

HIGH FREQUENCY LITIGATION: SEC RESPONSES TO HIGH FREQUENCY TRADING AS A CASE STUDY IN MISPLACED REGULATORY PRIORITIES

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**HIGH FREQUENCY LITIGATION: SEC RESPONSES TO HIGH FREQUENCY
TRADING AS A CASE STUDY IN MISPLACED REGULATORY PRIORITIES ^{di}**Nathaniel E. Sokol ^{a1}

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In 1975, Congress amended the Securities and Exchange Act of 1934, calling for the establishment of a National Market System (“NMS”). The NMS rests on the philosophy that fostering competition between private actors through smart regulation can produce stronger markets and greater innovation than dictatorial mandates and aggressive enforcement.

Advances toward this goal have generally arrived only in response to major crises of market confidence or jumps in market technology that critically distort the competitive horizon. Regulators often over-prioritize enforcement against individual bad actors to rein in excesses which they are unequipped to understand or deter.

This Note employs High Frequency Trading (“HFT”) as a case study of this misplaced regulatory priority. It examines the rise of HFT, the economics behind its profitability, the controversies it has spawned and the reactions it has elicited from the SEC and its agency peers.

Next, this Note highlights how relevant enforcement actions brought by the SEC have only peripherally related to the high frequency nature of the target firms or trading strategies, and have failed to address any of the broader concerns raised by market participants regarding HFT’s impact. The Note evaluates many of the alternative regulation-based levers the SEC has available, and suggests changes in both the culture and operation of the agency.

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*405 I. INTRODUCTION

The Securities and Exchange Commission (“SEC” or the “Commission”) has contributed to the evolution of equity markets over the last four decades in large, jolting steps. The overarching goal behind those steps has been the construction of what is known as the National Market System (“NMS”). Envisioned as an open, democratic, securities market, the NMS rests on the philosophy that fostering healthy competition between private actors through smart regulation can produce stronger markets and more innovation than dictatorial mandates and aggressive enforcement action.

Major regulatory advances toward this goal have generally arrived only in response to crises of market confidence or rapid leaps in market technology that critically distort the competitive horizon. Regulators too often forget or ignore the philosophy underlying the NMS vision. Instead, they over-prioritize enforcement against individual bad actors to rein in excesses, which they are unequipped to understand or deter.

High frequency trading (“HFT”) and related advances in market technology have produced the most recent crisis in market confidence. Surprisingly ill-defined, the term HFT is commonly used to describe a body of related trading strategies that rely on high-speed hardware, and computer-driven, algorithmic trading. This Note offers no normative discussion of HFT and takes no position on its net impact on market health. Rather, it examines HFT's growth to illustrate the shortcomings of the SEC's regulatory and enforcement priorities in its efforts to advance the NMS.

This Note begins by describing the history of the NMS and laying out examples of catalysts for past regulatory advances led by the SEC. The second section explains HFT's general market impact and the resulting controversy. It also works through a more detailed definition of HFT and provides a high level view of the economics behind its operation, as well as trends in industry composition and profitability.

The third section reviews the HFT-related enforcement actions brought by the SEC and its regulatory cousin, the Commodity Futures Trading Commission (“CFTC”), to explain why both have proven ineffective in response to these market developments. Specifically, the Note highlights how the cases only peripherally relate to the high frequency nature of the firms or trading strategies involved and fail to even

touch upon any of the broader concerns *406 that market participants raise regarding HFT's effect on market health.

The fourth section acknowledges the Commission's responses to the crisis and the improvements it has made in its technological toolkit and approach to regulating market structure. This section also identifies the likely shortcomings in these efforts, underscoring the Commission's need to shift away from a regulatory crisis response strategy.

The Note concludes by surveying some of the untaken options available to the Commission in response to the HFT crisis. It highlights those that can form the basis for a regulatory template prioritizing constant study and enhancement of market design and deemphasizing the myopic pursuit and punishment of individual "bad actors." The SEC has better technology, more research, and better resources than ever before. It should leverage these tools to sponsor increased access to market data for private researchers and innovators, establish more effective incentives for market participants to foster healthy trade flow, and channel private competition to encourage more productive investment.

II. NMS

A. History and Purpose

Every year, the SEC issues an annual report surveying its finances, its enforcement record, and its major regulatory efforts from the trailing twelve months. Its last several reports started with two sections titled "Mission, Vision, and Values" and "History and Purpose."¹ The Commission acknowledges that it was founded as a kind of Congressional crisis-management effort in response to the great Depression by the passage of the Securities Act of 1933 and the Securities Exchange Act of 1934.² Those laws embraced Congress's basic goals of ensuring that public companies would "tell the truth about their businesses [and] the securities they [were] selling" and that "brokers, dealers[,] and exchanges" would "treat investors fairly and honestly."³

**407 B. "Technology is More Powerful than Laws"*

The SEC's purpose evolved a few decades later with the introduction of the concept of the NMS. In 1975, Congress adopted significant amendments to the Securities and Exchange Act of 1934, including the addition of Section 11A, which contains an explicit statutory commitment to the establishment of a "national market system."⁴ Congress expressed an expanded list of fundamental goals in chartering this system, including:

1. The economically efficient execution of transactions;
2. Fair competition among broker-dealers, among exchanges, and between exchanges and other markets;
3. The ready availability of quotation and transaction information to broker dealers and investors;
4. The ability of broker-dealers to execute orders in the best market; and
5. The opportunity, consistent with the other goals, for investors to execute orders without the participation of a dealer.⁵

In the view of the SEC, chief among these goals was the promotion of market competition.⁶ Eugene Rotberg, then SEC *408 Associate Director for Regulation, later recalled that the SEC's staff members (in the early 1960s) adhered to a straightforward theory: "The only way to regulate an industry as strong and effective and with so many bright people as the securities industry was to let competition work, as distinguished from regulation."⁷

This philosophy recognized two significant underlying truths. First, the SEC and other agencies tasked with market regulation (CFTC, Federal Energy Regulatory Commission, etc.) will always be substantially outgunned and outmanned by the private industries they monitor. Second, there will always be some percentage of market participants willing to cheat and steal, no matter how many new rules the regulators propagate. Irving Pollack, an SEC Commissioner who served during the implementation of NMS, noted prudently that "[a]s a bureaucrat, you're much better off if you can cause events to evolve without being dictatorial."⁸ Smart regulation that harnesses private competition to drive innovation and self-governance is the only hope for achieving the NMS vision.

The rise of electronic trading in the 1990s illustrated another fact that now seems self-evident: "When it comes to unleashing the forces of competition, technology is more powerful than laws."⁹ Like the rest of the world, securities markets have been transformed through technological development over the last few decades, shifting trading off the exchange floors into bits and bytes flying via microwave transmission between dozens of different trading venues.

C. Litigious Litigators

Too often, however, the SEC and other regulators have centered their attention on enforcement action, rather than on *409 questions of intelligent regulation and market design. Too quickly regulators had forgotten the words of Pollack and Rotberg and attempted to dictate their desired behavior through investigations of and penalties against individual "bad actors." Prioritizing enforcement has squandered the greater opportunity for regulators to leverage evolving technology and enhanced research to optimize market design.

It must be acknowledged that the SEC regularly seeks comment on new technologies and market developments. It published a Concept Release in 1997 soliciting comments on alternative responses to recent "technological advances and ... corresponding growth of alternative trading systems and cross-border trading opportunities."¹⁰ The SEC's 2010 Concept Release similarly requested market input on a wide swathe of issues related to market structure, market fragmentation, and high frequency trading.¹¹

Over the last several years, annual growth in agency resources allocated to market structure analysis and economic research has been substantial.¹² In spite of this, those divisions remain minor fractions of the SEC's operations. As a percent of reported total net operational budget, the Trading and Markets Division grew from 4.8% in 2009 to 5.5% in 2014, while the Economic Risk Analysis Division grew from 1.5% to 3%. In contrast, the Enforcement Division shifted marginally from 34% to 33.8% in the same time period.

**410 D. Glacial Evolution*

Budget allocations and concept releases notwithstanding, actual regulatory evolution still occurs at a glacial pace. Moreover, many of the significant regulatory changes over the past 40 years only gained critical

support following major crises in market confidence or dramatic advances in technology that critically warped market operation. The 1997 Concept Release and subsequent Regulation ATS,¹³ for example, only arrived after the Commission calculated that alternative trading systems (ATSs) had grown to process “more than twenty percent of the orders in securities listed on the NASDAQ.”¹⁴ Even the initial idea behind the NMS itself arose out of what was known as the “Back Room Crisis” in 1968 and 1969.

Trading volume in shares increased exponentially at a time when the mechanism for settling or clearing trades still required the physical transfer of certificates from one place to another In the late ‘60s, the cumbersome physical process [was breaking] down and ... [u]p to 40% of the trades [were] fail[ing].¹⁵

Quote interval rules tell a similar story of SEC crisis response. For over two hundred years the markets quoted stocks at one-eighth of-a-dollar intervals, following a convention established by the use of Spanish pieces of 8.¹⁶ Although antiquated and highly inconvenient, the SEC did not act to alter the convention until it became the center of a controversy in the mid-1990’s known as the Quote-Rigging scandal.¹⁷ In a now famous paper,¹⁸ William Christie and Paul Schultze offered evidence that NASDAQ market *411 makers consistently avoided odd-eighth quotes in 70 of the 100 most heavily traded stocks,¹⁹ while NYSE and AMEX stocks “consistently use [d] the full spectrum of eighths.”²⁰ As a result, spreads were usually some multiple of \$0.25, making them wider than spreads on the national exchanges. From this, Christie and Schultze concluded that NASDAQ dealers implicitly colluded to keep spreads wide to pad their profits.

The SEC applied its crisis response playbook again, with two changes in short-selling restrictions made in quick succession. In 2007, in part at the behest of increasingly influential HFT funds and financial tech leaders,²¹ the SEC removed the nearly 80-yearold uptick rule,²² which required stocks to record a tick upward in price before new short-sale orders could be placed.²³ With this change, the SEC granted high frequency traders greater flexibility and speed when jumping in and out of positions. The uptick rule was subsequently reinstated following the market crash in 2008 and the political storm generated by “vulture” short sellers allegedly exacerbating equity declines.²⁴ In 2010, the SEC enacted Rule 201, which imposes restrictions on short selling only when a stock “has triggered a circuit breaker by experiencing a price decline of at least 10 percent in one day.”²⁵

III. THE HFT PROBLEM

A. *The Most Recent Crisis*

HFT has catalyzed the most recent crisis of market confidence. Its rise to market dominance generated controversy in both the financial and popular press, and the SEC responded with its usual *412 playbook of insufficient regulatory efforts and an excessive rush to litigate. This story provides an opportunity to examine the shortcomings in SEC priorities, and highlights some options for structural and cultural changes. First, it is important to establish the magnitude of the impact that HFT has had on market structure and provide a brief impression of the debate over its costs and benefits.

HFT became the hot topic a few years ago when popular financial writers such as Michael Lewis and Scott Patterson were quoted alleging that the securities markets are “rigged,” and that the exchanges have collaborated with HFTs to swindle both institutional and retail investors alike.²⁶ Lewis, author of *Liar's Poker* and *The Big Short*, released his book *Flash Boys* on March 31, 2014. It tells the story of an upstart, “fair” trading venue named IEX. According to Lewis, the legacy brokers and banks, enslaved by the trade

volume offered by big HFT customers, had actively tailored their products to assist the ultra-fast traders in skimming profits from traditional investors. The numbers and inflammatory anecdotes in such stories easily captured the attention of the press, the public, and the regulators.

First are the dramatic statistics describing changes in “average” trader behavior. “At the end of World War II, the average holding period for a stock was four years. By 2000, it was eight months. By 2008, it was two months. And by 2011 it was twenty-two seconds”²⁷ “A decade ago, ten orders might be cancelled for every one executed. Today, that order cancellation ratio can be closer to 60.”²⁸

Second is the relative magnitude of HFT's role in U.S. equity markets. While estimates have varied, it is the general consensus that HFT has accounted for over 50% of total U.S. equity volume since 2008.²⁹ Moreover, HFT ascendance in U.S. equity markets *413 entails more than just its percent of trade volume. These “firms largely have replaced more traditional types of liquidity providers in the equity markets, such as exchange specialists on manual trading floors and Over the Counter (“OTC”) market makers that trade directly with customers.”³⁰

Finally, perhaps most discussed, is the incredible increase in speed at which trading occurs, and the enormous volume of money spent to achieve it. “In 2010, Spread Networks completed construction of a new high-speed fiber optic cable connecting financial markets in New York and Chicago ... [costing] \$300 million” to reduce the “[r]ound-trip communication time ... from 16 milliseconds to 13 milliseconds. Microwave technology has further reduced round-trip transmission time ... to 8.5 [milliseconds].”³¹ Most recently, military grade laser arrays have reduced data transmission to below 5 milliseconds.³²

*414 Academics and industry experts have engaged in a heated debate over the effect on market health resulting from the growth of HFT and related phenomena such as dark liquidity and market fragmentation.³³ The SEC staff published a white paper on March 18, 2014, the second part of a series reviewing “economic literature on equity market structure.” In it, the staff provides a survey of the recent empirical research on the impact of these market structure changes.³⁴ Some studies indicate that HFTs “facilitate price efficiency” by trading in the direction of permanent price changes.³⁵ Others suggest that HFT trading “improves traditional market quality measures--decreasing spreads, increasing displayed depth in the limit order book, and lowering short-term volatility.”³⁶ Still others find evidence of rampant “quote-stuffing,” which involves submitting and cancelling a large number of orders to *415 generate artificial congestion, and conclude that the speed race drives socially wasteful investment.³⁷ Regardless of whether HFT increases price efficiency and market liquidity, or produces toxic price sniping and market manipulation, there can be no denying that regulators face both a crisis of market confidence and an evolution of market technology that has left them far behind.

