According to media

¹⁵⁷ Christine Stebbins, “High Speed Trading A Stiff Challenge for U.S. Regulators,” Reuters, May 20, 2013, at <http://news.yahoo.com/analysis-high-speed-trading-stiff-challenge-u-regulators-215833552.html>.

¹⁵⁸ FR Vol 78 No. 177, p. 56542, “Concept Release on Risk Controls and System Safeguards for Automated Trading Environments,” *Commodity Futures Trading Commission*, September 12, 2013, available at <http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/federalregister090913.pdf>.

¹⁵⁹ *Ibid.*, p. 56545.

¹⁶⁰ See Fred Gehr, “High Frequency Trading Lowdown,” *Futures Magazine*, May 13, 2010, available at <http://www.futuresmag.com/2010/05/13/high-frequency-trading-lowdown>.

¹⁶¹ The bid-ask spread is the difference between what a dealer will pay for a security and the price at which that dealer is willing to sell the same security. Wider spreads are equivalent to higher transaction costs for investors.

¹⁶² See Jonathan Brogaard, “High Frequency Trading and Its Impact on Market Quality,” *Fifth Annual Conference on Empirical Legal Studies Paper*, November 22, 2010, available at SSRN: <http://ssrn.com/abstract=1641387>; and Joel Hasbrouck, and Gideon Saar, “Low-Latency Trading,” *Johnson School Research Paper Series No. 35-2010*, February 1, 2011, available at SSRN: <http://ssrn.com/abstract=1695460>.

¹⁶³ See Adam Brown, “SEC To Bring In New Rules To Monitor High Frequency Trading,” February 21, 2013, *Inside Investor Relations*, available at <http://www.insideinvestorrelations.com/articles/disclosure-regulation/19327/sec-bring-new-rules-monitor-high-frequency-trading/>.

¹⁶⁴ The CFTC Glossary defines wash trading as “Entering into, or purporting to enter into, transactions to give the appearance that purchases and sales have been made, without incurring market risk or changing the trader’s market position,” available at http://www.cftc.gov/consumerprotection/educationcenter/cftcglossary/glossary_wxyz.

¹⁶⁵ See CFTC Glossary at http://www.cftc.gov/consumerprotection/educationcenter/cftcglossary/glossary_wxyz.

reports, the CFTC is investigating whether HFT at times floods markets with such wash trades to influence prices or trading volumes for short periods of time so certain HFT traders could profit.¹⁶⁶

Another issue in the futures markets, as in the equities markets, is the impact of HFT on market stability. In this context, an aforementioned joint study by the SEC and CFTC attributed the 2010 market disruption known as the Flash Crash to a single mutual fund's trading algorithm, which continued to sell after all buying interest was exhausted.¹⁶⁷ More recently, on August 1, 2012, HFT firm Knight Capital Group Inc. lost about \$440 million in less than an hour, and its stock plunged 73%, after a computer malfunction bombarded the stock market with errant orders.¹⁶⁸ The incident further underscored concerns over the potential impacts on market stability of any HFT technical trading problems.

The CFTC oversees trading, including HFT, on futures exchanges such as the Chicago Mercantile Exchange (CME) and Intercontinental Exchange (ICE). The SEC oversees HFT for the securities market. In addition to reportedly investigating potential wash trades related to HFT, the CFTC regularly holds meetings of its Technical Advisory Council (TAC). In February 2012, the TAC created a Subcommittee on Automated and High Frequency Trading that includes CFTC and industry participants and examines various HFT trading practices.¹⁶⁹

The CFTC's May 2013 Interpretive Guidance

On May 16, 2013, the CFTC issued an interpretive guidance on disruptive trading practices, which touches on issues that may involve HFT.¹⁷⁰ Section 747 of the Dodd-Frank Act (P.L. 111-203) amended the Commodity Exchange Act (CEA) to prohibit disruptive trading practices in futures, options, or swaps trading. Among other changes, Section 747 amended CEA Section 4c(a)(5) to outlaw spoofing—bidding or offering with the intent to cancel the bid or offer before executing a trade. One study of HFT by the Swedish financial regulatory authority in 2012 found that spoofing was associated with HFT, at least in the experiences of traders, and that market participants believed it was being used to manipulate the prices for some financial instruments.¹⁷¹

In its May 2013 guidance, the CFTC prohibited spoofing on any futures exchange or swap execution facility as long as the canceling of the bids and offers before trade execution was intentional rather than the result of reckless, negligent, or accidental behavior.¹⁷² On July 22,

¹⁶⁶ Scott Patterson, Jenny Strasburg and Jamila Trindle, "Wash Trades Scrutinized," *The Wall Street Journal*, March 17, 2013, available at <http://online.wsj.com/article/SB10001424127887323639604578366491497070204.html>.

