The Need for Speed: Regulatory Approaches to High Frequency Trading in the United States and the European Union

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ABSTRACT

High frequency trading (HFT) is a financial investment execution technique with a growing presence in world financial markets. Investment firms engaging in HFT use computer-automated algorithms to trade financial instruments at high speeds. There is much debate as to what HFT entails, particularly its risks, benefits, and costs, and whom HFT affects (positively or negatively). In particular, this Note addresses efforts in the United States and the European Union to define and regulate HFT. The proposed Regulation Systems Compliance and Integrity (Reg SCI) and Regulation Automated Trading (Reg AT) in the United States and Markets in Financial Instruments Directive II (MiFID II) in the European Union contemplate measures to increase transparency and decrease volatility surrounding HFT, particularly in light of flash crashes in various influential markets. Recent events like the emergence of the Investors Exchange (IEX) and the flash crash following "Brexit" draw the role of HFT in ensuring the continued operation of the market into higher relief. As such, combining elements from both US and EU regimes to create a "transparency within reason" approach will help balance competing interests in effectively addressing HFT through a cohesive framework.

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I. INTRODUCTION

"People no longer are responsible for what happens in the market, because computers make all the decisions."[1] High frequency trading (HFT) is a phenomenon some perceive as the next imminent failure of modern markets. To critics like Michael Lewis, author of *Flash Boys: A Wall Street Revolt*, HFT is a scheme by which computer whizzes can program computers with algorithms to cheat more traditional investors out of an honest day's work.[2] While dramatized, his depiction captures the heart of critics' argument that HFT should be regulated because it represents the worst of technological innovation and human nature combined.

Yet others perceive HFT as a market-moving mechanism that benefits the exchange of securities and derivatives and a natural progression of market competition. In *Flash Boys: Not So Fast*, former Goldman Sachs trader Peter Kovac critiqued Lewis's attacks on HFT and the related call for regulation, denouncing the alleged "cheat" aspect of HFT and possibly fully discrediting the existence of HFT.[3]

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   1.   *See* MICHAEL LEWIS, FLASH BOYS: A WALL STREET REVOLT 270 (2014) (asserting that the US stock market faces the increasingly controlling influence of computer-based technology).
   2.   *See id.* at 3.
   3.   *See generally* PETER KOVAC, FLASH BOYS: NOT SO FAST: AN INSIDER'S PERSPECTIVE ON HIGH-FREQUENCY TRADING (2014) (evaluating Michael Lewis's stipulations about HFT).

If nothing else, this feud demonstrates that HFT is on the public's mind, and certainly not for the first time. Starting as far back as the "Black Monday Crash" of October 19, 1987, when the stock market took its steepest ever single-day dive, many saw such stark volatility as a failure of market makers, which HFT traders are now considered.[4] More recently, the 2008 Financial Crisis instilled a renewed aversion to risk and set the stage for the rise of HFT, since HFT is a seemingly low risk operation. The May 2010 "Flash Crash" highlighted HFT's effect on computer-driven markets as "far more dangerous than anyone had realized,"[5] even though markets quickly rebounded to recover all losses that same day.[6]

As HFT traders have gained further influence in the markets, regulatory efforts have multiplied in the interest of leveling the playing field between more traditional algorithmic trading and HFT. In particular, regulators are concerned that the speed at which HFT traders operate could marginalize traditional traders and potentially destabilize markets.[7] Attempts to address such concerns include the U.S. Securities & Exchange Commission's (SEC) proposed Regulation System Compliance and Integrity (Reg SCI) in 2014 and, more recently, the U.S. Commodity Futures Trading Commission's (CFTC) proposed Regulation Automated Trading (Reg AT).[8] Moreover, a new US stock exchange, Investors Exchange (IEX), recently began operations on the premise of heightening efficiency and fairness among traders.[9]

While US regulatory efforts have seen mixed results, in April 2016 the European Union implemented a plan for the Markets in Financial Instruments Directive II (MiFID II). Fully effective in 2018, MiFID II represents the European Union's first attempt to regulate

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4.   *See* Scott Patterson, *Man vs. Machine: Seven Major Players in High-Frequency Trading*, CNBC (Sept. 13, 2010), http://www.cnbc.com/id/39038892 [https://perma.cc/PH7D-XVWU] (archived Oct. 4, 2016) (noting the relationship between HFT and the stock market crash of 1987).

5.   *See* SCOTT PATTERSON, DARK POOLS: THE RISE OF THE MACHINE TRADERS AND THE RIGGING OF THE U.S. STOCK MARKET 3 (2013).

6.   *See* U.S. SEC. & EXCH. COMM'N [hereinafter SEC], EQUITY MARKET STRUCTURE LITERATURE REVIEW: HIGH FREQUENCY TRADING 11 (2014), https://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf [http://perma.cc/N8HH-TGEA] (archived Oct. 4, 2016) (noting HFT's large selling pressure that may have exacerbated market volatility during the Flash Crash).

7.   *See* Tim Cave, *EU Regulators Agree on Definition of HFT*, FIN. NEWS (Apr. 25, 2016), http://www.efinancialnews.com/story/2016-04-25/eu-regulators-agree-on-definition-of-hft [https://perma.cc/BZ27-PCQ4] (archived Oct. 4, 2016) (noting regulators' universal concern that HFT may negatively affect markets).

8.   *See* SEC, SEC SPOTLIGHT: REGULATION SCI (2016), https://www.sec.gov/spotlight/regulation-sci.shtml [https://perma.cc/93TZ-J7HJ] (archived Mar. 1, 2017).

9.   For more information on the IEX concept, see IEX, https://www.iextrading.com [https://perma.cc/P4KS-378H] (archived Oct. 4, 2016); *see also* LEWIS, *supra* note 1, at 164 ("[IEX's] goal was not to exterminate the hyenas and the vultures but, more subtly, to eliminate the opportunity for the kill.").

HFT and could be a step in a long line of future regulations.[10] Like the United States, the European Union has seen HFT account for an increasing proportion of trading, but as of yet European HFT traders have escaped the level of oversight applied to other traders (i.e., brokers).[11]

But what exactly is HFT, and how can it be regulated without completely smothering market competition? This Note addresses the debate across the United States and the European Union on HFT as a practice. Part II compares efforts to reach a holistic definition of HFT and its common strategies in the United States and the European Union. Part III evaluates HFT in terms of its prominence in and impact on markets in the United States and the European Union. Part IV compares US and EU approaches to regulate HFT, particularly the US Reg SCI and Reg AT and the EU MiFID II. Part V evaluates the approaches discussed in Part IV in light of regulators' concerns and the individualized needs of the United States and the European Union.

II. DEFINITIONS: WHAT EXACTLY IS HFT?

The debate over how to regulate HFT originates in its definition. To fully understand HFT, one must first distinguish it from larger umbrellas of trading, such as algorithmic trading. Algorithmic trading usually refers to fund managers' use of trading strategies to exchange large volumes of assets at minimized cost under preset limits of risk and time.[12] The crux of algorithmic trading lies in these preset rules on how to execute each trade order; the goal is to secure a good price relative to specified benchmarks and to minimize the impact of trading by actively responding to events in the market.[13]

HFT, which refers to complete automation of the quantitative trading process, forms a subset of algorithmic trading.[14] HFT narrows the scope of algorithmic trading because it uses computer-automated algorithms to execute trades without human influence.[15] Such computer automation hinges on quantitative modeling and indicator tracking to determine when and how to execute trades, taking

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10.   *See* Cave, *supra* note 7.
11.   *See id.*
12.   *See generally* Ash Booth, *The Difference Between Automated, Algorithmic and High-Frequency Trading,* DR. ASH BOOTH BLOG (Nov. 16, 2012), http://www.ashbooth.com/blog/2012/11/16/the-difference-between-automated-algorithmic-and-high-frequency-trading/ [https://perma.cc/7ZQE-PLJ7] (archived Oct. 4, 2016) (distinguishing between algorithmic trading, automated trading, and HFT).
13.   *See id.*
14.   *See* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 4; *see also* Booth, *supra* note 12.
15.   *See* Booth, *supra* note 12.

traders' activism out of the equation except in the event of "flash crashes." Hedge funds typically implement algorithmic trading to execute trades and monitor portfolio risk, and HFT can be used to incorporate this information into pricing and trading decisions.[16]

Most agree that the hallmark of HFT is its transience; HFT traders seek and act on opportunities in a matter of milliseconds (thousandths of a second).[17] While many brokers and dealers offer solely algorithmic trading, algorithmic trading is less anticipatory, less high-frequency, and less high-tech than HFT. Beyond the time frame, however, characterization of HFT is hazy. From types of securities traded to specific trading strategies, authorities across the United States and the European Union lack uniformity in their descriptions.

A. *Key Characteristics of HFT*

Recent US and EU attempts to outline the key characteristics of HFT share a lack of commitment to a set of uniform features. The SEC has named non-defining but important criteria for HFT in the United States.[18]

Along with short time frames and the use of algorithms, the SEC highlights the location of computer servers close to trade exchanges, a phenomenon known as co-location.[19] The amount of time taken to execute a trade, down to the millisecond, can greatly affect who gets to trade on that particular opportunity. So, the greater the physical distance from the server to the actual exchange (i.e., New York Stock Exchange [NYSE]), the longer it takes for the computer signal to travel round trip to execute the trade.[20] As a result, a new sideline market has arisen in which HFT competitors pay millions of dollars for the right to place their servers in the same room as the exchange hub to eke out an edge of mere milliseconds.[21] Such competition also breeds from the algorithms used by each HFT trader, so in reserving the coveted floor space in the exchanges, HFT traders cautiously

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16.   *See id.*
17.   *See, e.g.*, Yesha Yadav, *How Algorithmic Trading Undermines Efficiency in Capital Markets*, 68 VAND. L. REV. 1607, 1623 (2015) [hereinafter *Algorithmic Trading*] (discussing how HFT involves securities exchanging hands in milliseconds).
18.   *See* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 4.
19.   *See id.*
20.   *See id.* (noting the creation of the market surrounding "proximity services," or co-location, through which traders paid to limit the distance between their computers that sent orders into the stock market and the stock exchange hubs).
21.   *See* LEWIS, *supra* note 1, at 60, 135–39 (describing Goldman Sachs's co-location efforts).

physically cover their servers such that no information will leak to the competition.[22]

The SEC also characterizes HFT as using small amounts of daily capital to make a tiny gain per individual transaction. HFT traders generate money by trading for small increments of time and making incremental but steady profits on each individual trade.[23] Because of the high speed at which HFT traders execute trades, they process a high volume of transactions per day and thus turn a significant profit. Furthermore, HFT traders cancel over 90 percent of their orders before they are executed (see the "order anticipation" HFT strategy discussed in Part II.B).[24] This creates the perception that HFT is a low-risk operation, as several HFT firms can boast minimal losses over years of trading.[25]

While the characteristics and behaviors the SEC specifies are not limited to HFT, they outline the baseline view of HFT in the United States—fast, profitable, and competitive, for better or for worse.

B. HFT Strategies

The International Organization of Securities Commissions (IOSCO) characterizes HFT not as a single strategy but as a "set of technological arrangements and tools employed in a wide number of strategies, each one having a different market impact and hence raising different regulatory issues."[26] The three most prominent strategies of HFT—order anticipation, market making, and arbitrage—rely heavily on the speed at which HFT operates.