B. The Market Structure Evolution Behind HFT

1. HFT: What Is It?

To understand the impact and effectiveness of various responses from the SEC and its peer regulators, it is first necessary to establish a definition of HFT, as well as an explanation of the economics behind it, and the details of some of the more controversial HFT strategies.

a. Who Are They?

Belying the size and importance of its position in the markets, HFT remains imperfectly defined.³⁸ At a high level, the term encompasses a body of related trading strategies run by companies that variously categorize themselves as hedge funds, market makers, and financial technology firms, all of which rely on high speed hardware and computer-driven, algorithmic trading. This remains too broad a definition to be helpful, and academic research and industry practice provide a few other descriptive metrics by which to define and categorize HFTs.

Originally set out by the SEC in a 2010 concept release, the list below provides five characteristics which identify HFT-like behavior:

***416** (1) the use of extraordinarily high-speed and sophisticated computer programs for generating, routing, and executing orders; (2) use of co-location services and individual data feeds offered by exchanges and others to minimize network and other types of latencies; (3) very short timeframes for establishing and liquidating positions; (4) the submission of numerous orders that are cancelled shortly after submission; and (5) ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions over-night).³⁹

Still, not all HFTs present the same mix of these features, and some researchers have, therefore, differentiated among HFTs by trading strategy. These include “(1) acting as an informal or formal market maker, (2) high-frequency relative-value trading, and (3) directional trading on news releases, order flow, or other high-frequency signals.”⁴⁰ Alternatively, others have relied on the broader categories of “passive” and “aggressive” HFTs, which roughly map to strategy 1 and the aggregation of strategies 2 and 3, respectively.⁴¹ As the SEC focused on the passive versus aggressive ***417** distinction in its HFT Literature Review published in 2014, this Note uses those terms to frame the discussion of HFT behavior, below.

b. How Do They Profit

While aggressive and passive HFTs may have goals and trading strategies that differ significantly, their growth and evolution stem from two basic concepts: Maker/Taker rebates, and latency arbitrage.⁴²

Maker/Taker Rebates

Maker/Taker rebates have remained near the heart of the debate over HFT and equity market structure for the last two decades. Electronic Crossing Networks (“ECNs”) entered the market-making field in the 1990's competing against exchanges that not only offered substantial organic liquidity, but promised trade support even in turbulent times via the specialist system.⁴³ In order to draw liquidity onto their networks, ECNs introduced the maker/taker rebate system,⁴⁴ by which they offer partial refunds to liquidity-providing trades, and charge full fees to liquidity-consuming trades.⁴⁵ While such refunds generally come in the form of 1 to 2 millicents,⁴⁶ HFT strategies developed to multiply that sum into substantial profits through extreme trade volume. The “maker/taker” system has remained a core tactical point for exchanges and market centers in their competition over market share.⁴⁷

Latency Arbitrage

A concept as old as markets, latency arbitrage in this context broadly encompasses all methods by which high frequency traders are able to reap a first mover advantage through technology or market structure. Generally, faster access to quote data and distant exchanges through the use of fiber optics and microwave towers have supercharged traditional arbitrage strategies and competition between market-makers to close trades.⁴⁸

The root of this issue for HFT, however, stems from the trade and quotation data reporting rules first established in 1975. Regulation NMS (“Reg NMS”) updated these requirements with Rules 601 and 603(a).⁴⁹ Under these updated rules, all members of a self-regulatory organization (“SRO”) (e.g., exchanges such as NYSE, NASDAQ, etc.) submit their pricing data to a securities information processor (“SIP”) under a reporting plan (e.g., UTP⁵⁰ *419 for NASDAQ) to distribute to the public, but are allowed to sell or distribute that same data to any other party, so long as the data leave the provider for all destinations simultaneously.⁵¹ The SIPs link the U.S. markets by continuously collecting all the protected quotes⁵² from every trading venue, calculating the National Best Bid and Offer (“NBBO”) and consolidating the information into single data feeds open to public.⁵³

While Rule 603(a) requires that all data depart an exchange simultaneously, it does “not require a market center to synchronize the delivery of its data to end-users with delivery of data by a network processor.”⁵⁴ This distinction birthed the practices of colocation and direct data feeds, the main enablers of HFT latency arbitrage.

Nearly 40% of all trades are priced based on a SIP-provided NBBO--comprising practically all retail volume (i.e., trades placed by individual investors) and most dark pool trades (i.e., trades placed by large corporate investors in and out of their treasury holdings in private anonymous exchanges).⁵⁵ The practice of colocation, however, allows HFT and institutional traders to place the computers that direct and route their trades in the same data centers that house an exchange's computer servers.⁵⁶ Under Reg *420 NMS, the exchanges charge monthly subscription fees of tens of thousands of dollars⁵⁷ to high frequency and institutional traders for this right to collocate, along with access to a direct data feed into the exchange servers. Traders with access to the faster data can construct a “synthetic” NBBO, and snipe out-of-date quotes being submitted in reliance on the slower SIP feeds.⁵⁸ Measurements of latency for the official NBBOs vary by study and appear to have fallen over time,⁵⁹ but it is clear that the advantage remains substantial across exchanges.⁶⁰ Traders who participate in the practice understand the value of every microsecond. For the past several years, the exchanges have mandated cord lengths within their colocation facilities so as to equalize latency among computers that are located different distances from the main server within their datacenters.⁶¹

2. HFT: The Controversy

The real controversies surrounding HFT involve the “aggressive” strategies. Most such techniques are currently perfectly legal, though may or may not do much to improve price discovery or market liquidity. Others fall within grey areas newly created by advancing technology. Many, however, are just supercharged versions of age-old market manipulation and fraud. All together, they can be roughly bucketed into two subgroups: information seeking and queue gaming. The former category includes strategies focused on

creating informational advantages, whether by acquiring the most up-to-date quote data, or by eliciting indicators of market supply and demand. The latter category involves gaming the specific rules of different automated quote-taking systems to ensure a trade either skips ahead, or gets cancelled at just the right time to maximize profit or minimize loss.

***421 a. Information Seeking**

Order Anticipation

Formally defined, “[o]rder anticipators are speculators who try to profit by trading before others trade. They make money when they correctly anticipate how other traders will affect prices or when they can extract option values from the orders that other traders offer to the market.”⁶²

Opportunistic traders have always employed information-seeking strategies in order to predict and trade in front of waves of supply or demand. In modern markets, orders are routed through a maze of steps that may involve sending pings of interest across brokers, dark pools, crossing networks, and exchanges,⁶³ all leaking information to those “parasitic traders” watching for indications of impending waves of trade.⁶⁴ Brokers and institutional traders today employ complex algorithms to break up and spread out their orders in attempts to flummox the pattern recognition software of HFT traders.⁶⁵

According to industry experts, however, even with these algorithms, “demand innovations” (forthcoming buy orders) are relatively easy to predict for HFTs based on trading patterns and external information.⁶⁶ Research indicates that HFTs generate substantial profits by supplementing this information with “exploratory trading” strategies that evaluate price-elasticity of supply. HFTs place thousands of small, money losing orders to identify when new buy or sell orders will produce particularly large price impacts and thus create the greatest profit opportunities for those who enter the market first.⁶⁷

***422 Direct Data Feeds**

As discussed above, direct data feeds are a major source of information for the HFTs' order anticipation strategies. While the practice of providing direct data feeds has been around for years⁶⁸ and its legality clearly established,⁶⁹ debate continues over the substance of the data provided. To offer an example, as of October 2014, NASDAQ provided three public data feeds in its role as the SIP operator under the UTP Plan: 1) UTP Quotation Data Feed (UQDF) provides best bid and offer (BBO) quotes from the UTP participants as well as the consolidated national best bid and offer (National BBO) quotes for securities listed on the NASDAQ Stock Market.

2) UTP Trade Data Feed (UTDF) provides trade data from the UTP participants for securities listed on the NASDAQ Stock Market.

3) OTC Montage Data Feed (OMDF) provides data for over-the-counter brokers that quote securities listed on the NASDAQ Stock Market via the Financial Industry Regulatory Authority (FINRA-formerly NASD) Alternative Display Facility (FINRA ADF).⁷⁰

In contrast, NASDAQ lists almost 50 total categories of U.S. and Global data feeds and reports for private sale, including its oldest and most comprehensive product, NASDAQ TotalView-ITCH, which “[p]rovides tick-by-tick details for all displayable orders in the NASDAQ execution system ... [and] Net Order Imbalance Indicator (NOII) data for the Nasdaq Opening and Closing Crosses.”⁷¹

*423 The private data feeds do more than just provide more detailed quote data than the SIPs. Some feeds “also supply information on revisions and cancellations.”⁷² Payment for order flow has also enabled exchanges to increase the granularity of trading source information, identifying whether counterparties are retail or institutional traders.⁷³ This information “enables high frequency traders to model the behavior of institutional and retail investors” and is one reason for why demand innovations are so easy to predict for HFTs.⁷⁴

b. Queue Gaming

Special Order Types

Special order types are the most common method of manipulating order queues, and have grown into one of the largest controversies in the HFT universe today.⁷⁵ While the media and even the SEC only seemed to catch wind of their significance in HFT strategies in the last few years, they have been a core point of competition between trading platforms for much longer. As of 2005, NYSE Arca (then Archipelago, an early leading electronic exchange), already offered 24 different order types, including reserve orders, discretionary orders, immediate or cancel orders, now orders, and pegged orders.⁷⁶ In 2009, an official at NYSE publicly explained the exchange's strategy of increasing rebates, upgrading technology to boost speed, and offering “new hidden order types” to woo algorithmic and high frequency traders.⁷⁷ While current lists of order types provided by the exchanges *424 appear to indicate comparable variety to Archipelago's offering a decade ago, a closer review of the descriptions reveal that multiple layers of conditional customizations and “modifiers”⁷⁸ attached to each order category present literally scores of order options that vary from market to market.⁷⁹

HFTs leading the speed race were always able to ensure they could receive market data and place trades faster than could their competitors. They continued to face trade execution uncertainty, however, due to the price/time priority⁸⁰ model followed generally by most exchanges.⁸¹ Custom order types promised two benefits: 1) new ways to reach the top of the order queue and ensure execution and 2) expanded tools to use as part of the order anticipation strategies discussed above.

While discussion of these order types and their possible strategic combination could fill hundreds of pages, a brief coverage of two of the more controversial order types will provide examples of how HFTs achieve their twin goals of queue manipulation and order anticipation.

“Hide and Light”⁸² orders are a class purportedly designed to satisfy the prohibition of “locked markets” set out in Reg NMS *425 Rule 610.⁸³ Exchanges initially dealt with this prohibition with price-sliding protocols.⁸⁴ A non-routable limit order placed at a price that “locks” an away market normally has its price slid to a non-locking price, and then is placed at the back of the queue of orders at the new price. Hide and Light orders that would otherwise lock an away-market are registered as undisplayed orders, thereby satisfying the restriction on locked displayed orders, until the locking order on the away market is cancelled

or filled. At that point, the undisplayed order becomes “lit,” or displayed, at a price that places it at the top of the queue.⁸⁵

HFT latency arbitrage, rebate scalping, or momentum ignition strategies benefit substantially from this class of order types, which enable traders to effectively sit on top of the order queue, without having to race to place and cancel thousands of orders with nominal price improvements to stay ahead of their competitors. Furthermore, when combined with other order modifiers such as “Post Only” or “Immediate or Cancel,” traders receive instant feedback about available liquidity on both sides of the order book through the exchange's treatment of their orders.

Intermarket Sweep Orders (“ISOs”), explicitly approved by Reg NMS,⁸⁶ were introduced to assist large firms needing to sweep through multiple levels of the order book immediately without waiting for an exchange to ensure compliance with the “Trade-Through” restriction under Rule 611.⁸⁷

While normal orders routed to a venue not displaying the best price would create a trade-through and force an exchange either to reject or to reroute an order, ISOs are executed without any requirement to check away market pricing or to apply trade-through protections. The stipulation to using ISO orders is that the broker-dealer is required to access all Protected Quotations across all *426 markets that are covered by the trade-through rule and to assume all liability for compliance with Rule 611.⁸⁸

HFTs are able to use ISO orders matched with “Immediate Or Cancel” options to outflank other traders in rapidly shifting markets. Because exchanges are required to confirm 611 compliance via the slow public SIP, non-ISO orders might be rejected or re-routed to chase “phantom” orders that no longer exist by the time they reach an away venue.⁸⁹ HFTs, on the other hand, can display data from their more rapid direct feeds to receive permission to place aggressively priced ISO orders that would otherwise lock the market.⁹⁰

Sub-penny Queue Jumping

Sub-penny trading is perhaps an even more widely derided practice than the use of custom order types. Rule 612 under Reg NMS⁹¹ prohibits sub-penny quoting by banning traders from accepting, ranking, or displaying orders or quotations in price increments smaller than a penny. Rule 612 does not prohibit sub-penny trading, however, which can legally occur, provided that it does not result from executions of visible quotations in sub-penny increments.⁹² This occurs in two ways:

First, Reg NMS exempts Alternative Trading Systems (ATSS) from pre-trade transparency as long as they execute less than 5% of the average aggregate daily volume in a particular stock. This implies that a broker may operate an ATS with no pre-trade transparency (a dark pool) where invisible quotations can be posted in sub-penny increments. Second, Rule 612 allows broker-dealers to internally *427 execute non-displayed orders (typically retail orders) provided that this is done in compliance with their duty of best execution and so that orders are filled at prices that are better than the NBBO.⁹³

Research indicates that a large percentage of sub-penny trading involves price-improvements of the absolute minimum increment (1/100th of a cent) and therefore likely represents traders sniping bid/ask spreads by inserting themselves between other parties.⁹⁴ It remains uncertain how much (if any) of this trading is

actually conducted by HFTs, rather than by Broker-Dealers matching trades through internalization on their proprietary platforms.⁹⁵