¹⁶⁷ Findings Regarding The Market Events of May 6, 2010: Report Of The Staffs Of The CFTC And SEC To The Joint Advisory Committee On Emerging Regulatory Issues, Sep. 30, 2010, available at <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.

¹⁶⁸ Nina Mehta, "Knight \$440 Million Loss Sealed by Rules on Canceling Trades," *Bloomberg*, August 14, 2012, available at <http://www.bloomberg.com/news/2012-08-14/knight-440-million-loss-sealed-by-new-rules-on-canceling-trades.html>.

¹⁶⁹ See *CFTC Technical Advisory Committee Sub-Committee on Automated and High Frequency Trading, Working Group* report, available at <http://www.cftc.gov/PressRoom/Events/wg1presentation062012>.

¹⁷⁰ Commodity Futures Trading Commission, "Antidisruptive Practices Authority," 78 *Federal Register* 31890, May 28, 2013.

¹⁷¹ "Investigation into high frequency and algorithmic trading," *Finansinspektionen*, February 2012, p. 5, available at http://www.fi.se/upload/90_English/20_Publications/10_Reports/2012/htf_eng.pdf.

¹⁷² Commodity Futures Trading Commission, "Anti-disruptive Practices Authority," 78 *Federal Register* 31890, May (continued...)

2013, the CFTC announced its first enforcement order and settlement for spoofing under the Dodd-Frank Act's Section 747 prohibition of disruptive trading practices when it fined Panther Energy Trading LLC of Red Bank, New Jersey, and Michael J. Coscia of Rumson, New Jersey, \$1.4 million for engaging in the disruptive practice of spoofing by utilizing a computer algorithm designed to illegally place and quickly cancel bids and offers in futures contracts.¹⁷³

The CFTC guidance also prohibits a person from buying a derivatives contract on an exchange or swap execution facility "at a price that is higher than the lowest available price offered for such contract or selling a contract ... at a price that is lower than the highest available price bid."¹⁷⁴ This practice is termed *violating bids and offers*, and the CFTC required no intentional behavior to constitute a violation.¹⁷⁵

The CFTC's September 2013 Concept Release

A recent major CFTC action regarding what it refers to as Automated Trading Systems (ATS)—of which HFT is a subset—was its September 12, 2013, "Concept Release on Risk Controls and System Safeguards for Automated Trading Environments."¹⁷⁶ Broadly, the release asks whether existing risk controls in automated trading environments are sufficient to match current trading technologies and market risks.¹⁷⁷ It does not prescribe any new rules but instead solicits feedback on 124 questions it poses regarding potential new regulatory approaches to ATS and HFT.

In explaining the broader thinking behind the concept release, the CFTC observed,

U.S. derivatives markets have experienced a fundamental transition from human-centered trading venues to highly automated and interconnected trading environments. The operational centers of modern markets now reside in a combination of automated trading systems ... and electronic trading platforms that can execute repetitive tasks at speeds orders of magnitude greater than any human equivalent. Traditional risk controls and safeguards that relied on human judgment and speeds, and which were appropriate to manual and/or floor-based trading environments, must be reevaluated in light of new market structures....

(...continued)

28, 2013, p. 31896. The CFTC distinguished the need for the spoofing to be intentional (i.e., "requiring a market participant to act with some degree of intent, or scienter, beyond recklessness to engage in the 'spoofing' trading practices") from behavior that was reckless, negligent, or accidental, which would not constitute a violation.

¹⁷³ For more details, please see CFTC Press Release PR6649-13, "CFTC Orders Panther Energy Trading LLC and its Principal Michael J. Coscia to Pay \$2.8 Million and Bans Them from Trading for One Year, for Spoofing in Numerous Commodity Futures Contracts," available at <http://www.cftc.gov/PressRoom/PressReleases/pr6649-13>.

¹⁷⁴ *Ibid.*, p. 31893.