The order anticipation HFT strategy arguably receives the most attention of the three prominent strategies because some see it as the driver of unfairness behind HFT.[27] As a directional strategy, order

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22. See id. at 64–65 ("The HFT firm insisted on leaving the Toys 'R' Us logos in place [on the computer cage] so that no one would know they had improved their position, in relation to the matching engine, by several feet.").

23. See EQUITY MARKET STRUCTURE LITERATURE REVIEW, supra note 6, at 4.

24. See Algorithmic Trading supra note 17, at 1623; see also Irene Aldridge, Market Microstructure and the Risks of High-Frequency Trading 2–4 (Aug. 19, 2013) (unpublished manuscript), http://ssrn.com/abstract=2294526 [https://perma.cc/65JG-7PEA] (archived Oct. 4, 2016) (asserting that around 95 percent of limit orders on NASDAQ are cancelled within one minute of being placed).

25. See, e.g., Virtu Financial, Inc., Registration Statement Filing (Form S-1) (Mar. 10, 2014) (noting how Virtu Financial had lost money on only one day in four years of trading).

26. INT'L ORG. OF SEC. COMM'NS, REGULATORY ISSUES RAISED BY THE IMPACT OF TECHNOLOGICAL CHANGES ON MARKET INTEGRITY AND EFFICIENCY: CONSULTATION REPORT 23   (2011),   http://www.iosco.org/library/pubdocs/pdf/IOSCOPD354.pdf [https://perma.cc/4XQF-V4TY] (archived Nov. 5, 2016).

27. See LEWIS, supra note 1, at 53 (describing order anticipation as being "front-run—that some other trader was, in effect, noticing his demand for stock on one exchange and buying it on others in anticipation of selling it to him at a higher price"); see also PATTERSON, supra note 5, at 4–5 ("The heart of the problem . . . was that fast-

anticipation involves parsing out whether a major investor has placed a large order such that an HFT trader can use its advantageous speed to trade ahead of that investor.[28] To outmaneuver the major investor, HFT traders engage in "pinging." That is, HFT traders use pattern algorithms to send out "feeler-orders" to find potential larger orders and determine how large traders may behave.[29] Because HFT traders can submit high volumes of these feeler-orders quickly, they can capitalize on opportune orders ahead of traditional investors.[30] The feeler-orders are usually cancelled; as mentioned in Part II.a.1, approximately 90 percent of orders in HFT are cancelled.[31] Thus, HFT traders can quickly enter and exit the market with marginal gain before traditional investors can act on the same opportunities.

The market-making HFT strategy involves HFT traders' immediate readiness to buy and sell securities using their own capital, boosting market liquidity.[32] Combined with their ability to make high volumes of trades in mere milliseconds, HFT traders dominate over traditional traders as market makers.[33] In fact, Virtu Financial, a renowned HFT firm, acts as the designated market maker for the NYSE.[34] A 2013 study found that market making and other opportunistic HFT strategies, particularly more passive market-making activity, mitigated short term price volatility in Swedish equity markets.[35] In this way, HFT may fill a vital economic role by driving the market through its purchases and sales.

Like the market-making strategy, the arbitrage strategy can be seen to play a beneficial economic role in moving markets. HFT traders engage in arbitrage by searching markets for securities with prices that vary between different exchanges.[36] By relying on time advantages and algorithms, HFT traders can trade away the differences in prices more cheaply and expediently, paving the way

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moving robot trading machines were front-running long-term investors on exchanges such as the New York Stock Exchange and the Nasdaq Stock Market.").

28.   *See Algorithmic Trading, supra* note 17, at 1629–30.

29.   *See id.*

30.   *See id.*

31.   For rates of HFT order cancellation, see Scott Patterson & Andrew Ackerman, *SEC May Ticket Speeding Traders,* WALL ST. J. (Feb. 23, 2012), http://www.wsj.com/articles/SB10001424052970203918304577239440668644280 [https://perma.cc/LSC8-YR4N] (archived Oct. 4, 2016).

32.   *See Algorithmic Trading, supra* note 17, at 1628; *see also* Yesha Yadav, *Insider Trading and Market Structure,* 63 UCLA L. REV. 968, 975 (2016) [hereinafter *Insider Trading*] ("By virtue of constantly buying and selling, these HFT traders often fulfill what amounts to an economic market making function by being immediately available to trade with investors.").

33.   *See Algorithmic Trading, supra* note 17, at 1628.

34.   *See Insider Trading, supra* note 32, at 975 n.19.

35.   Björn Hagströmer and Lars Nordén, *The Diversity of High-Frequency Traders* (2012), https://ssrn.com/abstract=2153272 [https://perma.cc/NEY5-HAYL] (archived Nov. 5, 2016).

36.   *See Algorithmic Trading, supra* note 17, at 1627–28.

for traders to engage in market making.[37] A 2012 study found that the entry of a large, primarily passive HFT firm into the market for Dutch stocks correlated with a 15 percent decline in effective price spreads.[38] However, while investors may experience lower price differences after HFT traders enter the market, critics warn that those investors are effectively forced out of earning the associated spread as HFT traders may "snipe" the better prices.[39] As such, one should not overemphasize large spread reductions and volume increases associated with HFT entry as evidence of strong market improvement.[40]

The SEC stipulates two additional categories of strategies—structural and directional "moment ignition"—that closely resemble the three main strategies.[41] Through the use of structural strategies, which bear relation to the market-making strategy, HFT traders use their speed advantage to exploit structural vulnerabilities in the market. Namely, they trade with market participants through trading venues that offer transactions at "stale" prices (i.e., prices that have not yet updated to reflect market changes).[42] For example, an HFT firm can update its quote to 25.06 and simultaneously attempt to buy from slower market participants at 25.01 (the current ask price) or 25.02 and profit from the difference.[43]

The momentum ignition strategy, a type of directional strategy similar to order anticipation that incorporates market making, involves initiating large groups of orders and trades to try to initiate quick increases or decreases in price.[44] In this way, HFT firms seek the correct price level, which may benefit the market by helping to improve price discovery without the need for intermediate executions that tend to occur during periods of very low cancellation activity.[45] Some credit HFT firms' price-finding and adapting features for the lack of frequent market crashes.[46]

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37.   *See id.*

38.   Boyan Jovanovic & Albert J. Menkveld, *Middlemen in Limit Order Markets* (2016), https://ssrn.com/abstract=1624329 [https://perma.cc/4QJX-EK9T] (archived Nov. 5, 2016).

39.   *See id.*

40.   *See id.*

41.   EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 4.

42.   *Id.* at 13.

43.   Jesse Blocher et al., *Phantom Liquidity and High Frequency Quoting* 5 (2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2776745&download=yes [https://perma.cc/DM7Z-P5HP] (archived Nov. 5, 2016).

44.   *See* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 4.

45.   Jesse Blocher et al., *supra* note 43, at 16.

46.   *See id.* (arguing against "'crash insurance,' the notion that HFTs abandon the markets rather than assuming some obligation to endure losses in times of market stress").

C. *Traders and Types of Securities Traded*

Generally, there are three groups of traders in the marketplace: (1) longer-term investors, such as institutional or retail investors who hold their investment positions for longer than one day; (2) low frequency, intraday traders, such as investment brokers who hold their investment positions for shorter than one day; and (3) HFT traders.[47] However, because no one can agree on one all-encompassing definition of HFT, it is difficult to identify who engages in HFT and which securities HFT traders are trading.

In the United States, HFT is estimated to account for between approximately 50 and 70 percent of trading volume.[48] The level and nature of HFT activity, however, can vary greatly across different types of stocks. For example, HFT traders are much more active in large-capitalization stocks than in small-capitalization stocks, but 69 percent of their small-capitalization stock activity results from aggressive orders.[49] HFT is also emerging in the trade of other US securities, including treasuries, bonds, and equity-related futures— HFT accounts for approximately 60 percent of trading volume in the futures market.[50]

In the European Union, the European Securities and Markets Authority (ESMA) estimates that HFT accounts for somewhere between 24 and 43 percent of equity value traded, depending on the method implemented to calculate market share.[51] Using co-location as a proxy for HFT activity, HFT firms account for approximately 35 percent of co-location services (compared with investment banks,

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47.   *See id.* at 15.
48.   *Compare Algorithmic Trading, supra* note 17, at 1622 n.57 (50 percent), *with* X. Frank Zhang, High-Frequency Trading, Stock Volatility, and Price Discovery 1–3 (Dec. 2010) (unpublished manuscript) (on file with the Yale University School of Management) (70 percent).
49.   Jonathan Brogaard, Terrence Hendershott & Ryan Riordan, *High Frequency Trading and Price Discovery* 10–11 (Eur. Cent. Bank Working Paper Series, Paper No. 1602, 2013), https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1602.pdf [https://perma.cc/7XU2-8KV9] (archived Nov. 5, 2016); *see also* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 13 (finding that HFTs are less active in mid-capitalization and small-capitalization stocks).
50.   *See* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 6. To see how HFT is also emerging in the bitcoin market, see Bloomberg News, *High-Speed Traders Are Taking Over Bitcoin*, BLOOMBERG TECH. (Jan. 17, 2017 4:21 AM), https://www.bloomberg.com/news/articles/2017-01-16/high-speed-traders-are-taking-over-bitcoin-as-easy-money-beckons [https://perma.cc/5H9A-M3CX] (archived Jan. 17, 2017).
51.   *See* EUR. SEC. AND MKTS. AUTH. [hereinafter ESMA], ECONOMIC REPORT: HIGH-FREQUENCY TRADING ACTIVITY IN EU EQUITY MARKETS 11 (2014), https://www.esma.europa.eu/sites/default/files/library/2015/11/esma20141_-_hft_activity_in_eu_equity_markets.pdf [https://perma.cc/CVD6-DPYF] (archived Nov. 5, 2016) (explaining the direct and lifetime of orders methods for calculating HFT market share in the European Union).

which account for 44 percent).[52] Furthermore, when parsed into market share by the numbers of trades and orders, all methods of calculation yielded a trend: HFT market share by value traded was smaller than HFT share by number of trades, which in turn was smaller than HFT share by number of orders.[53] Therefore, because the HFT market share is smaller than non-HFT market share, and the order-to-trade ratio of HFTs is on average higher than the order-to-trade ratio of non-HFTs, HFT traders execute fewer trades per order than non-HFT traders. This finding is consistent with HFT's noted high volume characteristic, one of the few that the United States and the European Union regularly acknowledge.

III. PROMINENCE: HOW DOES HFT IMPACT MARKETS?

The desire for speed and competitive advantage is a recurring theme in financial markets and the modern information environment. Globalization, the internet, and social media grant amateur investors and ordinary citizens access to twenty-four-hour news, computerized trading platforms, and 401(k) investment decision making.[54] HFT capitalizes on this increasing dynamism, but the question remains as to whether resulting gains in efficiency trump the proposed "decoupling of predictability and profitability" in the market.[55]

A. *Benefits of HFT*

While the aforementioned benefits of individual strategies are important considerations for HFT firms in evaluating investment options, regulators must analyze HFT's effect on the marketplace as a general practice.

One significant benefit of HFT is that it limits holding risk, or the risk an investor incurs by holding an investment in the market for a long period of time. The average holding period in the United

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52.   *Id.* at 13 (implementing the direct method for calculating HFT market share).

53.   *See id.* at 11.