3. Clearly Fraudulent HFT Strategies

Several variations on the HFT strategies discussed above involve techniques that are currently, unequivocally illegal. The SEC has explicitly found the strategies listed below⁹⁶ to violate either or both § 9(a)(2) of the Exchange Act of 1934⁹⁷ and § 10(b) and Rule 10b-5 thereunder.⁹⁸

Momentum Ignition

While traditional order anticipation strategies are as old as the markets and generally legal,⁹⁹ other trading patterns have been *428 identified that cross the line into market manipulation.¹⁰⁰ Momentum ignition strategies, rather than seeking to discern “organic” trade behavior by other market participants, aim at artificially stimulating trade reactions that create profit opportunities for the HFTs. Low-tech versions of these strategies include basic “pump-and-dump”¹⁰¹ maneuvers that continue to be witnessed regularly in microcap stocks today.¹⁰²

By comparison, in the high frequency world, HFTs manipulate the coded behaviors of institutional trading algorithms instead of the frailties of human investors. A common category of institutional algorithms is designed to break up large block trades into small pieces at a fixed percent of the presiding market volume over the course of several hours to reduce price impact of the trades. Predatory HFTs open initial positions, then submit massive order volume designed to create minimal price impact, but which triggers those volume-based algorithms. This strategy artificially draws out institutional block trades, creating a large temporary price impact and profit for the HFT's initial position.¹⁰³

Alternatively, HFTs can create a temporary price collapse by triggering standing stop loss orders or momentum trading algorithms with rapid submission of large blocks of cancellable orders.¹⁰⁴ More complex strategies involve manipulating the *429 coding of algorithms set to conduct cross-market arbitrage. By accounting for the latency between the futures markets in Chicago and the stock markets in New York,¹⁰⁵ an HFT can produce artificial momentum in futures and index products in Chicago and safely move in and out of correlated stocks in New York as it knows ahead of time which direction the market is going to swing.¹⁰⁶

Spoofing/Layering

Spoofing, and layering, a common subset of that strategy, is a tactic designed to manipulate other market participants to trade based on misleading “non-bona fide” orders.¹⁰⁷ Unlike general momentum ignition, layering often involves submitting multiple orders on one side of a book “at various price levels at or away from the National Best Bid and Offer (NBBO) to create the appearance of a change in the levels of supply and demand,” driving others to join or improve the NBBO.¹⁰⁸ The spoofer then cancels its original orders and completes a trade on the opposite side of the market at the temporarily, artificially improved price.¹⁰⁹

Price fade,¹¹⁰ an oft-complained about phenomenon in modern markets, has been attributed in part to spoofing and layering *430 practices. HFTs engaging in layering by filling out one side of an order book away from the NBBO can quickly cancel these orders, which were never intended for completion anyway, if a trader begins to execute against them.¹¹¹ Venue fade is a similar concept in which trading at the NBBO in one venue is often followed by disappearing liquidity lower down in the book on other venues.¹¹²

*Quote Stuffing/Capacity Saturation--Latency on Demand*¹¹³

HFTs can win the latency arbitrage game in other ways than colocation, access to microwave towers, and queue gaming. HFTs can also flex their technical muscle to create extra latency for other market participants through a practice known as quote stuffing. By entering a sufficient number of quotes on away markets, HFTs can increase the latency between the SIP and proprietary data feeds and slow down the inter-venue routing of the quotes of other market participants.¹¹⁴ The practice has been found to be “pervasive, with several hundred events occurring each trading day ... impact[ing] over 74% of US listed equities.”¹¹⁵ A study covering data between 2008 and 2012 demonstrates that even while equity trading sunk in total throughout the period, quote volume skyrocketed, filling all new capacity as fast as it was brought online.¹¹⁶ Importantly, quote stuffing need not involve bidding on the security an HFT wants to purchase. Activity spread across all the stocks that NYSE reports to the Consolidated Quotation System (“CQS” is the counterpart to NASDAQ's UTP, and *431 handles quote data from NYSE, and several other exchanges),¹¹⁷ for example, materially slowed SIP reports from that exchange.¹¹⁸

4. HFT Industry Status Today

Actual HFT profitability remains a matter of great debate, discussion, and scandal. Media attention is frequently caught by statements like those pulled from Virtu Financial's S-1 filing in 2014, indicating that it had only lost money one day out of four years of trading.¹¹⁹ As Virtu was one of the first HFTs to file for a public offering, there is little detailed documentation on actual profitability across the industry, and the evidence remains mixed.¹²⁰ While Virtu has demonstrated steady increases in revenue and profit over the last few years,¹²¹ its competitor, Getco, reported substantial profit volatility in filings it released in *432 preparation for its acquisition of Knight Capital in 2012.¹²² KCG, the entity that emerged from the Getco-Knight combination, reported a nearly 40% Y/Y increase in pre-tax earnings from its Market Making business in 2014. The prior year includes only 6 months of merged results,¹²³ however, and parsed results imply the gains may have resulted entirely from aggregating the two businesses, while second half market making revenues and pre-tax earnings fell 14% Y/Y and 63.8% Y/Y respectively. Market making revenue slid another 1.8% Y/Y in 2015.¹²⁴

Industry-wide profit estimates likewise vary substantially, though generally indicate that the heyday of HFT equity funds occurred several years ago. Larry Tabb, head of market data shop Tabb Research, calculated that 2013 HFT industry revenue was “1.3b down from 7b in 2009.”¹²⁵ Rosenblatt Securities alternatively reported that industry-wide HFT revenue fell from around \$5 billion in 2009 to \$1 billion in 2013, while average profit per share [traded] roughly halved.¹²⁶ Some theoretical studies indicate evidence of revenue persistence, but these only account for individual market segments over limited periods of time.¹²⁷

*433 While comparing rumors on the profitability of different HFTs may be more entertaining to media sharks and Internet commentators,¹²⁸ matching these industry trends with some of the economics believed to underlie HFT profits will prove vital in a discussion of the effectiveness of different regulatory strategies.

Speed

Theoretical analysis on the prevailing continuous limit order market model¹²⁹ predict that speed should be a winner-takes-all arms race with a prize that is a “mechanical constant” rather than an inefficiency that can be competed away.¹³⁰ Empirical work on data released by the CFTC has backed up this theory to a degree, finding that across all categories of HFT strategy, relative speed among competitors proves a statistically significant indicator of profit.¹³¹ This study also found that the effect was substantially more pronounced for Aggressive HFTs than Passive funds.¹³² This result dovetails with the description of Passive HFTs as market makers earning their profits from collecting spreads and rebates in the maker/taker system rather than information gathering or queue gaming strategies.

**434 Volatility*

There appears to be a common perception that low volatility in the markets was a contributing factor to reduced profits among HFTs in the years after the recession.¹³³ This belief follows the simple intuition that less trading implies that less volume exists which HFTs can intermediate. Empirical research highlights the difference between Passive and Aggressive funds on this front as well, however. The study on the CFTC data separated the impact of changing volume from changing volatility to determine that increased volatility benefits Aggressive HFTs and harms Passive HFTs. The authors of that paper reasoned that volatility offers Aggressive HFTs more opportunities for adverse selection of less informed market participants through their directional anticipation strategies.¹³⁴ Passive HFTs, on the other hand, do not rely on directional strategies and find themselves adversely selected more often in higher volatility environments.¹³⁵

Timescale of Profits

The CFTC study also highlights the difference in timescales on which Passive and Aggressive strategies lose or make money on average. Aggressive HFTs were found to lose money on short and long time horizons and earn money on a medium horizon,¹³⁶ whereas Passive funds made money over the shortest horizon and lost money on longer intervals.¹³⁷ The authors reasoned that Aggressive HFT funds lost money from the bid-ask spread and by paying fees for taking liquidity as a cost for their information seeking strategies in the short term, while profiting from directional *435 predictions and adverse selection over the medium term.¹³⁸ This matches the discussion of exploratory trading strategies above. In contrast, the authors found the “results consistent with the idea that Mixed and Passive HFTs earn the bid-ask spread in the short-run but are adversely selected on a longer time scale.”¹³⁹

Division by Category: Disappearance of the Mixed HFT

Two separate studies on data in the US and Canada indicate a clear and increasing bifurcation of the HFT categories. The Canadian study found a bimodal distribution in that market with predominantly Passive and Aggressive HFTs and a small number of funds that did not cluster near either pole.¹⁴⁰ The CFTC study

identified a decline in total HFT market volume between 2010 and 2012, mainly driven by the disappearance of the “Mixed” strategy category.¹⁴¹ Percent volume increased for Aggressive HFT and declined modestly for Passive HFT in the dataset over that time.¹⁴²

Concentration of Profits

These studies also presented complementary data on the bifurcation of trends in concentration of profit and volume between Aggressive and Passive HFTs. The CFTC data demonstrated that profits are highly skewed and are disproportionately collected by the top performing HFTs. On the other hand, the data indicated no trend in profit and volume Herfindahl indices for Aggressive funds over time, while both concentration indices climbed steadily for Passive funds between 2010 and 2012.¹⁴³ The Canadian data documented a substantial increase in “aggressiveness” among new HFT entrants in 2012 *436 relative to those in 2008, implying that a declining number of Passive funds were attempting to enter the market over that period.¹⁴⁴

Persistence of Profits

Persistence of profits may be the most important measurement in analyzing HFT performance. “Persistent profits over time suggest that something other than luck is driving a firm's performance[;] ... it may be ... human skill and experience, ... [or], it could be purely technological advantages.”¹⁴⁵ Most likely it is some combination of these factors and the existence of a constant “prize” for speed under the current market structure. The CFTC study found persistency of profits by studying the predictive value of lagged returns.¹⁴⁶ This was complemented by its finding of high concentration of profit and volume among HFTs and increasing concentration among Passive HFTs in particular.¹⁴⁷

Both studies found new entrants to be less profitable than incumbents, possibly due to those hypothesized differentials in skill, experience, and technological investment.¹⁴⁸ The CFTC data found new Aggressive entrants in particular to have a greater likelihood of exiting the market than incumbents.¹⁴⁹

Notably, the Canadian study found persistent profits over time as well, but identified a statistically significant impact on volume from increased competition.¹⁵⁰ Only early market entrants were able to expand the overall HFT revenue and volume pie, while successive increases in competition entailed stealing volume and revenue from each other.¹⁵¹

This highlights a very significant aspect of the HFT market. “[T]here appears to only be a certain portion of order flow with which HFT firms want to trade. [In the Canadian data], the threshold portion was between 40% and 50% of order flows.”¹⁵² While speed may be a winner-takes-all game, there intuitively must *437 be an absolute and exogenous cap to the amount of revenue available to HFTs, whether they are seeking to capture spreads or use information gathering strategies to predict short term price movements. HFTs can only continue to increase revenue through the organic growth of institutional and retail order flow, expansion to other asset classes and geographies, or the addition of traditional investment horizon strategies.

IV. RUSHING TO LITIGATE

The SEC & CFTC (along with the DOJ and its State peers), responded to the brewing controversy by rushing into a batch of enforcement actions. Examining the list of cases and investigations brought by both agencies

over the last several years highlights the short-term nature and unsuitability of an enforcement strategy in addressing the type of issues raised by the growth of HFT. First, most of these cases only peripherally relate to the high frequency nature of the firms or strategies involved. Second, they do not even touch upon the broader concerns that market participants raise in regard to the effect HFT has had on market health.

A. Recent Cases

Then newly-appointed SEC Chairperson Mary Jo White laid out her Commission priorities in early 2014, including a focus on potential misbehavior by HFTs, shortly after Michael Lewis published his book, Flash Boys.¹⁵³ “When high frequency traders cross the line and engage in fraud we will pursue them as we do with anyone who manipulates the markets.”¹⁵⁴ The SEC trumpeted its enforcement campaign more loudly in July of that year by announcing its investigation of 10 registered broker dealers as part of “an ongoing investigation into high-frequency trading strategies.”¹⁵⁵

A similar pattern has occurred at the CFTC over the past three years. Well prior to Flash Boys, Dodd-Frank introduced the *438 criminalization of “disruptive practices.”¹⁵⁶ Aside from an acceleration of civil cases brought for violations like spoofing in the futures markets, the CFTC has also prioritized coordination with DOJ investigations to “maximize deterrence of future misconduct.”¹⁵⁷ “According to the CFTC, approximately 93 percent of the major fraud cases it filed during the 2013 Fiscal Year included a parallel criminal proceeding.”¹⁵⁸

Finally, both the DOJ and its State counterparts have become increasingly vocal and willing to commit resources to fight securities fraud and market manipulation.¹⁵⁹ “In [an] April 2014 congressional testimony, Attorney General Eric Holder confirmed that the DOJ is investigating HFT ‘to determine whether it violates insider trading laws.’”¹⁶⁰ The US Attorney's Office established a Securities and Commodities Fraud Section that month in the Northern District of Illinois, a state which is home to “more than two-thirds of all US futures market registrants.”¹⁶¹

1. Spoofing

The CFTC kicked off its campaign against futures spoofers with a case against Bunge Global Markets in 2010¹⁶² for a typical *439 exploratory trading strategy designed to test market depth.¹⁶³ Though “‘spoofing’ (bidding or offering with the intent to cancel such bid or offer before execution) [would] be explicitly illegal under provisions of the Dodd-Frank Act ... effective ... July 16, 2011, the CFTC issued its order ... based on its existing authority under the Commodity Exchange Act.”¹⁶⁴ The CFTC's second spoofing case arrived in 2012 against Eric Moncada for manipulation of the wheat futures market.¹⁶⁵ Moncada, unlike Bunge, actually employed a layering strategy, placing large false orders near the NBBO to artificially juice the prices.¹⁶⁶