¹⁷⁵ *Ibid.*, p. 31893. Under the Commodity Exchange Act Section 4c(a)(5)(A), as amended by Section 747 of the Dodd-Frank Act, a new section was added to the CEA making it unlawful for any person to engage in any trading practice that violates bids or offers.

¹⁷⁶ "Concept Release on Risk Controls and System Safeguards for Automated Trading Environments," *Commodity Futures Trading Commission*, Federal Register, vol. 78 no. 177, p. 56542, September 12, 2013, available at <http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/federalregister090913.pdf>.

¹⁷⁷ Testimony of Vincent McGonagle, Director of the Division of Market Oversight, Commodity Futures Trading Commission, Before the Senate Committee on Agriculture, Nutrition, and Forestry, May 13, 2014, p. 8, available at <http://www.cftc.gov/PressRoom/SpeechesTestimony/opamcgonagle05131>.

[M]arket participants must ensure that regulatory standards and internal controls are calibrated to match both current and foreseeable market technologies and risks.¹⁷⁸

The release goes on to solicit public feedback. The 124 questions the CFTC posed in the release are divided into four broad categories described below:

Pre-Trade Risk Controls. These refer to policies by a firm or a CFTC-registered entity such as a swap dealer (SD), major swap participant (MSP), futures exchange, or swap execution facility (SEF) that seek to protect against the submission of a large volume of orders, trade executions, or positions over a short period of time.¹⁷⁹

Specific pre-trade proposed solutions could include the following: (1) execution throttles that would impose maximum message or execution rates and associated alerts aimed at helping identify rogue algorithms and preventing entities from placing orders faster than risk systems; (2) greater volatility awareness by implementing alerts for price changes over a set period of time aimed at helping identify rogue algorithms and providing alerts when human intervention is required; (3) self-trade and self-matching, which refers to controls aimed at preventing wash trades and other potentially illicit trades; (4) price collars, which could impose certain allowable trading price ranges aimed at preventing erroneous order executions, particularly during thinly traded market regimes; (5) a maximum order size regime, which refers to protocols designed to curb large trades of certain sizes to prevent problematic trading abnormalities such as so-called fat finger (or, human) errors; and (6) trading pauses, which would entail the imposition of temporary time-outs for trading platforms when market conditions were deemed problematic.

Post-Trade Risk Controls. The CFTC concept release also notes that post-trade risk controls, when used together with pre-trade controls, could yield benefits in reducing unexpected negative feedback loops or malfunctioning pre-trade risk controls. It asks for comments on a number of specific types of such post-trade controls.¹⁸⁰

System Safeguards. The release broadly describes such safeguards as intended to address a number of potential operational, market abuse, and transmission risks, including those that might protect against potential abuses or disruptions unique to electronic trading.¹⁸¹

Potential new system safeguards could include the following: (1) controls related to order placement, which refers to order cancellation protocols such as “auto-cancel on disconnect” and “kill switches” that would cancel working orders under certain problematic market conditions; (2) design, testing, and supervision of ATS refers to regulatory protocols that would require firms operating ATS to undergo standardized testing and be subject to minimum standards; and (3) self-

¹⁷⁸ Ibid. On January 17, 2014, the CFTC announced it would reopen the comment period for its ATS concept release until February 14, 2014. The comment period had originally closed on December 11, 2013. It is not yet certain when the CFTC will release a final rule, or other regulatory action, on HFT based on the comments solicited from its 2013 concept release.

¹⁷⁹ More specifically, the CFTC release asks for comments regarding the following types of pre-trade controls: message and execution throttles; volatility awareness alerts; self-trade controls; price collars; maximum order sizes; trading pauses; and credit risk limits.

¹⁸⁰ The CFTC specifically asks about the following types of post-trade controls: order, trade, and position drop copy; and trade cancellation or adjustment policies.

¹⁸¹ Within this category, the CFTC specifically asked questions about the following: controls related to order placement; policies and procedures for the design, testing, and supervision of automated trading systems; self-certifications and notifications; identifying definitions of ATS and “algorithm”; and data reasonability checks.

certifications and notifications, in which firms operating ATS and clearinghouses would be required to certify their adherence to CFTC requirements and notify others when “risk events” occur.