54.   *See* HOLLY A. BELL, POLICY ANALYSIS No. 731 HIGH FREQUENCY TRADING, DO REGULATORS NEED TO CONTROL THIS TOOL OF INFORMATIONALLY EFFICIENT MARKETS?, CATO INSTITUTE 3–4 (2013), https://object.cato.org/sites/cato.org/files/pubs/pdf/pa731_web_1.pdf [https://perma.cc/U99T-RA9E] (archived Jan. 15, 2017) (evaluating to what extent HFT should be regulated).

55.   Clive Jones, *High Frequency Trading and the Efficient Market Hypothesis*, BUS. FORECAST BLOG (Jan. 29, 2015), http://businessforecastblog.com/high-frequency-trading-and-the-efficient-market-hypothesis/ [https://perma.cc/8MC5-B23W] (archived Jan. 15, 2017).

States for stocks has been quoted at twenty-two seconds.[56] Because HFT firms can quickly enter or exit the market, they do not need to "invest deeply in understanding the longer-term behavior of securities" or to provide for risk by holding large amounts of capital.[57] Thus, HFT firms do not carry significant, unhedged positions from trading day to trading day.[58]

As a direct result, more nontraditional, specialized trading firms have gained access to the market.[59] The stock market crash of 1987 saw the rise of the "Automated Trading Desk" on the notion that computers could automate the function of market makers trading stocks on their clients' behalf.[60] Since then, specialized HFT firms like Global Electronic Trading Co. (Getco), Tradeworx, Tradebot Systems, Tower Research Capital, and RGM Advisors have increased their market share on the premise of "providing multiple benefits to everyday investors."[61]

Indeed, critics can distort the prospect of benefits to the client by focusing solely on the benefits HFT firms themselves receive. Financial markets continue to be busy, and poor results are usually interpreted as long term ramifications of the 2008 crisis, rather than of HFT activity.[62] HFT can use its role in market making to provide investors with more efficient access to markets at a lower cost through competitive advantage and greater liquidity.[63] As Bloomberg's Matt Levine stipulates, "The basic raison d'être of high-frequency trading is that it makes markets more efficient . . . . It's also about efficiently extracting value from amateur . . . traders and

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56.   Paul Farrow, *How Long Does the Average Share Holding Last? Just 22 seconds*, THE TELEGRAPH (Jan. 18, 2012), http://www.telegraph.co.uk/finance/personalfinance/investing/9021946/How-long-does-the-average-share-holding-last-Just-22-seconds.html   [https://perma.cc/3M4L-G3DY] (archived Jan. 15, 2017).

57.   *Algorithmic Trading, supra* note 17, at 1624.

58.   *See* Equity Market Structure, Exchange Act Release No. 34-61358, 17 C.F.R. 242 (Jan. 14, 2010), https://www.sec.gov/rules/concept/2010/34-61358.pdf [https://perma.cc/5QVE-J9HE] (archived June 10, 2017) (reviewing the current equity market structure).

59.   *See Algorithmic Trading, supra* note 17, at 1624.

60.   *See* Scott Patterson, *Man vs. Machine: Seven Major Players in High-Frequency Trading*, CNBC (Sept. 13, 2010), http://www.cnbc.com/id/39038892 [https://perma.cc/PH7D-XVWU] (discussing the evolution of specialized HFT firms in the aftermath of the crash of Black Monday, 1987).

61.   *See id.* (noting Tradeworx founder Manoj Narang's estimate that trading in Tradeworx's HFT system [approximately $10 million in capital] accounts for 3 percent of daily volume in Spiders [S&P 500 ETF]).

62.   *See* Gianluca Virgilio, *High-Frequency Trading and the Efficient Market Hypothesis*, 6 THE BUS. AND MGMT. REV., no. 3, at 79 (2015), http://www.abrmr.com/myfile/conference_proceedings/Con_Pro_42356/2015roge10.pdf [https://perma.cc/6VVJ-7TWC] (archived Jan. 15, 2017) (examining the impact of HFT on the Efficient Market Hypothesis).

63.   *See Algorithmic Trading, supra* note 17, at 1628.

giving it to professionals."[64] These considerations place HFT in the middle of a larger debate in modern markets over efficiency versus distributional effects.

Even then, while individual investors do not have access to the milliseconds' worth of information that HFT firms secure through algorithms, retail investors in contemporary markets have access to far more information than they did in the 1990s.[65] Furthermore, researchers have found that HFT reduces bid–ask spreads, or the differential between the highest price a buyer is willing to pay for an asset (bid price) and the lowest price for which a seller is willing to sell the asset (ask price).[66] Thus, investors can more cheaply and easily enter and exit the marketplace, catalyzing a more efficient capital allocation across the economy.[67]

B.   *Costs of HFT*

1. Competitive Advantage

HFT's drive for competitive advantage produces many of the costs attributable to HFT. The economic costs of creating HFT algorithms to execute trades, and then of integrating those algorithms into investment practice, can provide a significant barrier to market entry. HFT requires good programming, which can create an intellectual property rights issue for a programmer who wishes to market his or her algorithm, as well as for a competitive HFT firm that wishes to maintain competitive advantage.

That competitive advantage can force exit from the market, because it transfers costs to informed traditional traders and alters their incentives. As mentioned in Part III.A, HFT firms' ability to quickly enter into or exit from the market diminishes their need to understand long-term behavior of securities; thus, more nontraditional trading firms have gained access to the market.[68]

While this is an economic "win" for HFTs looking for low-stake investment opportunities, traditional informed traders rely on research and experience regarding long-term behavior of securities as

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64.   Matt Levine, *Snap Votes and Banker Bonuses*, MONEY STUFF, BLOOMBERG VIEW (Jan. 17, 2017, 9:24 AM), https://www.bloomberg.com/view/articles/2017-01-17/snap-votes-and-banker-bonuses [https://perma.cc/NNY8-SPXH] (archived Jan. 17, 2017).

65.   *See* BELL, *supra* note 54, at 4.

66.   *See generally* Terrence Hendershott, Charles M. Jones & Albert J. Menkveld, *Does Algorithmic Trading Improve Liquidity?*, 66 J. OF FIN. (2011), http://faculty.haas.berkeley.edu/hender/algo.pdf   [https://perma.cc/ASF8-C43S] (archived Jan. 20, 2017) (finding that algorithmic trading narrows bid–ask spreads, reduces trade-related price discovery, and improves liquidity).

67.   *See Algorithmic Trading, supra* note 17, at 1646–47.

68.   *See id.* at 1624 (describing that by entering and exiting the market quickly they only need to anticipate very recent trends).

their competitive advantage. When speed-minded HFT traders use order–anticipation strategies to anticipate traditional trades, informed traders receive diminished marginal returns from their research such that investment in information is no longer practical from a business standpoint.[69]

Yet in the wake of financial crisis, the SEC and the CFTC set the bar high for "robust, accessible, and timely market data."[70] Put simply:

> So how do traders compete in a marketplace full of computers? The answer, ironically enough, is to not compete. Unless you are prepared to pay for a low latency feed and write software to react to market movements on the millisecond timescale, you simply will not win. . . . [T]he required reaction time is on the order of 10 milliseconds. You could be the fastest human trader in the world chasing that spike, but 100% of the time, the computer will beat you to it.[71]

As a result, some critics of HFT fear that an increase in algorithmic trading will lead to a two-tiered market system, with large HFT traders on one tier and more traditional traders and investors on another.[72] However, this trade-off is complex, and traditional, informed traders benefit from the immediate liquidity and smaller bid–ask spreads HFT provides.

The sheer number of trading exchanges in the United States and the European Union adds to the information cost as well as the economic cost.[73] Algorithms must be capable of independently interpreting news from multiple sources (i.e., social media, news broadcasts, and regulatory reports), in addition to the exchanges themselves, for buzz words that might impact the market.[74]

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69.   *See id.* at 1615. ("By free-riding on the intelligence of others, algorithmic traders save themselves time and money while also taking home a share of the winnings.").

70.   STAFFS OF THE CFTC AND SEC, FINDINGS REGARDING THE EVENTS OF MAY 6, 2010, at 45 (2010), http://www.sec.gov/news/studies/2010/marketevents-report.pdf [https://perma.cc/2FY5-NVDH] (archived Nov. 6, 2016) ("Whether trading decisions are based on human judgment or a computer algorithm, and whether trades occur once a minute or thousands of times each second, fair and orderly markets require that the standard for robust, accessible, and timely market data be set quite high.").

71.   *See* Jones, *supra* note 55.

72.   *See, e.g.*, BELL, *supra* note 54, at 4.

73.   In the United States, exchanges include: NYSE, Nasdaq, American Exchange [AMEX], Boston Stock Exchange [BSE], Chicago Exchange [CHX], Philadelphia Stock Exchange [PSE]; in the European Union, exchanges include Euronext, Frankfurt Exchange [DAX], Italian Exchange [FTSE MIB], Swiss Exchange [SIX], Stockholm Exchange [STO], Norex, Spanish Exchange [IBEX]. *See, e.g.*, Norman S. Poser, *The Stock Exchanges of the United States and Europe: Automation, Globalization, and Consolidation*, 22 U. PA. J. INT'L ECON. L. 497, 500–07 (2014) (naming NYSE and Nasdaq in the United States and Euronext, Frankfurt Exchange [DAX], Italian Exchange [FTSE MIB], Swiss Exchange [SIX], and Stockholm Exchange [STO] in the European Union).

74.   *See Algorithmic Trading, supra* note 17, at 1624.

Beyond the new incentive against research on long-term securities behavior, information that could potentially impact the market can be lost in translation because HFT puts a premium on speed. Thus, HFT may increase the amount of information in the markets but decrease the amount of useful information in the markets.[75] Nobel Prize-winning economist Joseph Stiglitz described as "socially wasteful" the effort necessary to separate the valuable information from the useless information, resulting in a harmful "loss of confidence in markets."[76]

Critics often cite that useless information, or "market noise," as a cost of HFT. Noise exists when there is competing or contradicting information in the market or when the amount of information becomes too great for the market to process, harming market integrity.[77] HFT firms create noise as algorithms implement "pinging" (see Part II.B) to ignite market momentum, a method some argue should be regulated.[78]

2. Model Risk

Model risk arises from a dependence on pre-set algorithmic programming to address the logistical challenge of real-time intervention.[79] In her work on algorithms that undermine capital market efficiency, Professor Yesha Yadav describes a clash here as the "Goldilocks Dilemma"—"For models to work optimally, market conditions should be exactly attuned to their assumptions and projections."[80] Studies suggest that HFT traders transacting in the direction of permanent price changes best predict price changes over horizons of three to four seconds.[81] While some claim HFT firms' price-finding and adapting features decrease the chance of frequently occurring market crashes (see Part II.C), others argue that HFT predictions and trades during times of financial stress are not reliable.[82]

The Flash Crash of 2010 provides an excellent stage for this controversy. On May 6, 2010, the Dow Jones Industrial Average fell by almost one thousand points, the largest one-day decline in broad

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75.   Felix Salmon, *The Problems of HFT, Joe Stiglitz edition*, REUTERS BLOG (Apr. 16, 2014), http://blogs.reuters.com/felix-salmon/2014/04/15/the-problems-of-hft-joe-stiglitz-edition/ [https://perma.cc/AYJ3-DFAW] (archived Jan. 15, 2017).

76.   *Id.*

77.   *See* BELL, *supra* note 54, at 8.

78.   *See id.*

79.   *See Algorithmic Trading, supra* note 17, at 1613.

80.   *Id.*

81.   *See id.* at 1614.