*440 The first case brought under the Dodd-Frank regulations barring disruptive trade practices came against Panther Energy Trading LLC and its owner Michael Coscia in 2013.¹⁶⁷ Like Moncada, Coscia applied a layering strategy to produce temporary price disruptions in the commodities futures markets.¹⁶⁸ The settlement announcement in July 2014¹⁶⁹ for the CFTC's civil suit was quickly followed by the opening of parallel criminal proceedings. A grand jury issued Michael Coscia the first federal indictment for alleged

violation of the anti-spoofing provisions added to the CEA by Dodd-Frank.¹⁷⁰ On November 3, 2015, Coscia became the first person convicted under those provisions when a jury found him guilty of six counts of spoofing and six counts of commodities fraud.¹⁷¹

***441 2. Layering**

The first securities layering censure came in 2010 from FINRA (Financial Industry Regulatory Authority),¹⁷² not the SEC, against Trillium Brokerage Services.¹⁷³ “Trillium, through nine proprietary traders, entered numerous layered, non-bona fide market moving orders to generate selling or buying interest in specific stocks. By entering the non-bona fide orders, often in substantial size relative to a stock's overall legitimate pending order volume, Trillium traders created a false appearance of buy-side or sell-side pressure.”¹⁷⁴

The SEC brought its first high speed layering case against Hold Brothers On-Line Investment Services,¹⁷⁵ charging violation of Sections 9(a)(2) of the Securities Exchange Act of 1934 for manipulation of security prices.¹⁷⁶ Hold Brothers also received censure from FINRA, NYSE Arca, Inc., The Nasdaq Stock Market LLC, NASDAQ OMX BX, Inc., and BATS Exchange, Inc., paying fines of \$3.4 million for manipulative trading activities, anti-money laundering (AML), and other violations.¹⁷⁷

In 2014 the SEC charged Visionary Trading LLC and Joseph Dondero under Section 9(a)(2) for “engag[ing] in a sophisticated, manipulative trading strategy, typically referred to as ‘layering’ or *442 ‘spoofing,’” but also added charges under 10(b) and Rule 10b-5 for misrepresentations and fraud.¹⁷⁸

Trillium and a more recent layering case brought by the SEC against Aleksandr Milrud¹⁷⁹ highlight the fact that the enforcement actions available to the regulators and SROs are not directly tied to HFT. Trillium may have actually employed human traders to place and cancel its false bids and offers, manually manipulating the automated responses of coded trading algorithms.¹⁸⁰ Similarly, Milrud “recruited lots of traders in China and Korea, ... [who] could move fast because ‘Milrud worked with a gaming software company to develop hot keys that allowed his traders to quickly place and cancel multiple orders via their computers with only a few strokes of their keyboards.’”¹⁸¹

3. Net Capital Requirements

The SEC brought its first enforcement action against an HFT, Latour Trading, LLC, in September of 2014.¹⁸² The Commission charged Latour with violation of its capital requirements as a registered broker dealer, as set out in Section 15(c)(3) of the Exchange Act and Rule 15c3-1 thereunder.¹⁸³ According to the *443 charge, Latour regularly miscalculated the risk of its positions when determining the amount of capital necessary to set aside. Similar to the layering cases, this charge related only indirectly to the high frequency nature of the strategies and trading involved.

4. Marking the Close

In October 2014, the SEC issued an order sanctioning Athena Capital Research under Section 10b of the Securities and Exchange Act of 1934 and Rule 10b-5 for a practice known as Marking the Close.¹⁸⁴ Similar

to layering, Athena's strategy employed massive, high frequency order volume, run by a program named "Gravy," to abuse the structure of Nasdaq's outstanding order settlement auction at the close of each trading day and produce artificial price dislocations.¹⁸⁵ "Although Athena was a relatively small firm, it[s] ... trading in the last two seconds accounted for 73% of the entire NASDAQ market volume, on average, for the stocks it traded during those two seconds."¹⁸⁶ Its methodology ensured that its orders were "at least partially filled more than 98 percent of the time."¹⁸⁷ Notably, Athena relied in *444 part on special order types known as imbalance-on-close orders to execute the strategy, gaming NASDAQ's own system.¹⁸⁸

5. Market Access Rule¹⁸⁹

Another peripheral strike against HFT market abuses stems from the 2010 Market Access rule, which established more robust risk monitoring and reporting requirements¹⁹⁰ on broker dealers who had been providing sophisticated customers such as HFTs¹⁹¹ with direct, unsupervised market access. The SEC justified the rule with concerns that high frequency and algorithmic trading increases the likelihood of "erroneous orders as a result of *445 computer malfunction or human error," "fail[ure] to comply with various regulatory requirements," and "breach[ing] of a credit or capital limit."¹⁹²

Two notable enforcement actions have been brought under the rule to-date. The first, against Knight Capital,¹⁹³ involved its infamous \$440 million dollar computer glitch in 2012.¹⁹⁴ Unsurprisingly, the SEC found numerous deficiencies in Knight's risk management and supervisory controls as well as its documentation of those controls, under several prongs of 15c-5.¹⁹⁵ The Order was "informative as it reflect[ed] the [wide] scope of activities the SEC view[ed] as falling within the parameters of the Rule,"¹⁹⁶ which stretched well beyond a narrowly targeted attack on sponsored access. The second action, taken against Wedbush Securities in 2014, involved a more direct violation of the Rule for "provid[ing] market access to overseas traders without pre-approval and without ensuring that they complied with U.S. law."¹⁹⁷

6. Special Order Types

Controversy aside, no enforcement actions have yet been brought by the SEC alleging improper functionality of a special order type. The SEC has studied the issue, however, since at least *446 2011, when well-known algo trader Haim Bodek¹⁹⁸ approached the Commission alleging that some order types were being used to provide HFTs unfair advantages over other investors.¹⁹⁹

In January 2015, the SEC closed the only two firm-specific order type investigations that have been publicized to-date.²⁰⁰ The first investigation of a BATS owned exchange was closed without action.²⁰¹ BATS settled the second, which targeted a legacy Direct Edge exchange,²⁰² without admitting or denying wrongdoing, but paying a \$14 million fine for charges of selectively disclosing information about its order types to certain HFTs only.²⁰³ Again, this charge had nothing to do with nature of the participants involved or their HFT capabilities.

7. Direct Data Feeds

Over the past 4 years the SEC has brought two enforcement actions against NYSE, both involving charges for improper provision of its colocation and direct data feed services. In 2012, in the first SEC financial

penalty against an exchange, the NYSE *447 settled charges for violation of Rule 603(a).²⁰⁴ According to the SEC Order,²⁰⁵ NYSE's data architecture sent its quote and trade data to its private data feeds-- Open Book Ultra and PDP Quotes--prior to sending it to the SIP.²⁰⁶ In 2014, the NYSE reached a second settlement²⁰⁷ for, among other things, charges of having provided colocation services under “individually negotiated [contracts] with private firms” which had “not [been] submitted for SEC approval” as required under § 19(b)(1) of the Exchange Act.²⁰⁸

Notably, the second charge appeared to be more of a political declaration by the SEC than a real attempt to fix a wrong. Not only could the Exchange easily bear the fine, but the problem had been solved years earlier, with the knowledge of the SEC, when “all co-location customers were re-located to a data center in Mahwah, New Jersey, and the co-location fees were standardized pursuant to a subsequent rule filing.”²⁰⁹ This settlement followed quickly on the heels of the release of Flash Boys and the subsequent public announcements by Andrew Ceresney and Chairperson White of the SEC's intentions to investigate HFT and market structure.²¹⁰

***448 B. No-Impact Litigation**

These cases highlight the failures of an enforcement-centric strategy in dealing with the HFT crisis. First, many of these cases only peripherally relate to the high frequency nature of the firms or strategies involved. The majority of layering and spoofing cases have been brought against manual traders, often ironically manipulating the predictable reactions of algorithmic trading strategies. Violation of net capital requirements can make any improper strategy more profitable, not just the high frequency ones.²¹¹ The order type and direct data feed violations are simply emblematic of aggressive traders throughout history trying to have an informational advantage over other market participants, and do not relate directly to high frequency technology. Finally the 15c3-5 cases actually reaffirm the point that improved reporting and procedural regulation can be the appropriate response to structural market gaps.

Second, these cases fail to address the broader concerns that market participants have raised in regards to the effect of HFT on market health. Those concerns, as briefly discussed above, include the arms race over speed, HFT's impact on price discovery, market instability, and liquidity flight during times of high volatility, price and venue fade, and general inequity among market participants.

At best, these cases only add cost to HFT operations by increasing the risk of violating capital or reporting requirements. We can all applaud the SEC and CFTC for rooting out market manipulators and spoofers, but it is not clear this campaign is actually targeting sophisticated HFT shops whose behavior has, to-date, been significantly more difficult to monitor and evaluate. Moreover, they do not alter the liquidity provision requirements of HFTs during a crisis or the revenue economics of latency arbitrage. The empirical research into HFT strategies even raises doubts about the impact of policing exchange disclosure of special order types and colocation contracts. HFTs will continue to flood the market with orders and cancellations and battle over queue position as long as exploratory trading strategies produce timely supply and demand information and the “mechanical prize” for winning the speed race outweighs the marginal cost of investing in new communications tech and trading software.

***449 V. REGULATORY RESPONSES**

More positively, the crisis has, as usual, catalyzed the SEC into some notable regulatory actions. Although these responses have arrived slowly, and only after the SEC's hand was forced following the 2010 Flash Crash, the Commission has taken significant steps in improving its market monitoring technology and beefing up the reporting requirements of market centers that fill its own proprietary data feed.

A. Data, Data, Data

Until recently, the SEC has mainly relied on a combination of three systems to acquire the trade data it used for market research and enforcement action. First is the electronic blue sheet (“EBS”) system, which the SEC has used for decades to request records from broker dealers.²¹² Historically, the EBS system was the only available data source that included trade records with customer identities. Second, the Commission can request equity cleared reports from the National Security Clearing Corporation, which receives them from all trading venues on a daily basis. These reports detail volume and number of trades by security name and CUSIP number. Neither the EBS system nor the equity cleared reports include data on orders or quotes. Finally, most SROs maintain their own audit trails with record requirements applicable to their members to track trade and order data.²¹³ The Commission does not have direct access to these audit trails and must request the data through the Intermarket Surveillance Group, often waiting for days or weeks for fulfillment.²¹⁴

***450 1. The Market Information Data Analytics System**

In its assessment of the 2010 Flash Crash, the Commission was forced to acknowledge the severe inadequacy of the surveillance tools it used to monitor and analyze the market.²¹⁵

[T]he events of May 6 clearly demonstrate[d] the importance of data in today's world of fully-automated trading strategies and systems. This is further complicated by the many sources of data that must be aggregated in order to form a complete picture of the markets upon which decisions to trade can be based. Varied data conventions, differing methods of communication, the sheer volume of quotes, orders, and trades produced each second, and even inherent time lags based on the laws of physics add yet more complexity.²¹⁶

Over the course of the next two years, the SEC sought proposals from private vendors to establish a system that would grant it “the same speed, ease, and reliability of data collection and analysis that is available to sophisticated market participants.”²¹⁷

Tradworx, an HFT and data and technology vendor involved in building the microwave towers between Chicago and New York,²¹⁸ won the bid and built MIDAS, the Market Information Data Analytics System.²¹⁹ MIDAS aggregates consolidated public feed data with private feed data from the 13 national exchanges, and funnels it through Tradeworx's proprietary, internal analytics package.²²⁰ MIDAS collects about 1 billion records each day and “captures all orders posted on the national exchanges, all modification and cancellation of those orders, all trade execution *451 of those orders, and all off-exchange executions.”²²¹ In addition to data on listed stocks and exchange-trade products, MIDAS also collects and processes data on equity options and futures contracts.²²² MIDAS cost the government roughly \$2.5 million in its first year of operation.²²³

2. The Consolidated Audit Trail

MIDAS, though an incredible leap forward from the use of EBSs and ECRs to monitor trade activity, still only puts the regulators, at best, on equal footing with private firms. Shortly after soliciting bids for MIDAS, the SEC initiated a substantially more ambitious plan.

In July 2012, the SEC “adopt[ed] Rule 613 under Regulation NMS requiring the national securities exchanges and [SROs] ... to submit an NMS plan ... to the SEC to create, implement, and maintain a consolidated audit trail (“CAT”).²²⁴ When complete, CAT “will allow for the prompt and accurate recording of material information about all orders in NMS securities, including the identity of customers, as these orders are generated and then routed throughout the U.S. markets until execution, cancellation, or modification.”²²⁵ “Where MIDAS collects vast quantities of public data, CAT will capture non-public data”²²⁶ as well.

B. Market Structure Research and Enforcement

In addition to improving its data feeds, the SEC has also begun to organize staff around divisions specifically focused on employing *452 the new data. The Commission opened an Office of Analytics and Research in 2012 within its Division of Trading and Markets and a Center for Risk and Quantitative Analytics in 2013 within its Division of Enforcement. It also established an external SEC Equity Market Structure Advisory Committee in early 2015.²²⁷ The Office of Analytics and Research has been tasked with analyzing market structure questions and sharing its findings and much of its data with the public through the www.sec.gov/marketstructurewebpage.

C. Shortcomings and Pitfalls

As usual, the SEC has taken some impressive actions to improve its regulatory strategy in response to this newest crisis. There are several notable shortcomings in its efforts, however, and its track record nearly guarantees suboptimal execution on its chosen strategies.

First, the most meaningful reforms are inevitably arriving at a glacial pace. Market fragmentation exploded immediately after implementation of Regulation NMS, “with more than 40 trading platforms available to traders in 2008 ... [i]nclud[ing] seven US registered stock exchanges, five ECNs, 20 or more ATS platforms. ... Add to this the internalization of orders by the more than one hundred broker-dealer firms, and the number of venues executing trades becomes larger still.”²²⁸ Similarly, as noted above, a variety of sources indicate that HFT trading actually peaked in 2009 and subsequently declined on both a volume and revenue basis over the next several years. MIDAS, on the other hand, rolled out in 2013, three years after the Flash Crash and four years after this estimated HFT peak. The Commission’s designated selection committee has yet to even make its final selection among the *453 proposed managers for CAT,²²⁹ and incredible delays have pushed the expected launch date until 2019 or 2020.²³⁰

The pace at which these new tools are being rolled out is exacerbated by the manner in which they are constructed. The SEC has neither the expertise nor the resources to construct such tools in house and is forced to rely on third party providers. In such a highly technical industry, the only firms able to provide suitable systems are the very firms that the SEC plans to monitor with new the tools. While Tradeworx built MIDAS as a propriety analytics engine for the SEC, it admitted from day one that it intended to market

the package to other firms.²³¹ The nature of this relationship guarantees accelerated obsolescence for the SEC technology relative to the most sophisticated market players.