Other Protections. The CFTC also requested comments on a range of other potentially significant changes, such as the type and quality of data that ATS or HFT market participants, if required to register with the CFTC, would possibly provide to the commission.¹⁸²

In comment letters on the proposal, the Mercatus Center, a think tank, expressed criticism of the CFTC’s release, commenting that the self-interest of derivative market participants to help ensure stable markets should generally be sufficient motivation for them to adopt a range of effective risk-control protocols.¹⁸³ Mercatus also expressed the concern that “if risk control and system testing methods are standardized by regulatory intervention, they essentially become fixed and modifications will generally require either new regulations or exemptions.”¹⁸⁴ Other commenters engaged in HFT had more technical concerns with the CFTC release. For instance, the proprietary trading firm Citadel commented that if any mandatory minimum “resting periods” for order executions were imposed, that would harm market liquidity by exposing liquidity providers to greater risks and leading to wider bid-ask spreads.¹⁸⁵

The Chicago Federal Reserve Bank challenged the belief in the voluntary adoption of risk controls as a solution. In comments to the CFTC, it observed, “[M]any industry and regulatory groups have devised best practices for HFT. Nevertheless, many firms do not fully implement these best practices because they are not required to do so. We believe it would be beneficial for the Commission [CFTC] to work with the industry to define best practices for HFT and to communicate penalties for non-compliance with those best practices.”¹⁸⁶

In congressional testimony on May 13, 2014, a CFTC official noted that the agency had received 43 public comments to the concept release and that commenters had widely divergent opinions regarding the need to regulate HFT more closely.¹⁸⁷ For instance, commenters disagreed on the need for the CFTC to create a regulatory definition of HFT, with just over half of the parties who commented opposed to a definition and the remainder in favor.¹⁸⁸

¹⁸² More specifically, the CFTC release asks for comments regarding the following types of other protections: registration of firms operating ATS; market quality data; market incentives; policies and procedures to identify “related contracts”; and standardizing and simplifying order types.

¹⁸³ Holly A. Bell, “Comments on the Concept Release on Risk Controls and System Safeguards for Automated Trading Environments,” *Mercatus Center*, 2013, available at <http://comments.cftc.gov/PublicComments/ViewComment.aspx?id=59440&SearchText=COMMENT>.

¹⁸⁴ *Ibid.*, p. 3.

¹⁸⁵ Adam Cooper, Senior Managing Director and Chief Legal Officer, Citadel LLP, “Comments on the Concept Release on Risk Controls and System Safeguards for Automated Trading Environments,” December 11, 2013, available at <http://comments.cftc.gov/PublicComments/ViewComment.aspx?id=59455&SearchText=>.

¹⁸⁶ “Federal Reserve Bank of Chicago Response to the CFTC Concept Release on Risk Controls and System Safeguards for Automated Trading Environments,” December 11, 2013, available at <http://comments.cftc.gov/PublicComments/ViewComment.aspx?id=59452&SearchText=>.

¹⁸⁷ Testimony of Vincent McGonagle, Director of the Division of Market Oversight, Commodity Futures Trading Commission, Before the Senate Committee on Agriculture, Nutrition and Forestry, May 13, 2014, p. 12.

¹⁸⁸ *Ibid.*, p. 12.

At the same hearing, MIT academic and former CFTC Chief Economist Andrei Kirilenko noted that the HFT industry is highly concentrated and dominated by a small number of fast, opaque firms (often not registered with federal regulators) that earned high and persistent returns.¹⁸⁹ He advocated that the CFTC create a broad new category of “automated brokers and traders,” which would include all active proprietary traders.¹⁹⁰ These traders would be required to register with the CFTC and maintain records and an audit trail that regulators could examine in case of a mini-flash crash or technological malfunction, he proposed.¹⁹¹ Kirilenko also urged regulators to examine the root causes of the high level of concentration in the HFT industry to determine whether such concentration was in fact benign and why market forces were not eroding it.¹⁹² He suggested that automated exchanges be required to publish data on system latencies—in other words, how long of a delay exists before market information reaches participants. Such reporting should specifically include the latency for messages for submitted, canceled, modified, and executed orders.¹⁹³

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¹⁸⁹ Testimony of Andrei Kirilenko, Professor of the Practice of Finance, Sloan School of Management, Massachusetts Institute of Technology, Before the Senate Committee on Agriculture, Nutrition & Forestry, Hearing on High Frequency and Automated Trading in Futures Markets.

¹⁹⁰ *Ibid.*, p. 6.

¹⁹¹ *Ibid.*

¹⁹² *Ibid.*

¹⁹³ *Ibid.*

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