82.   *See* Austin Gerig, High-Frequency Trading Synchronizes Prices in Financial Markets (Nov. 2012) (unpublished manuscript) (on file with author) (arguing market stress may lead to stress spreading quickly).

market prices in its history, but it quickly rebounded.[83] According to an SEC–CFTC report, HFT traders did not initiate the crash but exacerbated the liquidity issue during freefall.[84] HFT firms continued to trade at high levels, in the aggregate representing 50.3 percent of total volume at exchanges and other venues and selling $1.34 billion of value.[85] Then, during the price rebound, HFTs in the aggregate represented only 36.6 percent of total volume.[86] HFT traders faced censure for reportedly fleeing the market in large numbers to save themselves from the stress of the crisis rather than staying to ensure liquidity, which exacerbated market volatility.[87] This is consistent with the notion that HFT can exaggerate price reaction and increase stock price volatility, possibly because of model risk.[88]

3. Macroeconomics

Faster is not always better. HFT market making might not actually *improve* price discovery in terms of net gains to society. Some critics stipulate that any macroeconomic benefit yielded by faster price discovery cannot compare with the high costs associated with the few extra milliseconds provided. In particular, the resulting higher market volatility negatively affects welfare, the structure of the economy, and overall economic performance.[89]

Private actors like HFT firms are too narrowly focused to consider large scale public goods and gains. To HFT firms, time is relative; they gain from the competitive advantage of outpacing other HFT firms and traditional traders. Because ultra-fast is not equally accessible to all, Gianluca Virgilio of the University of Hertfordshire asserts, HFT is the chief reason for technology-led market inefficiency.[90] The information asymmetry on which HFT firms profit

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83. David Easley et al., *The Microstructure of the Flash Crash*, 37 J. PORTFOLIO MGMT. 118, 118–19 (2011) (explaining two liquidity crises that followed the crash).

84. *See* STAFFS OF THE CFTC AND SEC, *supra* note 70, at 45.

85. EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 11.

86. *Id.* For more information on HFT activity in the U.S. Treasury market in October 2010, see STAFFS OF THE U.S. TREASURY ET AL., JOINT STAFF REPORT: THE U.S. TREASURY MARKET ON OCTOBER 15, 2014, 4–6 (Jul. 13, 2015) (noting HFT firms accounted for the largest share in liquidity-removing trades).

87. *See* Easley et al., *supra* note 83 ("This generalized severe mismatch in liquidity was exacerbated by the withdrawal of liquidity by some electronic market makers and by uncertainty about, or delays in, market data affecting the actions of market participants"). *But see* Jesse Blocher et al., *supra* note 43, at 16 (arguing against "'crash insurance,' the notion that HFTs abandon the markets rather than assuming some obligation to endure losses in times of market stress").

88. *See* Zhang, *supra* note 48, at 3.

89. *See* Salmon, *supra* note 75; *see also* Virgilio, *supra* note 62, at 80 ("Certainly, HF traders speed up price discovery - but at their own benefit and to the detriment of the many other slower investors, that is, to the detriment of the market at large.").

90. Virgilio, *supra* note 62, at 72.

yields a large redistributive effect; considering the transaction cost of gathering information and a lack of any tangible social benefit, there is a net social cost.[91]

IV. REGULATION: HOW *CAN* REGULATORS CONTROL HFT?

A. *Purpose of Regulation*   ,

Beyond the ongoing debate over the definition and the overall market impact of HFT, regulators face controversy over their role in the markets in relation to HFT. The baseline question—Is there even a need for regulation?—is complex. The desire for market intervention to prevent unfairness, volatility, and informational asymmetries is not new, and it is certainly not specific to HFT. Purely as a matter of systemic risk, regulation cannot remove all the uncertainty in the market. Software may help traders to make more informed decisions and to diversify risk more rationally, but it will never alone guarantee risk-free return.[92]

1. Competition in the Market

Some argue that intervention could prevent such problems from resolving themselves through market mechanisms, harkening to classic *laissez-faire* economic theory and Friedrich Hayek's theory that markets are the most efficient way of aggregating information dispersed among individuals within a society.[93] Perhaps increased competition in the HFT industry breeds increased efficiency.[94]

Holly Bell of the Cato Institute indicated that as HFT has increased in market share, it has become more commonly understood and less effective.[95] Because HFT firms are developing new algorithms to separate HFT-related market noise from actual market news, their ability to ignite major, unfounded market swings weakens as they become better consumers of the market information created

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91.   *See* Salmon, *supra* note 75.

92.   *See* Virgilio, *supra* note 62, at 79.

93.   Friedrich Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV., No. 4, 519–21 (1945), http://www.kysq.org/docs/Hayek_45.pdf [https://perma.cc/6TAC-S26Y] (archived Jan. 16, 2017).

94.   *See* Virgilio, *supra* note 62, at 79 (quoting FORESIGHT, THE FUTURE OF COMPUTER TRADING IN FINANCIAL MARKETS, FINAL PROJECT REPORT, THE GOVERNMENT   OFFICE   FOR   SCIENCE,   LONDON,   at   54, http://www.cftc.gov/idc/groups/public/@aboutcftc/documents/file/tacfuturecomputertradi ng1012.pdf [https://perma.cc/2Z6H-23M2] (archived Jan. 16, 2017) (asserting "the more competitive the HFT industry, the more efficient will be the market in which they work").

95.   BELL, *supra* note 54, at 8.

by other algorithms.[96] As such, Bell concludes that regulators adopt "appropriate restraint" by leaving the control of those who exploit algorithms through misinformation to the competitive market.[97]

Institutionally, regulators can improve the technology they use to monitor markets for purportedly illegal activity without needing to heighten regulation of HFT:

> The key issue for regulators is to be careful to distinguish between inappropriate uses of a technology (such as order ignition, intentional quote stuffing, wash trades, and other manipulative practices) and the technology itself. . . . [D]eveloping additional regulatory requirements that restrict the activities of all high frequency traders will likely create market distortions and disrupt the efficient movement of market information, liquidity, and short-term price stability. This is likely to be more damaging to the market than HFT-induced noise.[98]

In light of this proposed lessening impact of HFT, one might question the value of regulation at this stage. If Bell is correct, HFT may soon reach its maximum market velocity.[99] From a marginal cost–marginal benefit analysis standpoint, the marginal cost of the algorithms HFT firms use to exploit ever-smaller time gaps could outpace the marginal benefit those algorithms and associated time gaps produce.[100]

Even if there is a need for regulation, the purpose of the regulation—to incentivize, alter, or curb HFT—is still unclear, as it reflects a judgment, positive or negative, on HFT practices.

2. The Efficient Capital Markets Hypothesis

HFT's defiance of the Efficient Capital Markets Hypothesis (ECMH) indicates why accountability through market competition alone might not sufficiently address volatility and inequity concerns. The ECMH draws on the concept of controlling fluctuation through competitive market normalization.

Eugene Fama and Paul Samuelson developed the ECMH to reflect the theory that markets follow a "random walk," or that prices fluctuate randomly.[101] In essence, the ECMH states that the market

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96.   *Id.*

97.   *Id.*

98.   *Id.* at 9.

99.   *See id.* at 3–4 (describing the two-tiered market system, volatility, flash ·crashes, market liquidity, noise and market integrity are evidence HFT may reach maximum market velocity).

100.   *See id.*

101.   *See* Eugene F. Fama, *The Behavior of Stock-Market Prices*, 38 J. OF BUS. 34, 36 (1965), http://www.e-m-h.org/Fama65.pdf [https://perma.cc/FMH6-6JBF] (archived Jan. 16, 2017) (establishing the random walk hypothesis); *see also* Paul A. Samuelson, *Proof that Properly Anticipated Prices Fluctuate Randomly*, 6 INDUS. MGMT. REV. 41, 42   (1965),   http://lib.cufe.edu.cn/upload_files/file/20140522/3_20140522_4.Proof%

price of an actively traded security will incorporate some amount of information related to that security.[102] Fama divided the ECMH into three forms—strong ECMH, semi-strong ECMH, and weak ECMH—which differ in the amount of information reflected in the prices of actively traded securities.[103] In strong ECMH (the most expansive), prices reflect all past and present information, privately and publicly available.[104] In semi-strong ECMH (the most applicable to modern markets), prices only reflect all publicly available information.[105] In weak ECMH (the most restrictive), prices only reflect past information.[106]

The ECMH posits that prices encompass market information such that no one can consistently make profits above the market average (i.e., greater than those achievable with a buy-and-hold strategy).[107] Whenever securities pricing becomes inefficient, rational investors will engage in arbitrage to realign prices to their fundamental value.[108] Any profit resulting from that arbitrage is shared among many competing market players and averages to zero over time.[109]

HFT casts doubt on the ECMH. In contrast to the EMCH, Virgilio concluded that a small number of HFT firms could achieve risk-free returns consistently by extracting most of the gains from arbitrage rather than allowing them to efficiently spread among the greater investor pool.[110] HFT thus allows a limited number of traders to "beat the market" by exploiting the time advantage accrued through use of algorithms, faster networks, and co-location. Typically, traditional retail and individual investors do not have the information and skill to engage in arbitrage opportunities.[111]

20that%20Properly%20Anticipated%20Prices%20Fluctuate%20Randomly.pdf [https://perma.cc/4SV8-YTXG] (archived Jan. 16, 2017) (providing a proof for Fama's random walk hypothesis).

    102.   STEPHEN J. CHOI & A.C. PRITCHARD, SECURITIES REGULATION: CASES AND ANALYSIS 30 (4th ed. 2015).

    103.   Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. OF FIN., No. 2, at 383 (1970), http://efinance.org.cn/cn/fm/Efficient%20Capital%20Markets%20A%20Review%20of%2 0Theory%20and%20Empirical%20Work.pdf [https://perma.cc/UXZ7-M44B] (archived Jan. 16, 2017).

    104.   Virgilio, *supra* note 62, at 69.

    105.   *Id.*

    106.   *Id.*

    107.   *See id.* at 69, 71.

    108.   *See id.* at 69, 73.

    109.   *See* Fama, *The Behavior of Stock-Market Prices, supra* note 100; *see also* Gianluca Virgilio, *High-frequency trading and the efficient market hypothesis*, 6 THE BUS. AND MGMT. REV. 73 (2015), http://www.abrmr.com/myfile/conference_proceedings/Con_Pro_42356/2015roge10.pdf [https://perma.cc/6VVJ-7TWC] (archived Jan. 15, 2017).

    110.   *See* Virgilio, *supra* note 62, at 80.

    111.   *Cf.* Andrei Shleifer & Robert W. Vishny, *The Limits of Arbitrage*, 52 J. OF FIN. 35, 36–37 (1997), http://ms.mcmaster.ca/~grasselli/ShleiferVishny97.pdf

Professor Adam Clark-Joseph analyzed CFTC audit-level trading data in the eMini S&P 500 futures market and proposes that HFT aggressive orders generate valuable private information:

> When an HFT places an exploratory order and observes a large price-impact, he learns that supply is temporarily inelastic. If the HFT knows that there is going to be more demand soon thereafter, he can place a larger order (even with a big price-impact) knowing that the price-impact from the coming demand will drive prices up further and ultimately enable him to sell at a premium that exceeds the price-impact of his unwinding order. When an HFT knows that supply is temporarily inelastic, he follows a routine demand-anticipation strategy. The purpose of exploratory trading is not to learn about future demand, but rather to identify the times at which trading in front of future demand will be profitable.[112]

As a result, only a relatively small number of professional, highly specialized HFT investors can outmaneuver traditional investors, and ECMH's assumption that no one can consistently beat the market no longer holds.[113]

Virgilio created a simple arbitrage model to this effect, demonstrating that HFT firms can make statistically significant profits.[114] Thus, while smart software might never nullify trading risk, only HFT speed and co-location seem to provide the possibility of defying the ECMH and guaranteeing risk-free return.[115] Consequently, regulation may be necessary to address this inequity.