CAT is similarly to be built by a third party and constructed based on a rapidly aging snapshot of what data might be most relevant and feasible for the new reporting system.²³² The Rule requires, for example, “synchronization of its Business Clocks at a minimum to within 50 milliseconds ... consistent with industry standards.”²³³ While the Rule also dictates that the Chief Compliance Officer of the plan participants “will annually evaluate ... whether industry standards have evolved such that the required synchronization should be shortened or the required time stamp should be in finer increments,”²³⁴ such a system guarantees that the SEC will only know after-the-fact if the clock precision it requires among NMS plan participants is obsolete.

CAT faces even greater obstacles than MIDAS as a rules-based solution to the SEC's data problems. The rounds of hundreds of *454 comments, questions, and meetings with affected market participants ensures heavy pressure against the strictest reporting and data management requirements initially requested.²³⁵ The SRO participants have been steadily propagating requests for exemptions, some of which threaten to open loopholes that materially weaken the plan.²³⁶ History has proven private actors will always find ways to leverage regulatory gaps assumed to be immaterial at the time rules are propagated.²³⁷

Finally, there remains the danger that the SEC will end up utilizing the data mostly for enforcement cases, rather than continuous and thorough reexamination of market structure issues. The pressure from the press and special interest groups will require that the SEC demonstrate the “use” of all this investment and rule crafting as quickly as possible, likely through enforcement action against all the “bad actors.”²³⁸

VI. REGULATORY OPPORTUNITIES

A. Don't Regulate the Player, Regulate the Game

The SEC faces a new era of regulatory options, with rapidly advancing technology and improved research and resources. Regulators have the power to alter market structure in both more dramatic and more precise fashions than ever before. The SEC should focus on smart regulation, optimizing market structure and improving its deployment of technology, rather than aspiring to narrow, dictatorial mandates, or increasing enforcement action against individual wrong doers. The former approach will prove more effective and pragmatic given the insurmountable resource deficit between the regulators and the regulated, and more in sync *455 with the SEC's longstanding philosophy of encouraging private innovation and competition.

Academic research and government action in other jurisdictions present a bevy of regulatory options of varying extremity and foci in response to the market impact of HFT. A survey of some of these options confirms the superiority of a smart regulation approach over the enforcement efforts discussed above, and highlights specific areas for improvement in the SEC's regulatory responses to this most recent market crisis.

B. The Big Guns

1. Frequent Batch Auction

Several market participants have advocated for fundamental market restructuring in response to the “threats” posed by HFT and market fragmentation. Most radical among these suggestions is the proposal to shift from continuous limit order markets to frequent batch auctions.²³⁹

Proponents of the batch auction argue that more modest responses such as transaction taxes or minimum holding times “do not address the core problem”²⁴⁰ Budish, et al., argue that the speed race results from the inherently flawed nature of the current continuous limit order book market structure.²⁴¹ By studying a millisecond-level data-feed, the authors demonstrated that, among other things, standard asset correlations break down entirely at that time scale and latency arbitrage becomes a winner-take-all race for a constant mechanical prize.²⁴² The authors conclude from this that the speed race in the modern HF world is a natural and irreversible result of the current continuous limit order market design.

***456** While adoption of a batch auction proposal would involve a revolutionary restructuring that the SEC and other regulators are unlikely to find digestible, Budish, et. al., highlight two important points. First, adding cost to high frequency market participants through investigation and litigation does nothing to alter the profit incentives driving their behavior, and only adds to the aggregate wasted cost of the system (e.g., investment in the speed race + regulation implementation + enforcement action). In other words, the regulators need to look elsewhere if they want to permanently increase market health and decrease socially wasteful behavior.

Second, Budish, et. al., demonstrate the potential insights produced by private research with access to sufficiently granular and comprehensive market data. While sharing data and analytical insights with the public has been an espoused purpose of the Office of Research and Analytics and the establishment of its Market Structure webpage, the shared metrics are limited to those the Office has pre-selected and the research output has been steady, but rather modest over the last two years.

2. Trade-At Rule

The second most dramatic proposed structural change, a “Trade-At” rule, was floated by the SEC itself in its 2010 Concept Release, and enjoys a much greater possibility of enactment.²⁴³ “Under this type of rule, ... a trading center that was not displaying the NBBO at the time it received an incoming marketable order could either: (1) execute the order with significant price improvement (such as the minimum allowable quoting increment (generally one cent)); or (2) route ISOs to full displayed size of NBBO quotations and then execute the balance of the order at the NBBO price.”²⁴⁴

Like the batch auction concept, a Trade-At rule promises its proponents a permanent structural strategy to eliminate some of ***457** the “toxic” HFT behavior.²⁴⁵ Rather than focus on the speed race, a Trade-At rule theoretically makes sub-penny queue jumping impossible on both lit and dark markets.²⁴⁶ By reducing the incentive for broker-dealers to step in front of the NBBO without offering material price improvement, it also increases the likelihood that organic liquidity providers on lit exchanges have their trades filled.²⁴⁷ Opponents of the rule cite risks of reduced liquidity and greater overall trading costs²⁴⁸ as well as an anti-competitive effect that will stifle innovation.²⁴⁹ Joe Ratterman, then CEO of Bats Global, characterized the Trade-At rule floated in the 2010 Concept Release as the “regulatory equivalent of a sledgehammer.”²⁵⁰

The SEC currently intends to include a version of the Trade-At rule as a component of a Tick-Size pilot program discussed further below.²⁵¹ Many public commenters have argued that simultaneous testing of both programs will distort the resulting impact and muddy the Commission's findings.

The Trade-At Rule, like the Batch Auction proposal, may indeed be a regulatory sledgehammer and may not fit neatly into the Tick-Size pilot program. The proposal ought to be thoroughly evaluated, however. Its delayed and inadequate examination demonstrates again how a lack of prioritization on smart regulation *458 led to an unacceptably slow response to a well-identified market concern. Since the SEC floated the idea of a Trade-At rule in 2010, similar price improvement rules have been implemented in Canada and Australia, and approved in Europe for implementation by 2017.²⁵² The SEC, on the other hand, delayed approval of its two-year pilot program until May 2015,²⁵³ then further delayed implementation from May 2016 to October 3, 2016.²⁵⁴ It can be argued that the amalgamation of the Trade-At and Tick-Size studies may not achieve scientifically clear results at its conclusion anyhow.

C. Incremental Measures

There are also several well-discussed regulatory alternatives that would impact HFT behavior in an incremental fashion, including minimum quote holding times, quote limits, volume taxes, and variable tick sizes. As discussed above, a common concern related to HFT is that they overload exchanges with submissions and cancellations either to manipulate prices or to mine information from other market participants. The listed tactics are all responses suggested to curb excessive quoting or cancellations stemming from trades that are not organically or individually profitable.

Like the Trade-At Rule, many forms of these programs have already been attempted in various jurisdictions, including private fines for excessive orders and caps on message volume on *459 exchanges.²⁵⁵ Academics studying the results of minimum holding times and message or transaction taxes seem to conclude that they generally produce wider spreads and increased volatility and reduce the profitability of passive HFTs in particular.²⁵⁶ *460 Conversely, widened tick increments may damage aggressive HFT profitability and pressure undisplayed liquidity, but substantially buoy passive HFT market making.²⁵⁷

*461 Studies of these tactics are more robust than those of Trade-At rules, and the strength of these findings again highlight the value of well-supported research in identifying the correct tools to alter HFT behavior without fundamentally reconstructing the market. Significantly, most of the leading studies have relied on combinations of private data sets acquired from the exchanges or from regulatory datasets produced by the SEC's counterparts abroad.²⁵⁸ While the EU, a number of individual European countries, Canada, India, Brazil, and even several domestic exchanges, began to experiment with such tactics, it will be over six years since the SEC's 2010 Concept Release before a pilot plan experimenting with tick sizes is implemented.²⁵⁹

D. Data Redux

One of the most powerful tactical measures available to the SEC stems from the Commission's ability to control the use and distribution of market data. Management of market data has always played a central role in the SEC's vision of the NMS.²⁶⁰ Rather than attempting to "fix" the HFT crisis by adding a new lever like a Trade-At rule or a message tax, the Commission may *462 be best served adjusting or improving some of the levers it already has in place.

1. Upgrade The Securities Information Processor

Notably, the U.S. is one of the only countries that uses a Securities Information Processor (“SIP”) model for data distribution,²⁶¹ and its architecture is one of the greatest areas of criticism of the U.S. market structure. SIP design plays a critical role in the HFT debate, as its relative latency, inferior traffic capacity, and limited information content provide much of the structural basis for HFT arbitrage strategies.

As a basic response to the current crisis, the SEC required increased technical investment in the SIP. NASDAQ's SIP contract came up for negotiation²⁶² after a high-profile software failure in 2013.²⁶³ The renewal of NASDAQ's contract included extracting a promise by the Exchange to upgrade the SIP by reducing the time it takes to process quotes and establishing a more robust backup system.²⁶⁴ The speed stats are not particularly impressive relative to private data feeds, however, and the delivery date for the upgrades was set multiple years off. Altering the multi-year contract plan or setting more stringent upgrade requirements would allow the SEC to directly manage HFT capabilities and increase the cost of *463 participating in the speed race. Following the renewal of NASDAQ's contract, SIFMA²⁶⁵ submitted a strongly worded letter questioning the SIP governance committees that oversaw the bidding process, and categorizing the SIPs as “critical industry utilities.”²⁶⁶

2. Change the Fee Structure

Perhaps more effective and easier to manage, the SEC could redesign the revenue split underlying SIP participation. Currently, the SIP participants divvy up approximately \$400 to \$500 million a year in revenues from public sale of the SIP data according to an equation the SEC set in Reg NMS in 2007.²⁶⁷ The equation that governs the split of these revenues awards equal dollars for the number of trades executed and the number of quotes that meet certain criteria.²⁶⁸

While NASDAQ's allocation of public data revenue fell from \$149 million to \$117 million between 2007 and 2012,²⁶⁹ this remains a powerful lever and there are numerous ways it could be used to alter market incentives. The SEC could award dollars based on data submission or relative processing performance between trading venues, shifting the speed race from between private market participants over private data feeds to the exchanges and trading venues over provision of public data. Rather than adding a transaction tax or quote cap, the fee structure could incorporate a tiered award based on quote holding time, incentivizing the exchanges to compete over longer lasting quotes *464 and to innovate new methods of encouraging such behavior by market participants.

While more drastic, the SEC could also explore new rules governing release of private market data. Many complain that the profitability of private data has created a conflict of interest for the exchanges operating the SIPs (i.e., NYSE and Nasdaq) that has caused the under-investment discussed above. While public data revenue was falling between 2006 and 2012, “Nasdaq's proprietary market data revenue more than doubled, to \$150 million from \$69.6 million.”²⁷⁰ Aside from increasing the stringency of data distribution equality under Rule 603, the Commission might also incorporate regulation of private data feeds into the SIP plans. Either by allowing private companies to provide competing SIP services, or by requiring all data sales to at least partially fund the SIP plans, the Commission could open the system to substantially more competition and incentivize the provision of better public data distribution.

Opponents of employing market data in this fashion might argue that the SEC would be improperly micromanaging market participants and dampening private innovation. The Commission faced such complaints when drafting Reg NMS originally for including quotations in the fee splitting formula.²⁷¹

While it partially defended itself by claiming it was only “correct[ing] an existing flaw,”²⁷² this critique and the Commission's defense ignore the underlying truth that any formula it sets will alter market incentives and most “natural” market behaviors can arguably be characterized as “response[s] to an existing regulation.”²⁷³ Many of the decisions the Commission made in setting initial details of the formulas in NMS involved seemingly arbitrary decisions regarding computational complexity of different formula proposals and processing power restrictions.²⁷⁴ Contemplation of “corrections” to the current formula should not be nixed merely out of fear that current vested interests might be displaced.

*465 3. Research Partnerships and Data Access

While the establishment of new market structure research groups should empower future regulatory design efforts, the private research community will always vastly outnumber the staff at the Commission. The main obstacle to a more timely and informed response to the current HFT crisis has been a lack of data on actual market behavior.²⁷⁵ As discussed above, much of the research conducted on possible regulatory responses relied on private single asset or single market datasets, foreign regulatory datasets, or the CFTC dataset released several years ago.²⁷⁶

Establishing programs for private research partnerships and increasing access to private data could vastly accelerate regulatory development as well as allow the market to organically identify and respond to structure problems. As the Commission builds out MIDAS and CAT, it also needs to prioritize establishing data access for the private research community. The most well-funded SEC research division cannot compete with a data-rich private research community. The treatment of odd lot orders over the past few years provides a perfect case study on the power of private research to drive market reform.