B. *Efforts in the United States*

The SEC, the Financial Industry Regulatory Authority (FINRA), and the CFTC are the regulatory authorities leading the charge against HFT in the United States. Through recent regulatory proposals and enforcement actions, these institutions have taken steps to bring HFT under closer scrutiny.

[https://perma.cc/5ZVD-9MCF] (archived Jan. 16, 2017) (noting that "millions of little traders are typically not the ones who have the knowledge and information to engage in arbitrage").

112. ADAM CLARK-JOSEPH, EXPLORATORY TRADING 4 (2013), http://www.nanex.net/aqck2/4136/exploratorytrading.pdf [https://perma.cc/LLQ8-7FZY] (archived June 10, 2017).

113. *See* Virgilio, *supra* note 62, at 69. *But see* Kewei Hou, Chen Xue & Lu Zhang, *Replicating Anomalies* 31 (Fisher College of Business Working Paper Series, Paper No. 2017-03-010, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2961979 [https://perma.cc/Q3MN-ZCXZ] (archived June 10, 2017) (stipulating that because true "anomalies," or patterns that make stock prices predictable, are much less prevalent than reported, capital markets are more efficient than previously realized).

114. *See* Virgilio, *supra* note 62, at 76–79 (providing a model representing two markets, with a large number of traditional investors and a small number of HFT investors trading the same securities, to show how HFT investors can make consistent, abnormal, risk-free profit at traditional investors' expense).

115. *See id.* at 79.

1. The SEC and Regulation Systems Compliance and Integrity

The SEC adopted Regulation Systems Compliance and Integrity (Reg SCI) in November 2014 in hopes of strengthening the technology infrastructure of US securities markets. In implementing this set of rules, the SEC expressly sought to "[r]educe the occurrence of systems issues; [i]mprove resiliency when systems problems do occur; and [e]nhance the Commission's oversight and enforcement of securities market technology infrastructure."[116] These ambitions represent the typical counterargument to critics' contention that regulation interferes with the competitive market's ability to resolve problems (see Part IV.A.1)—regulation could help prevent such problems from occurring in the first place.

Reg SCI applies to "SCI entities"—(1) self-regulatory organizations, such as stock and options exchanges, registered clearing agencies, FINRA, and the Municipal Securities Rulemaking Board (MSRB), that trade stocks exceeding specified volume thresholds; (2) consolidated market data processors; (3) certain exempt clearing agencies; and (4) alternative trading systems (ATSs) that exceed volume thresholds. SCI entities that support "SCI systems"—trading, market data processing, market regulation, market surveillance, clearance and settlement, and order routing— are the specific target. SCI entities must establish written policies and procedures to ensure their technological systems "promote maintenance of fair and orderly markets" and comply with the U.S. Securities Exchange Act of 1934.[117]

More pertinent to HFT, Reg SCI requires SCI entities to mandate participation in testing of business continuity and disaster recovery plans. Among other things, this stipulation reflects the possibility of flash crashes, noting that SCI entities must take corrective action and disseminate information with respect to "SCI events"—systems disruptions, systems compliance problems, and systems intrusions.[118] In the final rule, the SEC noted that while recent technological advances have "substantially enhanced the speed, capacity, efficiency, and sophistication of the trading functions," they have increased the risk of operational problems associated with automated systems, which can have widespread and lasting effects.[119] To enhance accountability on this front, SCI entities must also establish procedures to identify and periodically review "SCI personnel," or those responsible for SCI systems.

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116. *See* SEC SPOTLIGHT: REGULATION SCI, *supra* note 8.
117. *See* Regulation Systems Compliance and Integrity, Final rule and form, 17 C.F.R. §§ 240, 242, 249 (2014), https://www.gpo.gov/fdsys/pkg/FR-2014-12-05/pdf/2014-27767.pdf [https://perma.cc/6BM6-FZV3] (archived Mar. 1, 2017); *see also* 15 U.S.C. § 78(f)(b)(1) (2012).
118. Regulation Systems Compliance and Integrity, *supra* note 117.
119. *Id.*

Reviews of Reg SCI are generally positive, seeing the requirements as a step in the right direction for regulators in light of growing cybersecurity concerns.[120] SEC Commissioner Luis Aguilar highlighted Reg SCI's strengths, including its risk-based (and not overly prescriptive) approach and its requirement that companies' senior management and boards of directors be actively involved in cybersecurity issues.[121] Commissioner Aguilar also commended the regulation's emphasis on information sharing with other industry participants, noting how increased awareness could reduce cyber risk and enhance recovery responses.[122]

If anything, Reg SCI is not enough. The Securities Industry and Financial Markets Association (SIFMA) believes regulations like Reg SCI are too limited. While noting the importance of issue prevention, SIFMA emphasizes containment and minimization of such problems to prevent the aforementioned lasting effects of automated system problems.[123] Referencing the 2010 Flash Crash (see Part II.B.2), SIFMA notes additional mechanisms to protect individual investors' confidence in technological advancements. Specifically, it proposes a hybrid approach:

> a price band in order to prevent trades from occurring outside acceptable pre-determined price ranges, a bid/offer wanted period to alert market participants to the need for additional liquidity within the acceptable price range to avoid unnecessary price swings, and trading halt to pause trading when necessary to promote proper price discovery.[124]

Indeed, the SEC has already indicated that it may expand the scope of Reg SCI in light of all market participants' increased use of automated technologies.[125] Commissioner Aguilar expressed a need

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120.   CYBER ATTACKS: THREATS, REGULATORY REACTION AND PRACTICAL PROACTIVE MEASURES TO HELP AVOID RISKS, KATTEN MUCHIN ROSENMAN LLP (June 24, 2015), https://www.kattenlaw.com/Cyber-Attacks-Threats-Regulatory-Reaction-and-Practical-Proactive-Measures-to-Help-Avoid-Risks [https://perma.cc/X47Z-GE2F] (archived Mar. 1, 2017).

121.   Stephen Joyce, *SEC's Reg SCI Should Encompass More Market Participants, Aguilar Says*, BLOOMBERG BNA (June 26, 2015), https://www.bna.com/secs-reg-sci-n17179928830/ [https://perma.cc/NB5G-P8CE] (archived Mar. 1, 2017).

122.   *Id.*

123.   SEC. INDUS. AND FIN. MKTS ASSOC. [hereinafter SIFMA], REG SCI RESOURCE CENTER, http://www.sifma.org/issues/capital-markets/equity-markets/reg-sci/overview/ [https://perma.cc/9AR4-89NE] (archived Mar. 1, 2017).

124.   SIFMA, FLASH CRASH RESOURCE CENTER, http://www.sifma.org/issues/capital-markets/equity-markets/flash-crash/overview/ [https://perma.cc/HEX4-3XFF] (archived Mar. 1, 2017).

125.   Annette L. Nazareth et al., *SEC Adopts Regulation SCI to Strengthen Securities Market Infrastructure*, DAVIS POLK CLIENT MEMORANDUM (Dec. 4, 2014), https://www.davispolk.com/sites/default/files/12.04.14%20SEC%20Adopts%20Regulation%20SCI%20to%20Strengthen%20Securities%20Market.pdf [https://perma.cc/KSX6-ZGC6] (archived Mar. 1, 2017).

for a more comprehensive list of market participants, like over-the-counter market makers and transfer agents.[126]

2. The SEC, FINRA, and Enforcement

The SEC has sought to enforce its regulations in favor of greater disclosure to unpack the "mystery" of HFT. For example, in October 2014 the SEC sanctioned HFT firm Athena Capital Research LLC for executing a large number of aggressive trades in quick succession at market closing, a practice known as "marking the close," on almost every trading day for six months.[127] According to the SEC, Athena knowingly used an algorithm, codenamed "Gravy," to create an order imbalance in which the number of orders to buy certain shares did not match the number of offers to sell those shares.[128]

While Athena neither admitted nor denied the SEC's charge for violation of Section 10(b) of the Securities Exchange Act of 1934 and SEC Rule 10b-5, it agreed to pay a $1 million penalty and to cease and desist from committing or causing any future violations of the securities laws.[129] SEC Chair Mary Jo White asserted, "When [HFT firms] cross the line and engage in fraud we will pursue them as we do with anyone who manipulates the markets."[130] Deeming Athena's activity fraudulent, SEC Division of Enforcement Director Andrew J. Ceresney added, "This action should send a clear message that the [SEC] and its Division of Enforcement have the expertise to investigate and charge even the most sophisticated fraudulent algorithmic trading strategies."[131]

Beyond these enforcement efforts, the SEC oversees FINRA, a self-regulatory organization that acts as the front-line regulator for broker-dealers (although most broker-dealers also must register with the SEC).[132] Traders who register with FINRA face disclosure

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126.   *See* Joyce, *supra* note 121.
127.   Press Release, SEC, SEC Charges New York-Based High Frequency Trading Firm With Fraudulent Trading to Manipulate Closing Prices (Oct. 16, 2014), https://www.sec.gov/News/PressRelease/Detail/PressRelease/1370543184457 [https://perma.cc/PU6P-J28W] (archived Jan. 20, 2017).
128.   *Id.*
129.   *See* Securities Exchange Act of 1934, 15 U.S.C. § 10(b) (2012); SEC Rule 10b-5, 17 C.F.R. § 240.10b-5 (2012); Press Release, SEC, *supra* note 127.
130. · Press Release, SEC, *supra* note 127.
131.   *Id.* The following year, the SEC charged proprietary trading firm Briargate Trading LLP and co-founder Eric Oscher with manipulating the markets through spoofing, or artificially inflating prices of particular stocks (see *infra* Section IV.B.3). *See* Press Release, SEC, SEC Charges Firm and Owner with Manipulative Trading (Oct.   8,   2015),   https://www.sec.gov/news/pressrelease/2015-236.html [https://perma.cc/9M8D-HPH9] (archived Jan. 20, 2017).
132.   *Cf.* RENA S. MILLER & GARY SHORTER, HIGH FREQUENCY TRADING: OVERVIEW OF RECENT DEVELOPMENTS, CONGRESSIONAL RESEARCH SERVICE 10 (2016), https://fas.org/sgp/crs/misc/R44443.pdf [https://perma.cc/D4ZX-3KCJ] (archived Jan. 20, 2017) (outlining requirements faced by traders subject to FINRA oversight).

requirements and examinations of their conduct.[133] According to Rule 15b9-1 of the U.S. Securities Exchange Act of 1934, in relevant part, many HFT firms that trade on exchanges through a third-party broker-dealer, or that trade on alternative trading systems, may be exempt from FINRA registration.[134]

However, the SEC passed a proposal in 2015 requiring previously exempt HFT broker-dealers to register with FINRA, and thus to face FINRA regulatory oversight.[135] The new, more focused exemption will only exclude approximately 125 firms from FINRA registration requirements.[136] The SEC admitted to targeting HFT firms with this regulation, hoping to enhance regulatory oversight of active proprietary trading · firms.[137] Echoing SEC Division of Enforcement Director Ceresney's comment on the Athena sanction, SEC Commissioner Aguilar noted that the finalized proposals were integral to advancing FINRA's trading surveillance program: "This will ensure that these [HFT firms] can be held responsible for any potential misconduct."[138]

3. The CFTC and "Spoofing"

Section 747 of the Dodd-Frank Wall Street Reform and · Consumer Protection Act (Dodd-Frank) amended the Commodity Exchange Act to specifically target HFT, albeit under a different name.[139] The new provision, 7 U.S.C. § 6c(a)(5)(C), prohibits "any trading practice, or conduct on or subject to the rules of a registered entity that . . . is, is of the character of, or is commonly known to trade as, 'spoofing' (bidding or offering with the intent to cancel the bid or offer before execution)."[140]

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133. *See id.*
134. *See* Securities Exchange Act of 1934, 15 U.S.C. § 78; SEC Rule 15b9-1, 17 C.F.R. § 240.15b9-1 (2012).
135. *See* MILLER & SHORTER, *supra* note 132.
136. Jeff Kern & Brian Garrett, *SEC Requires FINRA Registration for High Frequency Traders,* CORP. & SEC. L. BLOG (Mar. 27, 2015), http://www.corporatesecuritieslawblog.com/2015/03/sec-requires-finra-registration-for-high-frequency-traders/ [https://perma.cc/ZKB8-YJRX] (archived Jan. 20, 2017).
137. *Cf.* Exemption for Certain Exchange Members, 80 Fed. Reg. 1035 (proposed Apr. 2, 2015) (to be codified at 17 C.F.R. pt. 240).
138. · Kern & Garrett, *supra* note 136. In 2016, the SEC enforced its new regulation against two titans of the banking industry—Credit Suisse and Barclays—for manipulating investors through "dark pools," private trading platforms in which HFT firms operate. *See* MILLER & SHORTER, *supra* note 132 (discussing the settlement of SEC claims against Credit Suisse and Barclays for cumulatively more than $150 million).
139. *See* Dodd-Frank Act, 7 U.S.C. § 6c(a)(5) (2012) (outlawing "spoofing," a strategy similar to HFT strategies).
140. *Id.* § 6c(a)(5)(C).

The first US statutory provision to specifically ban "spoofing," Section 6c(a)(5)(C) targets HFT order anticipation strategies.[141] Because the provision relies on determining intent, however, enforcement of the spoofing prohibition against speed-driven HFT can prove challenging. To that end, the CFTC released additional guidance extrapolating on the intent requirement, specifically that reckless trading practices alone do not constitute spoofing and that the CFTC must prove that a trader intended to move the market (i.e., HFT market making).[142] As CFTC Director of Enforcement Aitan Goelman noted, "Spoofing seriously threatens the integrity and stability of futures markets because it discourages legitimate market participants from trading. The CFTC is committed to prosecuting this conduct and is actively cooperating with regulators around the world in this endeavor."[143]

Dampening criticism of Section 6c(a)(5)(C)'s unenforceability, the CFTC has enforced the prohibition in several actions involving HFT and algorithmic trading. In 2016, Michael Coscia, an HFT trader who implemented CFTC-flagged algorithmic trading strategies, was convicted on criminal charges for spoofing and commodities fraud.[144] The Court in *United States v. Coscia* specifically determined that the "intent to cancel" requirement of Section 6c(a)(5)(C) was significant; therefore, the statutory prohibition was not unconstitutionally vague.[145] The first defendant in the United States to stand trial under Dodd-Frank anti-spoofing legislation, Coscia was sentenced to three years in prison and two years of supervised release for "the use of computer algorithms to rig markets in fractions of a second."[146]

The CFTC has also pursued civil charges against manipulation in futures contracts. In 2015, the CFTC filed a civil complaint against

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141.   *Id.*; *see also* George S. Canellos, *Spoofing in the Derivatives and Securities Markets*, MILBANK (June 15, 2016), http://www.milbank.com/images/content/2/2/22241/ Spoofing-in-the-Derivatives-and-Securitites-Markets-Nov-2015.pdf [https://perma.cc/V3QT-3DWM] (archived Jan. 20, 2017).

142.   *See* U.S. Commodity Futures Trading Comm'n, Antidisruptive Practices Authority, 78 C.F.R. §§ 31890, 31892, 31896 (2013), https://www.gpo.gov/fdsys/pkg/FR-2013-05-28/pdf/2013-12365.pdf [https://perma.cc/ 7B3A-USZF] (archived Jan. 20, 2017).

143.   Press Release, CFTC, CFTC Charges Chicago Trader Igor B. Oystacher and His Proprietary Trading Company, 3 Red Trading LLC, with Spoofing and Employment of a Manipulative and Deceptive Device while Trading E-Mini S&P 500, Copper, Crude Oil, Natural Gas, and VIX Futures Contracts (Oct. 19, 2015), http://www.cftc.gov/PressRoom/PressReleases/pr7264-15 [https://perma.cc/JJ36-C2WQ] (archived Jan. 20, 2017).

144.   *See* U.S. v. Coscia, 100 F.Supp.3d 653, 659 (N.D. Ill. 2015), *aff'd*, 177 F.Supp.3d 1087 (N.D. Ill. 2016) (finding that the spoofing prohibition was not unconstitutionally vague as applied to the defendant involved in HFT).

145.   7 U.S.C. § 6c(a)(5)(C); *U.S. v. Coscia*, 100 F.Supp.3d at 659.

146.   Greg Trotter, *Trader Michael Coscia 1st in nation to be sentenced under 'anti-spoofing' law*, CHI. TRIB. (July 13, 2016, 4:36 PM), http://www.chicagotribune.com/business/ct-spoofing-trial-sentencing-0714-biz-20160713-story.html [https://perma.cc/5KTD-TKT6] (archived Jan. 20, 2017).

Igor Oystacher and his proprietary trading company, 3 Red Trading LLC (3 Red defendants), for spoofing and manipulation while trading futures contracts on four different futures exchanges: the E-Mini S&P 500 futures contracts on the Chicago Mercantile Exchange (CME); crude oil and natural gas futures contracts on the New York Mercantile Exchange (NYMEX); copper futures contracts on the Commodity Exchange Inc. (COMEX); and the volatility index (VIX) futures contract on CBOE Futures Exchange (CFE).[147]

Citing *Coscia*, the court in *CFTC v. Oystacher* found that the 3 Red defendants' trading strategy relied on an unlawful intent to cancel bids or offers before execution, following the language of Section 6c(a)(5)(C).[148] Effectively, the 3 Red defendants had placed and subsequently cancelled large passive orders, implementing an HFT market-making tactic that created a false impression of a growing market for the futures, and allowed the 3 Red defendants to flip their "buy"/"sell" position to turn a profit.[149]

Highlighting international efforts to control the behaviors of disruptive algorithmic traders, in 2015 the CFTC charged Navinder Singh Sarao, a UK resident, and Nav Sarao Futures Limited PLC (Sarao defendants) with unlawfully manipulating, attempting to manipulate, and spoofing with regard to E-mini S&P 500 near-month futures contracts.[150] In particular, the CFTC alleged that the Sarao defendants used a "layering algorithm" to follow price movements in the E-mini S&P 500 index and eventually canceled most of the orders the algorithm placed, allegedly creating a profit of over $40 million.[151]

The manipulation at the heart of the Sarao charge, however, was the Sarao defendants' use of the layering algorithm on May 6, 2010—the day of the Flash Crash (see Part III.B.2)—during which the Sarao defendants allegedly applied persistent downward pressure worth approximately $200 million on the E-mini S&P 500 index price.[152] According to the CFTC, such manipulation helped destabilize the E-mini S&P order book, contributing to the market conditions surrounding the Flash Crash.[153]

In an assurance of the CFTC's resolve, CFTC Director of Enforcement Goelman stated, "Protecting the integrity and stability

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147. Press Release, CFTC Charges Chicago Trader Igor B. Oystacher, *supra* note 143.
148. 7 U.S.C. § 6c(a)(5)(C); CFTC v. Oystacher, 203 F.Supp.3d 934, 944 (N.D. Ill. 2016).
149. Press Release, CFTC Charges Chicago Trader Igor B. Oystacher, *supra* note 143.
150. Press Release, CFTC, CFTC Charges U.K. Resident Navinder Singh Sarao and His Company Nav Sarao Futures Limited PLC with Price Manipulation and Spoofing (Apr. 21, 2015), http://www.cftc.gov/PressRoom/PressReleases/pr7156-15 [https://perma.cc/8ZLB-72DT] (archived Jan. 20, 2017).
151. *Id.*
152. *See id.*
153. *Id.*

of the U.S. futures markets is critical to ensuring a properly functioning financial system . . . [and the CFTC] will find and prosecute manipulators of U.S. futures markets wherever they may be."[154]

4. The CFTC and Regulation Automated Trading

The CFTC proposed Regulation Automated Trading (Reg AT) in 2015 to update its regulations in light of the emergence and prominence of electronic trading.[155] Part of a series of measures in response to financial regulators' concerns over market volatility, Reg AT represents a CFTC effort, in the name of transparency, to enhance its oversight over "automated trading activities," of which HFT is a primary example.[156]

In proposing Reg AT, the CFTC listed policy concerns it seeks to address with the regulation, including risks associated with market liquidity and market shocks, and sufficient risk mitigation in light of the high speed of trade execution.[157] In its 2015 Notice of Proposed Rulemaking for Reg AT, the CFTC focused on the algorithmic order routing, electronic order execution, and self-trade, market-making mechanisms characteristic of HFT.[158] Later, in its 2016 Reg AT Supplemental Proposal (Supplemental Proposal), the CFTC sought to clarify and structure many of the requirements it originally set forth in Reg AT.

Among their key requirements, Reg AT and the Supplemental Proposal impose three major requirements: (1) new trader registration related to algorithmic trading, (2) new risk control structure, and (3) algorithmic trading source code preservation.[159]

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154.   James Quinn & Gordon Rayner, *British man held over £500bn Wall Street 'flash crash,'* THE TELEGRAPH (Apr. 22, 2015, 10:30 AM), http://www.telegraph.co.uk/finance/financial-crime/11553433/British-trader-Nav-Sarao-charged-with-triggering-global-markets-flash-crash-in-2010.html [https://perma.cc/22HW-8DL7] (archived Jan. 20, 2017).
155.   *See* Regulation Automated Trading, 80 Fed. Reg. 78823 (proposed Dec. 17, 2015) (to be codified at 17 CFR pts. 1, 38, 40, 170), http://www.cftc.gov/idc/groups/public/@newsroom/documents/file/federalregister112415.pdf [https://perma.cc/8F47-FUA2] (archived Jan. 20, 2017) (discussing the purpose and requirements of Reg AT).
156.   *See, e.g.,* 17 C.F.R. §§ 180.1, 180.2 (establishing CFTC authority to prohibit deceptive financial devices and price manipulation); *see also* MILLER & SHORTER, *supra* note 132 (describing the condition of U.S. Treasury securities in 2014 as a stage for the proposal of Reg AT).
157.   *See* Regulation Automated Trading, *supra* note 155.
158.   *Id.*
159.   Reg AT and the Supplemental Proposal also require periodic review of compliance with Reg AT and offer options to facilitate the compliance of AT Persons' third-party systems. *See* CFTC, FACT SHEET – SUPPLEMENTAL NOTICE OF PROPOSED RULEMAKING ON REGULATION AUTOMATED TRADING (2016), http://www.cftc.gov/idc/groups/public/@newsroom/documents/file/regat_factsheet110316

First, Reg AT and the Supplemental Proposal require the registration of proprietary algorithmic traders who trade on a "designated contract market" (DCM) using "direct electronic access"—the practice of directly entering trades into an exchange's electronic trade matching system for a fee.[160] Direct electronic access essentially allows certain trading customers to avoid routing trades through brokers (e.g., Charles Schwab), whereby cutting out a major market participant.[161]

The Supplemental Proposal institutes a volume-based, quantitative threshold for determining whether an existing trader is an algorithmic trader, or "AT person," and whether an algorithmic trader trading on a DCM via direct electronic access must register as a New Floor Trader with the CFTC.[162] Such a requirement would expand the number and types of floor traders required to register with the CFTC.[163] The suggested volume threshold is twenty thousand contracts on average, per day, over a six-month period.[164] As a result, the CFTC estimates that 120 people will be classified as AT Persons, of which fifty would be New Floor Traders and seventy would be current registrants.[165] Along with the SEC's FINRA registration requirement (see Part IV.B.1), the CFTC's proposed registration requirement in Reg AT and the Supplemental Proposal is meant to illuminate the current black box in which HFT operates due to its speedy trade execution.