In 1976, the NYSE began allowing Specialists to handle trading in “odd lots,”²⁷⁷ i.e., trades for less than 100 shares of stock.²⁷⁸ Traditionally, odd lot orders constituted a marginal percent of trade and share volume, and were thought to originate from retail traders, thus carrying little informational content of value.²⁷⁹ The *466 Commission institutionalized this belief by excluding odd lot trades from consolidated tape reporting requirements.²⁸⁰

By convention, no exchange voluntarily shared this data in their public feeds, but they did report them in private feeds.²⁸¹ Research by O'Hara, Yao, and Ye (2013) (“OYY”), demonstrated that odd lot trades rose from 14% of total trades in January 2008 to about 25% in November 2011. Odd-lot share volume rose from 2.25% to about 6% in roughly the same time period.²⁸² Moreover, OYY demonstrated that percent trade volume was dramatically higher in certain large, heavily traded stocks (52.9% of trades in Google), a trend later confirmed by the SEC.²⁸³

According to OYY's research, 35% to 39% of price discovery could be attributed to odd lot trades, consistent, in their view, with the hypothesis that such trades were made to “hide” from the market.²⁸⁴ Not only have HFTs always had access to this “hidden” trade flow, however, OYY's data revealed that odd lot trading patterns easily identified human traders from “silicon traders” by the former's tendency to quote in round numbers.²⁸⁵

Whether or not these trades were designed to hide from the market entirely or merely the result of modern algorithms trying to split up larger orders,²⁸⁶ spreading awareness of the trend stimulated a response from

the market, and the SEC approved rule changes proposed by the Exchanges requesting to report odd-lot trades to the tape as of 12/9/2013.²⁸⁷

*467 Sharing reliable disclosure results with investors is a fundamental tenet of the Commission's mission, and it continues to offer more data every year. In 2015, for example, the SEC started publishing reports reflecting private fund industry statistics and trends, aggregated from private fund advisor disclosures on Forms ADV and PF.²⁸⁸ The Commission needs to expand its conception of the target users for such market data and the public benefit that can accrue from the potential resulting research.

VII. CONCLUSION

When the SEC first wrote to Congress for authorization to create the National Market System, it did so in recognition of the impossibility of achieving complete, direct control over the securities industry. Rather, it sought to establish guiding, intelligent rules that aligned the natural competitive forces between industry participants to check each other's misbehaviors, and catalyze innovation. Too quickly, however, the Commission slipped into a pattern of prioritizing enforcement over all other goals, and pursuing market design research and evolution only when pressured by market crises.

High Frequency Trading has presented the most recent shock to market confidence. Its rise entailed a revolution in trader speed and behavior, it displaced the traditional liquidity providers, and it facilitated the fragmentation of trading centers across the country. Both the financial and popular press rang with accusations that the markets were rigged and that HFT had bribed exchanges with their massive volume for the right to dupe and skim profits from traditional investors.

True to form, the SEC and CFTC responded with trumpeted announcements of investigation and litigation, and promises to find and punish the newest invasive species of financial wrongdoers. The Commissions and their counterparts in the federal and state *468 criminal justice agencies rushed to identify and prosecute all the cheats and frauds they could find whose behaviors offered even a whiff of the HFT scent. As it turned out, almost none of the challenged activity actually relied on high frequency trading strategies, and none of the settlements or penalties likely had any impact on the evolving market behaviors stirring up so much controversy.

Several notable steps have been taken by the SEC to tighten its focus on market structure and to expand and modernize its research toolkit. Most significant are the establishment of a Market Structure Committee, the efforts toward construction of a Consolidated Audit Trail, and the (modestly) increasing resource allocations toward its divisions of Trading and Markets, and Risk Analysis. These steps are insufficient, however, and they remain emblematic of an organization that prioritizes enforcement, and takes bolder regulatory steps only when forced into action by market crises. The philosophy underpinning the original call for the NMS must be dusted off and reembraced if the vision of a robust and democratic securities market is going to be protected.

Not all will agree with the conclusions of this Note. Richard Walker, 10-year member of the SEC and 3-year director of the Enforcement Division,²⁸⁹ gave a speech on October 25, 2000, highlighting the advantages he saw in enforcement over rulemaking.²⁹⁰ Walker validly argued that enforcement tools allow for “nimble” responses when compared to the “accumulation [of evidence] over time ... and lengthy notice and comment period” required for “drafting and adopting effective rules.”²⁹¹ He further observed that investigative and prosecutorial powers allow the Commission to attack a “new spin on an old fraud” and target “those

engaged in misconduct, without necessarily implicating the conduct of those engaged in similar, but legal, activity.”²⁹²

Walker's perspective, though, incorrectly framed the bounds of regulatory action, viewing the Commission as faced with a choice between enforcement, and “static” “[s]pecific regulatory prohibitions” that draw bright lines which tend toward rapid *469 obsolescence.²⁹³ This view ignores the opportunities to employ regulatory authority to share data, promote research and innovation, and foster healthy competition among all categories of participants in the securities markets. It ignores the critical need for intelligent regulation to inform and support the enforcement branch, to produce better-targeted investigations and to set more effective examples about the consequences for financial fraud.

This author is not debating the importance of the Commission's enforcement efforts, nor the inherent value in catching and punishing market cheats like Coscia, Dondero, or Latour. In fact, the proper response to both Walker and this Note may simply be to echo the continuous refrain heard from Commission members requesting greater overall resources. Efforts to allow for self-funding and increased independence have been rejected repeatedly by Congress,²⁹⁴ and even financing for the critical technological improvements discussed above has been cut back as fluctuating political tides have shifted priorities.²⁹⁵

In a world of limited resources, however, the Commission must transition away from its pattern of regulatory crisis response. It cannot afford to prioritize enforcement as a strategy to confront market developments like HFT, but must instead aim to take them in stride as part of a system that fosters constant examination and enhancement of market design. The SEC has more sophisticated regulatory levers, better technology, and a greater ability to engage with industry and private research leaders than ever before. It must remember the wisdom of those Commissioners who first envisioned the NMS, and reshape the agency to better advance a healthier, and more robust securities market. In the long run, this shift will prove more effective than the myopic punitive action that is currently the central SEC strategy.

Footnotes

d1 This Note may be cited as <http://www.stlr.org/cite.cgi?volume=17&article=Sokol>. This work is made available under the Creative Commons Attribution--Non-Commercial--No Derivative Works 3.0 License.

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1 See, e.g., U.S. SEC. & EXCH. COMM'N, AGENCY FINANCIAL REPORT 7-8 (2014); U.S. SEC & EXCH. COMM'N, AGENCY FINANCIAL REPORTTT 6-7 (2012).

2 U.S. SEC. & EXCH. COMM'N, AGENCY FINANCIAL REPORT 8 (2014).

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5 *Id.* (quoting Securities and Exchange Act, § 11A(a)(1)(C), 15 U.S.C. § 78k-1(a)(1)(C)).

6 In fact, the SEC had written to Congress in 1971, arguing for establishment of a regime that would “reduce the element of monopoly power which has accompanied past efforts to establish a central market and will make it possible for potential abuses of such monopoly power to be controlled not only by regulation but by an increasing degree of competition [O]ur objective is to see a strong central market system created to which

all investors have access, in which all qualified broker-dealers and existing market institutions may participate in accordance with their respective capabilities, and which is controlled not only by appropriate regulation but also by the forces of competition.” *Id.* at 618 (quoting SEC. & EXCH. COMM’N, INSTITUTIONAL INVESTOR STUDY REPORT, H.DOC. No. 64, 92d Cong., 1st Sess. (1971)); *see also* U.S. SEC. & EXCH. COMM’N, POLICY STATEMENT ON THE STRUCTURE OF A CENTRAL MARKET SYSTEM (Mar. 29, 1973); Arthur Levitt, *Dynamic Markets, Timeless Principles*, 2000 COLUM. BUS. L. REV. 1, 9-11; Laura N. Beny, *U.S. Secondary Stock Markets*, 2002 COLUM. BUS. L. REV. 339, 414 (2002); *Panel Discussion: Celebrating Thirty Years of Market Regulation*, 9 FORDHAM J. CORP. & FIN. L. 301, 308 (2004); *Equity Market Structure*, Concept Release No. 34-61358, 8-10 (Jan. 14, 2010), available at <https://www.sec.gov/rules/concept/2010/34-61358.pdf>.

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8 *Id.* at 140.

9 *Id.* at 192 (“NASDAQ is a brilliant example of what modern technology can do,’ [said] former SEC commissioner Irving Pollack, ‘even if your first steps are baby steps. NASDAQ brought a whole new element in to the equation. The Exchange had Rule 390, Rule 394, the floor business, but ultimately technology outran them.”).

10 “The Securities and Exchange Commission (“SEC” or “Commission”) is reevaluating its approach to the regulation of exchanges and other markets in light of technological advances and the corresponding growth of alternative trading systems and cross-border trading opportunities. Accordingly, the Commission is soliciting comment on a broad range of questions concerning the oversight of alternative trading systems, national securities exchanges, foreign market activities in the United States, and other related issues.” *Regulation of Exchanges*, Concept Release No. 34-38672 (May 23, 1997), available at <http://www.sec.gov/rules/concept/3438672.txt>.

11 *Equity Market Structure*, *supra* note 6, at 1.

12 The reported realized net budget for the Division of Economic Risk Analysis grew 26.4%, 10.7%, 1.1%, 45.4%, and 47% Y/Y in each year from 2010 to 2014; the reported realized net budget for the Division of Trading and Markets grew 15.1%, 14.9%, 9.3%, 12.2%, and 4% Y/Y in the same period. *See* U.S. SEC. & EXCH. COMM’N, AGENCY FINANCIAL REPORT (2014); *see also* U.S. SEC. & EXCH. COMM’N, AGENCY FINANCIAL REPORT (2013); *see also* U.S. SEC. & EXCH. COMM’N, AGENCY FINANCIAL REPORT (2012).

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- 26 John McCrank, *U.S. Stock Markets Are Rigged, Says Author Michael Lewis*, REUTERS (Mar. 31, 2014, 11:03 AM), <http://www.reuters.com/article/us-markets-hft-flashboys-idUSBREA2U03D20140331>; see PATTERSON, *supra* note 21, at 1-10.
- 27 PATTERSON, *supra* note 21, at 233-78.
- 28 Andrew G. Haldane, Exec. Dir. Fin. Stability, Bank of Eng., *The Race to Zero: Speech at the International Economic Association Sixteenth World Congress 3* (July 8, 2011) (transcript available at <http://www.bankofengland.co.uk/archive/Documents/historicpubs/speeches/2011/speech509.pdf>) (commenting on fundamental changes in the financial industry over the last century).
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- 38 Virtu Financial, a widely acknowledged and self-labeled HFT market maker, however, provided this list of firms as examples of competitors in its S1 filed in 2014: “Today, our major competitors continue to be large brokerdealers, such as Bank of America Merrill Lynch, Citigroup, Goldman Sachs, Morgan Stanley, UBS, and niche players such as Citadel, DRW Holdings, Hudson River Trading, IMC, KCG Holdings, Optiver, Peak6, Susquehanna, Timber Hill, and Wolverine Trading. Some of our competitors in market making are larger than we are and have more captive order flow in certain assets.” Virtu Financial, SEC Registration Statement (Form S-1) (Mar. 10, 2014), 110, <http://www.sec.gov/Archives/edgar/data/1592386/000104746914002070/a2218589zs-1.htm>.
- 39 SEC, *supra* note 6, at 45; *see also* Adam D. Clark-Joseph, *Exploratory Trading Job Market Paper 15* (Jan. 13, 2013), <http://www.nanex.net/aqck2/4136/exploratorytrading.pdf> (Other researchers “identify as HFTs those traders who exhibit minimal accumulation of directional positions, high inventory turnover, and high levels of trading activity.”); *but see* Charles M. Jones, *What Do We Know About High-Frequency Trading?* 5 (COLUMBIA BUS. SCH. RESEARCH PAPER NO. 13-11, 2013) (“Conversations with market participants indicate that many HFT do carry substantial inventory positions overnight; otherwise, there is considerable consensus that this is a workable definition of HFT.”).
- 40 Jones, *supra* note 39, at 6; SEC, *supra* note 39 (The SEC employed 4 strategy categories in its 2010 market structure concept release that overlap substantially: Passive Market Making, Arbitrage, Structural, and Directional.).
- 41 Passive HFTs are generally likened to the role of market-makers, like the specialists and floor traders of old, focused on earning a spread over millions of trades, rather than extracting profit through adverse selection of counterparties. Major self-proclaimed examples include firms like Virtu Financial; *see* Staff of the Division of

Trading and Markets U.S. Securities and Exchange Commission, *supra* note 34, at 16 (“Baron, Brogaard[,] and Kirilenko (2012) further divided the 65 HFT trading accounts into ‘Aggressive’ (at least 60% of their trades are liquidity taking), ‘Passive’ (less than 20% of their trades are liquidity taking), and ‘Mixed.’”); *see also* Jonathan Brogaard, Corey Garriott & Anna Pomeranets, *High-Frequency Trading Competition* (Bank of Canada Working Paper 2014-19, 2014), <http://www.bankofcanada.ca/wpcontent/uploads/2014/05/wp2014-19.pdf> (“We observe heterogeneity among HFT participants. Similar to Hagstromer and Norden (2013), we define two HFT subgroups: Passive HFTs and Aggressive HFTs. Passive HFTs are those that use marketable orders less than 33% of the time; Aggressive HFTs use marketable orders more than 75% of the time.”); *see generally* Björn Hagströmer & Lars Nordén, *The Diversity of High Frequency Traders*, SSRN ELECTRONIC J. 1 (2012); (“The regulatory debate concerning high frequency trading (HFT) emphasizes the importance of distinguishing different HFT strategies and their influence on market quality. Using unique data from NASDAQ OMX Stockholm, we are the first to empirically provide such a distinction for equity markets.”).

42 The purpose of this review is to offer a taste of the general mechanisms by which HFTs earn their profits, with no pretense of detailing a fully comprehensive analysis of their strategies.

43 Jerry W. Markham & Daniel J. Harty, *For Whom the Bell Tolls: The Demise of Exchange Trading Floors and the Growth of ECNs*, 33 J. CORP. L. 865, 870 (2008) (“Specialists are required to maintain a fair and orderly market in the stocks assigned to them. They do this by maintaining two-sided quotes for the stocks in which they specialize. Specialists have an affirmative obligation to ‘deal ... for [their] own account when lack of price continuity, lack of depth, or disparity between supply and demand exists or is reasonably to be anticipated.”) (quoting Staff of the Division of Trading and Markets U.S. Securities and Exchange Commission, *supra* note 34, at 2-21); *see also* “About 20 percent of the Exchange's volume is bought and sold by specialists.” Blume, *supra* note 7, at 38.