Second, the Supplemental Proposal sets forth a two-tier, pre-trade risk control structure set at the levels of (1) the AT Person or "executing" futures commission merchant (FCM) and (2) the DCM.[166] Under this system, an AT Person could choose to delegate compliance with risk control requirements to its FCM (with the FCM's consent).[167] The two-tier structure would replace the three-tier structure proposed in Reg AT and expand its risk control requirements to encompass algorithmic trading and electronic

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.pdf [https://perma.cc/DV2K-YTGF] (archived Jan. 20, 2017) (discussing specific proposals within the supplemental NPRM on Regulation Automated Trading).

160. MILLER & SHORTER, *supra* note 132.

161. *See id.* (discussing Reg AT's attempt to regulate direct electronic access).

162. *See* FACT SHEET, *supra* note 159, at 1–2; Athena Yvonne Eastwood et al., *CFTC Approves Supplemental Proposal for Proposed Regulation AT*, NAT'L L. REV. (Nov. 7, 2016), http://www.natlawreview.com/article/cftc-approves-supplemental-proposal-proposed-regulation [https://perma.cc/R6K9-DY2D] (archived Jan. 20, 2017); Paul M. Architzel et al., *CFTC Revises Proposed Reg AT*, WILMERHALE (Nov. 9, 2016), https://www.wilmerhale.com/pages/publicationsandnewsdetail.aspx?NewsPubId=17179 883173 [https://perma.cc/Z2ZS-KBPX] (archived Jan. 20, 2017).

163. *See* Eastwood et al., *supra* note 162.

164. Architzel et al., *supra* note 162.

165. Eastwood et al., *supra* note 162.

166. FACT SHEET, *supra* note 159, at 1–2.

167. *Id.*

trading, including electronic trading at the FCM and DCM levels.[168] In essence, the new two-tier structure would allow the CFTC to more closely monitor HFT by imposing risk control requirements at a greater number of levels in the trading chain.

Third, the Supplemental Proposal requires algorithmic trading source code to be preserved according to provisions other than the CFTC's general recordkeeping requirements, and accessible to the CFTC only via subpoena or CFTC-approved special call.[169] This is a revision of the Reg AT provision that required making source code available for inspection to the CFTC, which received a great deal of pushback from traders interested in protecting their intellectual property.[170] The Supplemental Provision also provides the CFTC with access both to records tracking changes to an AT Person's algorithmic trading source code and to log files recording the activity of an AT Person's algorithmic trading system.[171]

Resistance to Reg AT and the Supplemental Proposal ranges from criticism of its scope and objectives to attacks on the imbalance of power it allegedly manifests. One of Reg AT's most outspoken critics comes from within the CFTC itself; CFTC Commissioner J. Christopher Giancarlo neatly outlined some of the major concerns regarding Reg AT and has publicly condemned Reg AT as a "20th century analog response to the 21st century digital revolution in trading markets."[172]

The Reg AT algorithmic trading source code provision arguably faces the most criticism. While Reg AT implements industry best practices and provides flexibility in setting risk controls, many disagree with Reg AT's granting the CFTC and the Department of Justice access to algorithmic trading source code without subpoenas.[173] Noting the lack of specific confidentiality protections

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168.   The Reg AT three-tier structure provided controls at the levels of (1) the AT person, (2) the "clearing member" FCM, and (3) the DCM. *See* MILLER & SHORTER, *supra* note 132, at 9–10 (discussing the expansion of registration requirements to proprietary traders engaging in algorithmic trading); *see also* FACT SHEET, *supra* note 159, at 1 (explaining the expansion of the Reg AT risk control framework to also encompass electronic trading).

169.   FACT SHEET, *supra* note 159, at 2.

170.   *See id.* (describing source code availability requirement).

171.   *Id.*

172.   Lisa Lambert, *U.S. automated trading proposal out of date: CFTC commissioner,* REUTERS BUS. NEWS (Sept. 21, 2016, 12:14 PM), http://www.reuters.com/article/us-usa-regulation-trading-idUSKCN11R256 [https://perma.cc/ 2C2Y-JDRR] (archived Jan. 20, 2017).

173.   *See* CFTC, Statement of Dissent by Commissioner J. Christopher Giancarlo Regarding Supplemental Notice of Proposed Rulemaking on Regulation Automated Trading   (Nov.   ·   4,   2016), http://www.cftc.gov/PressRoom/SpeechesTestimony/giancarlostatement110416 [https://perma.cc/8QXM-E7YE] (archived Jan. 20, 2017) (discussing Commissioner Giancarlo's many different qualms with Reg AT); *see also* Lambert, *supra* note 172

for source code, Commissioner Giancarlo stated the Supplemental Proposal would deprive intellectual property owners of due process of law.[174]

Critics like Commissioner Giancarlo also fear the regulatory precedent adopting the algorithmic trading source code provision would set for other regulators, both domestic and foreign. Extrapolating from the likelihood that the SEC will implement source code provisions similar to those in Reg AT, Commissioner Giancarlo predicted that other US agencies, such as the Federal Communications Commission, the Federal Trade Commission, the National Security Agency, and even the Department of Transportation, might seek source codes from Apple, Facebook, Oracle, and Uber, respectively.[175]

Beyond the United States, Reg AT's source code provision could further empower government-led campaigns to mandate public disclosure of algorithms used in banking, search engines, and social networks.[176] The SEC bolsters this prospect, noting the impossibility of tracing orders and trades to HFT firms when relying solely on information currently made available to the public.[177]

Even setting aside the algorithmic trading source code provision, many see Reg AT as a governmental overreach. The FIA, a futures industry trade group, filed a comment letter with the CFTC emphasizing that the new regulation would impact far more market participants than just a small, specific subset of algorithmic trading firms.[178] The Managed Funds Association, a hedge fund group, concurred with the FIA, commenting that Reg AT too broadly regulates automated trading by unrelated types of market

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(reporting on Commissioner Giancarlo's dislike for Reg AT's "broad scope, hazy objectives, and several significant inconsistencies).

174. Statement of Dissent by Commissioner J. Christopher Giancarlo, *supra* note 173.

175. *Id.*

176. *See, e.g.,* Eva Dou, *U.S., China Discuss Proposed Banking Security Rules,* WALL ST. J. (Feb. 13, 2015, 7:23 AM), http://www.wsj.com/articles/china-banking-regulator-considering-source-code-rules-1423805889 [https://perma.cc/PME9-EWDX] (archived Jan. 20, 2017) (discussing US–China talks regarding Chinese banking regulations that could compromise sensitive US intellectual property); BBC News, *Angela Merkel wants Facebook and Google's secrets revealed,* BBC TECH. (Oct. 28, 2016), http://www.bbc.com/news/technology-37798762 [https://perma.cc/JR5Q-CHY4] (archived Jan. 20, 2017) (describing German Chancellor Merkel's view that algorithms, when not transparent, can distort public perceptions and narrow the scope of public information).

177. *See* EQUITY MARKET STRUCTURE LITERATURE REVIEW, *supra* note 6, at 8–9 ("As a result, it is impossible to identify orders and trades as originating from an HFT account when relying solely on publicly available information.").

178. Press Release, FIA, FIA comments on CFTC's Proposed Rule on Automated Trading (Mar. 16, 2016), http://www.futuresmag.com/2016/03/16/fia-comments-cftc%E2%80%99s-proposed-rule-automated-trading [https://perma.cc/6FD7-UHW8] (archived Jan. 20, 2017).

participants.[179] Commissioner Giancarlo concluded that Reg AT was "a classic Washington maneuver: force as many businesses as possible into the regulatory framework so there is someone to investigate if something goes wrong."[180]

C.   *Efforts in the European Union*

The European Securities and Markets Authority (ESMA), an independent EU regulatory agency, oversees securities trading across all EU member states. Formed in response to the 2008 Financial Crisis, ESMA identifies potential threats to financial stability and adopts emergency measures in crisis situations. Through an amalgamation of efforts by ESMA and the European Commission, the Regulation on Markets in Financial Instruments, comprised of the Markets in Financial Instruments Directive II (MiFID II) and the Markets in Financial Instruments Regulation (MiFIR), seeks to regulate firms and trading venues that engage in algorithmic trading and/or HFT.

1. MiFID II

The MiFID regulatory package (beginning with MiFID I) has been a cornerstone of financial market regulation in the European Union since 2007, seeking to improve market competitiveness through the creation of a single investment market and to ensure harmonized investor protection. To this end, MiFID I established a series of rules and requirements related to business organization and conduct, regulated market authorization, regulatory reporting to avoid market abuse, trade transparency, and instrument admission into trading.[181]

To inform further regulatory efforts, ESMA distributed a questionnaire on HFT that surveyed trading firms on their strategies, market access, latency requirements, algorithm development, and risk management.[182] For the purposes of the questionnaire, HFT was defined as:

> [t]rading activities that employ sophisticated, algorithmic technologies to interpret signals from the market and, in response, implement trading strategies that generally involve the high frequency generation of orders and a

179.   Gregory Meyer, *Industry criticises CFTC's plans for new automated trading rules*, FIN. TIMES (Mar. 16, 2016), https://www.ft.com/content/d6558728-ebba-11e5-9fca-fb0f946fd1f0 [https://perma.cc/M5EM-E8WF] (archived Jan. 20, 2017).

180.   Lambert, *supra* note 172.

181.   ESMA, MIFID (II) AND MIFIR (2017), https://www.esma.europa.eu/policy-rules/mifid-ii-and-mifir [https://perma.cc/H54H-GEU6] (archived Mar. 1, 2017).

182.   THE TRADE, ESMA DELVES INTO HFT FOR MIFID II (2017), http://www.thetradenews.com/Regions/Europe/ESMA-delves-into-HFT-for-MiFID-II/ [https://perma.cc/2EAM-D7NQ] (archived Mar. 2, 2017).

low latency transmission of these orders to the market. Related trading
strategies mostly consist of either quasi market making or arbitraging within
very short time horizons. They usually involve the execution of trades on own
account (rather than for a client) and positions usually being closed out at the
end of the day.[183]

Using feedback from these questionnaires, the European Commission
hoped to update regulations to adapt the existing MiFID I framework
to account for growth in HFT and to prevent or ameliorate the effects
of flash crashes. The Commission looked to include HFT under a
larger "automated trading" umbrella definition and to require all
markets to install their own circuit breakers, stress test their
platforms, and offer fair and equal access to co-location services.[184]

In 2014, after more than two years of negotiations, the European
Parliament and the Council of the European Union adopted the
Regulation on Markets in Financial Instruments, commonly referred
to as MiFID II and MiFIR. Ultimately scheduled to apply to EU
member states on January 3, 2018, MiFID II represents an ongoing
effort to dampen the effects of HFT.

While MiFID I was primarily a compliance mandate for the
financial industry, MiFID II poses potential problems for revenues,
organizational strategies, and business models.[185] Using a series of
definitional   tests,   regulation   benchmarks,   and   registration
requirements, ESMA intends MiFID II to improve the efficiency,
resilience, and transparency of financial markets in the aftermath of
the 2008 Financial Crisis. Under MiFID II, ESMA is developing
numerous draft regulatory technical standards (RTS) and draft
implementing technical standards (ITS) aimed at increasing the
scope of regulation. In particular, the new regulations will cover more
non-equity products—namely structured deposits issued or sold by
credit institutions, certain packaged retail investment products, and
financial instruments issued by investment firms—and over-the-
counter trading.[186]

The April 2016 Delegated Regulation supplementing MiFID II
specifically targets algorithmic trading and its subset, HFT, setting
forth standards for what qualifies as HFT similar to those adopted by
the U.S. SEC and CFTC. MiFID II characterizes HFT as an
algorithmic   trading   technique   whose   infrastructure   minimizes
latency through co-location, proximity, or high-speed direct electronic
access, and fosters order initiation, generation, routing, or execution

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183.   *Id.*
184.   *See id.*
185.   *See* Benjamin Collette et al., *From MiFID I to MiFID II, what are the main
changes?*,   DELOITTE   (May   2014),   https://www2.deloitte.com/content/dam/Deloitte/
lu/Documents/financial-services/IM/mifidii-changes.pdf   [https://perma.cc/2W6Z-AZL8]
(archived Mar. 1, 2017).
186.   *See* ESMA, *supra* note 181; Collette et al., *supra* note 185.

without human intervention.[187] The Delegated Regulation clarified the "high message intraday rates" stipulation of the MiFID II definition to include the submission on average of: (1) at least two messages per second per any single financial instrument traded on a trading venue; or (2) at least four messages per second for all financial instruments traded on a trading venue.[188] Under MiFID II, HFT firms must notify regulators that they are engaging in HFT and on which trading venue(s) they are trading.

The MiFID II technical standards stipulate a variety of requirements pertinent to HFT, flash crash consequences, and transparency concerns. For example, the standards specifically govern HFT by imposing a strict set of organizational requirements on investment firms and trading venues.[189] In order to increase competition, the standards also prohibit discriminatory access to central counterparties (CCPs), trading venues, and benchmarks. The standards introduce a trading obligation for shares and certain derivatives to be traded only on regulated platforms, limiting over-the-counter activity. More broadly, they institute tests to determine whether a non-financial firm's speculative investment activities are so great that it should be subject to MiFID II. The technical standards seek to promote transparency surrounding HFT, mandating disaggregated data from trading venues, liquidity assessments for non-equity instruments, volume cap devices and thresholds for pre- and post-trade transparency regimes, and disclosure to strengthen the best execution regime, among other things.[190]

2. Reactions to MiFID II

One of the primary criticisms of MiFID II involves the speed of its implementation timeline. While the process was initiated in 2014, the actual implementation date within EU member states, January 3, 2018, is subject to several choke points for delay. Given the growth of HFT, time is arguably of the essence. As a product of the slower pace, however, trading venues and regulators have more time to engage in active dialogue and to guarantee fair representation among those

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187. KINDERMAN ET AL., ALGO AND HIGH FREQUENCY TRADING UNDER MiFID2 – A FEW MORE PIECES IN THE PUZZLE, SIMMONS & SIMMONS ELEXICA (2017), http://www.elexica.com/en/legal-topics/asset-management/25-algo-and-high-frequency-trading-under-mifid2 [https://perma.cc/HU3X-2QU3] (archived Mar. 2, 2017).
188. *Id.*
189. ESMA, *supra* note 181.
190. *Id.*; *see generally* ESMA, GUIDELINES: TRANSACTION REPORTING, ORDER RECORD KEEPING AND CLOCK SYNCHRONISATION UNDER MiFID II (Oct. 10, 2016), https://www.esma.europa.eu/sites/default/files/library/2016-1452_guidelines_mifid_ii_transaction_reporting.pdf [https://perma.cc/GGS5-RPQM] (archived Mar. 2, 2017) (providing guidance on reporting requirements under MiFID II).

most immediately affected by MiFID II. The Electronic Debt Markets Association Europe (EDMA Europe) is a lobby group composed of fixed fixed-income trading venues seeking such representation, looking to ensure open access, fair electronic trading protocols, and equivalent regulatory treatment of all electronic trading platforms.[191]

Critics also question whether MiFID II will achieve its desired transparency without dire cost. Recall from Part III.B.2 that because HFT firms can quickly enter or exit the market, they have less of a need to understand the long-term behavior of securities. More traditional traders who rely on research and experience for their competitive advantage suffer diminished marginal returns, and investment in information is no longer practical from a business standpoint. MiFID II might contribute to this widening gap between HFT and more traditional trading.

Under the new regulations, "fund managers cannot receive free investment research from a broker unless it falls within narrow exceptions."[192] Equity managers generally must pay for most of their research anyway, and HFT traders do not desperately need the information in the first place. However, this restriction will more seriously affect bond managers in the European Union, as under MiFID II they will have to pay brokers both the bid/offer spread and additional specific research costs.[193] Because this regulation is specific to the European Union, EU bond managers are at an even greater competitive disadvantage compared with managers in North America and Asia. Furthermore, these regulations will impose considerable financial, personnel, and information systems technology costs on HFT and non-HFT firms alike.

Moreover, critics are concerned about the consistency of MiFID II application across EU member states. Although the Delegated Regulation and the technical standards will apply directly across the European Union to all MiFID investment firms on a harmonized basis, MiFID II (a directive) will need EU member states to implement it into their own national regulatory schemes for any of it to be effective. While stipulated that by the end of 2016 all EU member states would be on a "level playing field," in some sense these rules form a baseline or minimum for financial regulation, as several

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191. *See generally* EDMA EUROPE: LEADING TRADING VENUES ESTABLISH ELECTRONIC DEBT MARKETS ASSOCIATION (Oct. 13, 2016), http://www.edmae.org/edma/ [https://perma.cc/WDW2-46PQ] (archived Oct. 8, 2017).

192. Daniel Flynn, *Artemis' Foster: MiFID II research rules will 'disadvantage' European bond managers,* INV. WEEK (Feb. 17, 2017), http://www.investmentweek.co.uk/investment-week/news/3004836/artemis-foster-mifid-ii-research-rules-will-disadvantage-european-bond-managers [https://perma.cc/9WMB-73VV] (archived Mar. 2, 2017).

193. *See id.*

EU countries already have regulations in place that go beyond MiFID II.[194]

As algorithmic trading and HFT firms face enhanced scrutiny by EU regulators, some predict that EU member states will apply additional national regulations.[195] Particular to HFT reporting requirements, whether firms engaging in algorithmic trading or HFT will be required to disclose commercially sensitive details, most notably source codes, may become a question of how individual EU member states implement MiFID II into their national legal regimes.[196]

V.   POLICY CONCLUSION: HOW *SHOULD* REGULATORS CONTROL HFT?

Because US and EU efforts to define and regulate HFT activity have come in the aftermath of, among other significant events, the 2008 Financial Crisis, the 2010 Flash Crash, and the 2016 Brexit vote, it is too soon to predict how well they will be received, let alone how successful they will prove long-term. At present, US financial regulatory authorities could learn from the example of ESMA and the European Commission. Much as US securities regulation generally aims to slow down market activity to prevent speculative bubbles, MiFID II will force the trading venues on which HFT takes place to slow down the flow of orders and reduce trading activity. This should protect investors against flash crashes by highlighting HFT's liquidity and trade volume issues.

At present, US and EU regulators' efforts differ primarily in scope. Through Reg SCI and Reg AT, US regulators have focused on the securities market technology infrastructure surrounding HFT, intervening at the operational level. The SEC designed Reg SCI to create a framework of periodic tests and checks by which market participants could better prepare for and overcome system disruptions, from short term flash crashes to longer term crises like the 2008 Financial Crisis. While Reg AT might more specifically target HFT, it, too, seeks change at a relatively high level, introducing more stringent registration requirements for new traders.

On the other hand, EU regulators have taken a much more intensive approach. Compared with the MiFID and MiFIR regulations, Reg SCI and Reg AT only scrape the surface by instituting measures primarily aimed at transparency. While MiFID

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194.   *See* Collette et al., *supra* note 185.
195.   *See, e.g.,* KINDERMAN ET AL., *supra* note 187 (discussing Germany's taking the lead on HFT regulation and France's imposition of requirements for firms or individuals engaging in algorithmic trading).
196.   *See id.* (discussing uncertainty as to how commercially sensitive details will be disclosed).

II also requires transparency, it dives deeper by requiring traders to limit activity in certain financial instruments to particular regulated platforms and by setting strict organizational requirements on trading firms and venues.

EU regulations regarding algorithmic source codes, too, are much more comprehensive than US regulations. While EU regulators require traders to submit source codes, US regulators have received pushback against similar requirements on intellectual property grounds, as businesses in other sectors fear further government efforts to make more algorithms public. Thus, the success of a source code-related regulation in the style of the European Union's intensive effort is questionable.

In light of such resistance, the best option for US regulators may be a "transparency within reason" approach. This would require FINRA registration of firms engaging in HFT, much like the Delegated Regulation requires for MiFID II firms. Such an approach would also require subpoenas to access source code like those Reg AT contemplates. Requiring subpoenas would protect intellectual property as much as possible and avoid the potential EU individual member state implementation problem regarding the disclosure of commercially sensitive details.

Implementation itself is also a cross-border concern. Given the amount of interaction between US and EU financial markets, one could argue that their regulations should be harmonized, if not made identical. Looking at US and EU regulations as two separate financial regimes, US regulators can again learn from EU regulators as they attempt to implement MiFID II to all EU member states.

While US states are more closely linked in government, commerce, and culture than EU member states, US securities exchanges, by virtue of trade volume and sheer number, can serve as a proxy for EU member states in a discussion of how to effectively implement one universal regulatory scheme. Politically, financial regulation reform is arguably one of the most hotly contested issues of the new US presidency. Given the prompt changes in the international cooperative structure since the January 2017 US presidential inauguration, coordination between the United States and the European Union in terms of financial regulation may turn out to be more difficult than recently anticipated.

While the case for international coordination is fairly strong, the discrepancies between US and EU regulations as they stand may provide incentive for traders to flock to US markets that, by comparison, face lighter regulation. With fewer traders in their markets, EU traders may face not only higher trading costs and lower efficiency, but also lower costs for the markets at large. As such, US regulators must tread carefully in pursuing new avenues for regulating HFT. They should allow the European Union to serve as a testing ground for such an all-encompassing, far-reaching regulation

as MiFID II. However, they must consider the increasing influence of HFT activity and how it is reshaping the securities landscape, both intra- and internationally.

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