44 PATTERSON, *supra* note 21, at 158.

45 SAL ARNUK & JOSEPH SALLUZI, BROKEN MARKETS: HOW HIGH FREQUENCY TRADING AND PREDATORY PRACTICES ON WALL STREET ARE DESTROYING INVESTOR CONFIDENCE AND YOUR PORTFOLIO 104 (2012); PATTERSON, *supra* note 21, at 42.

46 ARNUK & SALUZZI, *supra* note 45, at 104.

47 *See* Jacob Bunge, *NYSE Adjusts Charges in Bid to Draw Traders*, WALL ST. J. (Feb. 3, 2009, 12:01 AM), <http://www.wsj.com/articles/SB123362152140241649> (“NYSE Euronext Inc. said it will adjust its fee structure and boost execution speeds in an effort to attract more high-frequency traders to the Big Board and its Arca electronic market.”).

48 Jones, *supra* note 39, at 7 (“A classic example is index arbitrage. S&P 500 futures are traded in Chicago on the Chicago Mercantile Exchange, while SPY is the ticker symbol for the largest exchange-traded fund (ETF) that tracks the S&P 500 index. SPY is traded on nearly every equity trading venue in the U.S. as well as several foreign trading venues. The two instruments are very similar, and their prices should move in lockstep one-for-one. If the futures price goes up due to the arrival of buy orders, but the ETF price does not move up at the same instant, HFT would quickly buy SPY, sell S&P 500 futures contracts, and lock in a small profit on the price differential between the two instruments.”).

49 *See infra* note 91.

50 UNLISTED TRADING PRIVILEGES, <http://www.utpplan.com/> (last visited Mar. 20, 2016).

51 *See generally* Gary Stone, *SIP v. Direct Feeds Latency--What are the Rules*, BLOOMBERG TRADEBOOK, <http://www.bloombertradebook.com/blog/sip-vs-direct-feeds-latency-rules/> (last visited Mar. 20, 2016).

52 Protected quotes is a term of art under SEC Rules, but can simplistically be thought of as the best bid or offer for a given security from any particular exchange. *See Responses to Frequently Asked Questions Concerning Rule 611 and Rule 610 of Regulation NMS*, U.S. SEC. EXCH. COMM'N, <https://www.sec.gov/divisions/marketreg/>

nmsfaq610-11.htm (last visited Mar. 10, 2016) (“To be protected, a quotation must, among other things, be immediately and automatically accessible and be the best bid or best offer of a national securities exchange or national securities association”).

- 53 See generally UNLISTED TRADING PRIVILEGES, *supra* note 50.
- 54 See *infra* note 91; see also Stone, *supra* note 51.
- 55 Nanex Research, *Direct vs. SIP Data Feed*, NANEX RESEARCH (Apr. 4, 2014), <http://www.nanex.net/aqck2/4599.html>; Dark pools are ATSS used to anonymously match traders without revealing the size or price details of a trade to the wider market. See Elvis Picardo, *An Introduction To Dark Pools*, INVESTOPEDIA (Feb. 20, 2016), <http://www.investopedia.com/articles/markets/050614/introduction-dark-pools.asp> (last visited Apr. 9, 2016); while corporate trades may be placed on traditional “lit” exchanges and dark pools are patronized by many other categories of traders, the point to highlight here is the disparity in access between professional and non-professional investors.
- 56 See *Co-Location (CoLo)*, NASDAQ, <http://www.nasdaqtrader.com/Trader.aspx?id=colo>; *Colocation Connectivity*, NYSE MKT. DATA, <http://www.nyxdata.com/Docs/Colocation> (last visited Mar. 10, 2016).
- 57 “Up to \$60,000/month from just one of 14 exchanges.” *Fantaseconds*, NANEX (Dec. 20, 2013), <http://www.nanex.net/aqck2/4518.html>.
- 58 See generally Shengwei Ding, John Hanna & Terrence Hendershott, *How Slow is the NBBO? A Comparison with Direct Exchange Feeds*, 49 FIN. REV. 313 (2014).
- 59 *Id.*
- 60 *Direct v. SIP Data Feed*, *supra* note 55.
- 61 Geoffrey Rogow, *Colocation: The Root of All High-Frequency Trading Evil?*, WALL ST. J. (Sept. 20, 2012, 1:57 PM), <http://blogs.wsj.com/marketbeat/2012/09/20/collocation-the-root-of-all-high-frequency-trading-evil/>.
- 62 SEC, *supra* note 6, at 54.
- 63 Matthew Phillips, *How Your Buy Order Gets Filled*, BLOOMBERG BUSINESS (Dec. 20, 2012, 3:18 PM), <http://www.bloomberg.com/bw/articles/2012-12-20/how-your-buy-order-gets-filled>.
- 64 SEC, *supra* note 6, at 55.
- 65 ARNUK & SALUZZI, *supra* note 45, at 143-45.
- 66 Adam D. Clark-Joseph, *Exploratory Trading* 15 (Jan. 13, 2013) (unpublished document) (on file with author), <http://www.nanex.net/aqck2/4136/exploratorytrading.pdf>; see also ARNUK & SALUZZI, *supra* note 45, at 145-48 (explaining how brokers often route orders to earn the highest rebates from exchanges, rather than to achieve best execution or minimize information leakage).
- 67 See generally Clark-Joseph, *supra* note 66.
- 68 In the Matter of N.Y. Stock Exch. LLC & N.Y.S.E. Euronext, Exchange Act Release No. 67857, 5 (Sept. 14, 2012), available at <http://www.sec.gov/litigation/admin/2012/34-67857.pdf>.
- 69 See 17 C.F.R. § 242.603 (2005).
- 70 NASDAQ Market Technology, *The UTP Plan Trade Data Feed Direct Subscriber Interface Specification*, UNLISTED TRADING PRIVILEGES (Nov. 2015), <http://www.nasdaqtrader.com/content/technicalsupport/specifications/utp/utdfspecification.pdf>.
- 71 NASDAQ, <http://www.nasdaqtrader.com/trader.aspx?id=dpspecs> (last visited May 15, 2016).

- 72 ARNUK & SALUZZI, *supra* note 45, at 102.
- 73 *Beware of Those Offering Free Retail Trades*, THEMIS TRADING LLC (Nov. 25, 2014), <http://dev2.themistrading.com/beware-of-those-offering-free-retailtrades/>.
- 74 ARNUK & SALUZZI, *supra* note 45, at 102.
- 75 See HAIM BODEK, *THE PROBLEM OF HIGH FREQUENCY TRADING* 8-12 (2013); MICHAEL LEWIS, *FLASH BOYS* 12 (2015); Scott Patterson & Jenny Strasburg, *For Superfast Stock Traders, a Way to Jump Ahead in Line*, WALL ST. J. (Sept. 19, 2012, 5:59 PM), <http://www.wsj.com/articles/SB10000872396390443989204577599243693561>; *Order Type Madness Part CXXIII--Thanks Bloomberg*, THEMIS TRADING LLC (Sept. 24, 2014), <http://blog.themistrading.com/2014/09/order-type-madness-part-cxxiii-thanksbloomberg/>.
- 76 Dale A. Oesterle, *Regulation NMS: Has the SEC Exceeded Its Congressional Mandate to Facilitate A "National Market System" in Securities Trading?*, 1 N.Y.U. J. L. & BUS. 613, 673 (2005).
- 77 Bunge, *supra* note 47.
- 78 "NYSE attempts to reclassify certain order types as order type 'modifiers' or combinations of modifiers. The distinction between 'order types' and 'modifiers' is subjective, and it should not be used to mask true functionality or provide incomplete disclosure. What might be considered as a distinct 'order type' by others (e.g., DAY ISO ALO) is presented by NYSE as a combination of modifiers. However, the whole may be different from the sum of its parts. The inherent properties of such modifiers may contradict each other or interact in a non-transparent and non-intuitive way, thus creating a lot of leeway for NYSE to decide on how such a combination might work or even allowing discretionary adjustments of this functionality from time to time." Letter from Haim Bodek, Founder, Decimus Capitals Markets to U.S. Securities Exchange Commission (Sept. 15, 2014), <http://haimbodek.com/NYSE-20140915.pdf>.
- 79 See generally *Order Types and Modifiers*, NASDAQ OMX, <http://nasdaqtrader.com/content/ProductsServices/Trading/OrderTypesG.pdf> (last visited May 11, 2016); *NASDAQ OMX Order Type Guide*, BRAINSHARK.COM, <http://www.brainshark.com/nasdaqomx/vu?pi=zF7zJ6aUZzoG0z0> (last visited May 11, 2016); *Order Type Guide*, DIRECT EDGE, http://cdn.batstrading.com/resources/membership/EDGE_Order_Type_Guide.pdf (last visited May 11, 2016) ("Many order types are standard across all markets, but some are unique only to Direct Edge[.]").
- 80 *Price-time priority*, MARKETSWIKI.COM (Sept. 29, 2011, 4:38 PM), http://www.marketswiki.com/wiki/Price-time_priority (last visited May 11, 2016).
- 81 See NASDAQ OMX, *supra* note 79.
- 82 BODEK, *supra* note 75, at 33-37 (This terminology describes a class of similar order types provided by different exchanges. Bodek includes the following as examples of order types in this class: NASDAQ's Price to Comply, BATS' Display-Price Sliding, NYSE ARCA's Post No Preference Blind, and Direct Edge's Hide Not Slide.).
- 83 § 87,414 Regulation NMS, Exchange Act Release No. 51808, Fed. Sec. L. Rep. (CCH), 2005 WL 6319729 (June 9, 2005).
- 84 NASDAQ OMX, *supra* note 79; *NASDAQ Order Type Guide*, *supra* note 79.
- 85 BODEK, *supra* note 75, at 33-36; Scott Patterson & Jenny Strasburg, *How 'Hide Not Slide' Orders Work*, WALL ST. J. (Sept. 18, 2012, 10:40 PM), <http://www.wsj.com/articles/SB10000872396390444812704577605840263150>.
- 86 § 87,414 Regulation NMS, 2005 WL 6319729 (June 9, 2005).
- 87 *Id.*

- 88 Bodek, *supra* note 75, at 38.
- 89 *Id.* at 40.
- 90 *Id.* at 39-40; *see also id.* at 41-45 (discussing a variant called the Day Intermarket Sweep Order which enables placement ahead of hidden Hide and Light orders placed earlier at the same price); *Fred and Ethel Called and Wanted To Know About Intermarket Sweep Orders (ISOs)*, THEMIS TRADING LLC (Dec. 6, 2012), <http://blog.themistrading.com/2012/12/fred-and-ethel-called-and-wanted-to-know-about-intermarket-sweep-orders-isos/>.
- 91 Regulation NMS, Exchange Act Release No. 34-51808, 2005 WL 1364545 (June 9, 2005), available at <http://www.sec.gov/rules/final/34-51808.pdf>; Regulation NMS, 17 C.F.R. § 242.612.
- 92 Sabrina Buti et al., *Sub-Penny and Queue-Jumping*, 4 (Nov. 2013), available at http://www.efmaefm.org/0EFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2014-Rome/papers/EFMA2014_0552_fullpaper.pdf.
- 93 *Id.*
- 94 *Sub-penny Price Anomaly*, NANEX RESEARCH (July 26, 2012), <http://www.nanex.net/aqck2/3517.html>; *Salami Slicing Sub-Penny Style*, NANEX RESEARCH (July 26, 2012), <http://www.nanex.net/aqck2/3519.html>.
- 95 *See generally* Robert P. Bartlett, III & Justin McCrary, *Shall We Haggle in Pennies at the Speed of Light or Nickels in the Dark? How Minimum Price Variation Regulations High Frequency Trading and Dark Liquidity 2* (unpublished draft), available at http://www.warwick.ac.uk/fac/soc/economics/intranet/calendar/justin_mccrary.pdf (presenting findings that HFT increased when sub-penny trading was allowed for sub-dollar stocks, while undisplayed trading decreased substantially).
- 96 *In the Matter of Visionary Trading LLC, Lightspeed Trading LLC, Andrew Actman, Joseph Dondero, Eugene Giaquinto, Lee Heiss & Jason Medvin, Respondents*, Release No. 31007 (Apr. 4, 2014), available at <http://www.sec.gov/litigation/admin/2014/34-71871.pdf> (providing a detailed description of a layering scheme in practice).
- 97 The Securities Exchange Act of 1934 (Pub. L. 73-291, 48 Stat. 881, enacted June 6, 1934, codified at 15 U.S.C. § 78a et seq.).
- 98 *Id.*
- 99 Concept Release on Equity Market Structure, Release No. 34-61358; File No. S7-02-10, 2010 WL 2726970.
- 100 *Id.* at 56-57.
- 101 “‘Pump-and-dump’ schemes involve the touting of a company’s stock (typically small, so-called ‘microcap’ companies) through false and misleading statements to the marketplace. These false claims could be made on social media such as Facebook and Twitter, as well as on bulletin boards and chat rooms Often the promoters will claim to have ‘inside’ information about an impending development or to use an ‘infallible’ combination of economic and stock market data to pick stocks. In reality, they may be company insiders or paid promoters who stand to gain by selling their shares after the stock price is ‘pumped’ up by the buying frenzy they create. Once these fraudsters ‘dump’ their shares and stop hyping the stock, the price typically falls, and investors lose their money.” *Pump-and-Dumps and Market Manipulations*, U.S. SEC. EXCH. COMM’N (June 25, 2013), <https://www.sec.gov/answers/pumpdump.htm>.
- 102 *See, e.g.,* Stephanie Clifford, *7 Indicted in \$50 Million Pump-and-Dump Scheme*, N.Y. TIMES (July 17, 2014), <http://dealbook.nytimes.com/2014/07/17/7-indicted-in-50-million-pump-and-dump-scheme/>.

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- 104 SEC Concept Release 2010 on Equity Market Structure, Exchange Act Release No. 34-61358; File No. S7-02-10, 2010 WL 2726970; Lawrence Takeuchi & Yu-Ying Lee, *Applying Deep Learning to Enhance Momentum Trading Strategies in Stocks* (Dec. 12, 2013), <http://cs229.stanford.edu/proj2013/TakeuchiLee-ApplyingDeepLearningToEnhanceMomentumTra>.
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- 107 *FINRA Joins Exchanges and the SEC in Fining Hold Brothers More Than \$5.9 Million for Manipulative Trading, Anti-Money Laundering, and Other Violations*, FIN. INDUS. REGULATORY AUTH. (Sept. 25, 2012), <https://www.finra.org/Newsroom/NewsReleases/2012/P178687>.
- 108 *Id.*
- 109 *Id.*; see *SEC Charges N. Y.-Based Brokerage Firm with Layering*, U.S. SEC. EXCH. COMM'N (Sept. 25, 2012), <https://www.sec.gov/News/PressRelease/Detail/PressRelease/1365171484972>; *Whac-A-Mole is Manipulation*, NANEX RESEARCH (Sept. 25, 2012), <http://www.nanex.net/aqck2/3598.html>.
- 110 Tyler Durden, *From High Frequency Trading to a Broken Market: A Primer in Two Parts*, ZERO HEDGE (Dec. 15, 2012, 3:25 PM), <http://www.zerohedge.com/news/2012-12-15/high-frequency-trading-broken-market-primer-two-parts>; *Legal Update: Increased Public and Private Scrutiny of High-Frequency Trading 3*, MAYER BROWN (May 14, 2014), available at https://www.mayerbrown.com/files/Publication/272e9281-0ab5-481d-b98b-bca0b872e344/Presentation/PublicationAttachment/53b4f4ad-1a78-4553-9ede-d850bf05458c/UPDATE_Increased_Public-Private_Scrutiny_0514.pdf.
- 111 Tse, *supra* note 103, at 4-5.
- 112 *Id.*
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- 114 *Id.*
- 115 Jared Egginton et al., *Quote Stuffing 3* (Mar. 22, 2014); see also Tse, *supra* note 103 (study indicating that equities in the STOXX600 experienced quote stuffing on average 18.6 times a day in the third quarter of 2012).
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- 123 See *KCG Announces Consolidated Earnings of \$0.23 Per Diluted Share for the Fourth Quarter of 2014*, KCG (Jan. 30, 2015), <http://investors.kcg.com/phoenix.zhtml?c=105070&p=irolnewsArticle&ID=2012102>.
- 124 See *KCG Announces Consolidated Loss of \$0.05 Per Diluted Share for the Fourth Quarter of 2015*, KCG (Jan. 29, 2016), <http://investors.kcg.com/mobile.view?c=105070&v=203&d=1&id=2133522>.
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- 126 Ivy Schmerken, *High Frequency Trading Loses Its Luster*, WALL ST. & TECH. (Apr. 1, 2013, 1:35 PM), <http://www.wallstreetandtech.com/tradingtechnology/high-frequency-trading-loses-its-luster/d/d-id/1267981?print=yes>; see also Matthew Philips, *What Michael Lewis Gets Wrong About High-Frequency Trading*, BLOOMBERG BUS. (Apr. 2, 2014, 2:29 PM), <http://www.bloomberg.com/bw/articles/2014-04-01/what-michael-lewis-gets-wrong-about-high-frequencytrading>.
- 127 Most empirical research on HFT to-date involves the use of limited datasets that represent either only one market venue or one asset class. The results from these studies are inherently incomplete, as we know that a core feature of HFT strategy is to compete across a fragmented market and across many different correlated asset classes. See Matthew Baron, Jonathan Brogaard & Andrei Kirilenko, *Risk and Return in High Frequency Trading*, COMMODITIES FUTURE TRADING COMM'N (Apr. 2014), http://www.cftc.gov/idc/groups/public/@economicanalysis/documents/file/oce_riskandreturn0414.pdf.
- 128 From the comments under Larry Tabb's post: “Wow! I guess they will have to downsize in the Hamptons.” Leon Turner (@Trots11), TWITTER (Mar. 30, 2014, 5:24 PM), <https://twitter.com/ltabb/status/450423445042376704>.
- 129 See Eric Budish, Peter Cramton & John Shim, *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*, 130 Q.J. OF ECON. 1547 (Nov. 2015), <http://faculty.chicagobooth.edu/eric.budish/research/HFT-FrequentBatchAuctions.pdf> (Modern U.S. markets generally all operate as continuous limit order books, meaning trades are placed and accepted on a real time basis and prioritized based

on price and time. Alternatives include batch auction models, in which blocks of trades placed over a chunk of time are collected and ordered by price and randomly across their arrival time.).

- 130 *Id.* at 1553.
- 131 Baron et al., *supra* note 127, at 31 (“Our results are consistent with theoretical predictions regarding winner-takes-all competition based on speed ... if speed advantages are relative, then increased competition won't drive profit opportunities to zero, since HFTs can always one-up the competition with an ever-smaller increase in speed.”).
- 132 *Id.* at 41.
- 133 Schmerken, *supra* note 126.
- 134 Baron et al., *supra* note 127.
- 135 *Id.*; see also Yacine Aït-Sahalia & Mehmet Saglam, *High Frequency Traders: Taking Advantage of Speed* (Nat'l Bureau of Econ. Research, Working Paper No. 19531, 2013), <http://www.nber.org/papers/w19531.pdf> (“We determine the provision of liquidity, order cancellations, and impact on low frequency traders as a function of both the high frequency trader's latency, and the market volatility. The model predicts that volatility leads high frequency traders to reduce their provision of liquidity.”).
- 136 Baron et al., *supra* note 127, at 27 (“Aggressive HFTs tend to make positive profits at medium time scales, in the 1,001-10,000 and 10,001-100,000 transaction range, with negative profits at short ranges (11-100 and 101-1,000 transaction intervals) and the longest time scale of 100,000+ transactions.”).
- 137 Baron et al., *supra* note 127.
- 138 *Id.* (“In order for an aggressive trade to be profitable, an HFT must not only predict the direction of the price process but also overcome the bid-ask spread. We suspect that this is the reason Aggressive HFTs fail to make money at the shortest time intervals.”).
- 139 *Id.*
- 140 Jonathan Brogaard et al., *High-Frequency Trading Competition*, (Bank of Canada Working Paper No. 2014-19, May 2014).
- 141 Baron et al., *supra* note 127, at 14 (“About half of that decline was from a reduction in Mixed HFT trading from 960,643 contracts in August 2010 to 564,200 contracts in August 2012.”).
- 142 *Id.*
- 143 *Id.* at 33 (“[The] Profit Herfindahl index [of Passive HFTs] increases from 0.287 in 2010, trending steadily upward, to 0.545 in the second half of 2012; similarly the volume Herfindahl index of Passive HFTs increases from 0.129 in 2010, trending steadily upward, to 0.331 in the second half of 2012.”).
- 144 Brogaard et al., *supra* note 140, at 13 (“Also, later entrant groupings are generally composed of more aggressive HFTs. The average aggressiveness of the first event group is 38%, whereas it is 88% for the last.”).
- 145 Baron et al., *supra* note 127, at 21, 23.
- 146 *Id.* at 21-23.
- 147 *Id.* at 33, 36.
- 148 *Id.* at 59; Brogaard et al., *supra* note 140, at 2-5.
- 149 Baron et al., *supra* note 127, at 37.

- 150 Brogaard et al., *supra* note 140, at 3-6.
- 151 *Id.*
- 152 *Id.* at 17.
- 153 LEWIS, *supra* note 75.
- 154 Press Release, U.S. Sec. & Exch. Comm'n (2014), SEC Charges New York-Based High Frequency Trading Firm With Fraudulent Trading to Manipulate Closing Prices, *available at* <https://www.sec.gov/News/PressRelease/Detail/PressRelease/1370543184457>.
- 155 John McCrank, *Exclusive: SEC Targets 10 Firms in High Frequency Trading Probe--SEC Document*, REUTERS (July 17, 2014), <http://www.reuters.com/article/us-sec-investigation-highfrequencytrading-idUSKBN0FM2TW20140717>.
- 156 Disruptive Trading Practices, U.S. COMM. FUT. TRADING COMM'N, http://www.cftc.gov/LawRegulation/DoddFrankAct/Rulemakings/DF_24_DisruptiveTrading/index.htm (last visited Mar. 16, 2016).
- 157 Paul M. Architzel et al., *2014 CFTC Enforcement Year-in-Review, and a Look Forward*, WILMERHALE (Feb. 10, 2015), *available at* https://www.wilmerhale.com/uploadedFiles/Shared_Content/Editorial/Publications/WH_Publications/Client_Alert_PDFs/2014-cftc-enforcement-year-in-review.pdf; *see also* Marcus A. Christian et al., *US Department of Justice Brings Its First Criminal Prosecution for Spoofing Commodities Markets*, MAYER BROWN (Oct. 14, 2014), *available at* <http://www.mayerbrown.com/publications/detailprint.aspx?publication=10715>.
- 158 Christian et al., *supra* note 157.
- 159 *See generally* Noam Noked, *Increased Scrutiny of High Frequency Trading*, HAR. L. SCH. F. ON CORP. GOVERNANCE AND FIN. REG. (Mar. 23, 2014), <http://blogs.law.harvard.edu/corpgov/2014/05/23/increased-scrutiny-of-high-frequency-trading/> (documenting the rising tide of legal scrutiny on the HFT industry across a wide spectrum of public and private entities).
- 160 Christian et al., *supra* note 157.
- 161 *Id.*
- 162 Robert Fallon, *CFTC Takes Early Enforcement Act Against Spoofing in Derivatives Markets*, STINSON LEONARD STREET DODD-FRANK.COM (Apr. 13, 2011), <http://dodd-frank.com/cftc-takes-early-enforcement-action-against-spoofing-in-derivatives-markets/> (In particular, “[t]he CFTC filed and simultaneously settled charges for \$550,000 against Bunge Global Markets, Inc. (“Bunge”) regarding allegations that Bunge employees had engaged in “spoofing” in the soybeans futures market.”).
- 163 *Id.* (For example, “[d]uring a thirteen minute period of the pre-opening session, the first Bunge employee entered 101 orders for 500 contracts each at prices above the prevailing bid. This trading caused the IOP to move ‘limit up.’ ... The employee later admitted that when he placed the orders, he had no intention of executing them at opening; the sole purpose of his activities was to determine the depth of support at specific price levels by causing the IOP to move up.”).
- 164 *Id.* (In fact “[b]y knowingly placing orders that they did not intend to execute, the traders violated Section 4c(a)(2)(B) of the CEA by causing the IOP to reflect prices that were not true and bona fide, and these prices were reported to the market. The trading activities also violated Section 9(a)(2) of the CEA by knowingly delivering (i) market reports or market information through interstate commerce, (ii) that were false and misleading, and (iii) that affected or tended to affect the price of the commodity in interstate commerce.”).
- 165 Robert Fallon, *CFTC Announces Second Spoofing Action Against Commodity Traders*, Making Sense of Dodd-Frank (Jan. 2, 2013), <http://doddfrank.com/cftc-announces-second-spoofing-action-against-commodity->

traders/ (“The Commodity Futures Trading Commission (CFTC) recently announced its second enforcement action against a commodity trader for engaging in the manipulative scheme called ‘spoofing.’ *U.S. Commodity Futures Trading Commission v. Eric Moncada*, 12 CV-8791, United States District Court for the Southern District of New York, December 4, 2012 (*Moncada*.”); Press Release, U.S. Comm. Fut. Trading Comm'n, Federal Court Orders Eric Moncada to Pay \$1.56 Million Penalty for Attempting to Manipulate the Wheat Futures Market (Oct. 1, 2014), available at <http://www.cftc.gov/PressRoom/PressReleases/pr7026-14> (The CFTC obtained a court order granting summary judgment on charges against Moncada and imposing a \$1.56 million civil monetary penalty and trading and registration restrictions in 2014.).

- 166 Press Release, U.S. Comm. Future Trading Comm'n, CFTC Files Complaint in Federal Court against Eric Moncada, BES Capital LLC, and Serdika LLC Alleging Attempted Manipulation of Wheat Futures Contract Prices, Fictitious Sales, and Non-Competitive Transactions (Dec. 4, 2012), available at <http://www.cftc.gov/PressRoom/PressReleases/pr6441-12> (“According to the complaint, Moncada’s scheme was to electronically enter and immediately cancel numerous large-lot orders for wheat futures that he did not intend to fill, but that he intended to use to create a misleading impression of increasing liquidity in the marketplace. As alleged, Moncada would enter orders of such a large size and at prices at or near the best bid or offer in a manner to avoid being filled and result in executed trades. The complaint alleges that Moncada would then seek to take advantage of any price movements that may have resulted from this manipulative scheme by placing smaller orders, which he hoped to fill at prices beneficial to him, on the opposite side of market from his large-lot cancelled orders.”).
- 167 In the matter of Panther Energy Trading LLC and Michael J. Coscia, U.S. COMM. FUT. TRADING COMM'N, CFTC No. 13-26 (July 22, 2013), available at <http://www.cftc.gov/ucm/groups/public/@lrenforcementactions/documents/legalpleading/enfpantherorder072213.pdf> (“Respondents engaged in conduct that is, or is of the character of, or is known to the trade as, spoofing, the conduct violated Section 4c(a)(5)(C) of the Act, 7 U.S.C. § 6c(a)(5)(C), which, inter alia, makes it unlawful for any person to engage in 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 the trade as, spoofing.”).
- 168 *Id.*
- 169 Silla Brush & Lindsay Fortado, *Panther, Coscia Fined Over High-Frequency Trading Algorithms*, BLOOMBERGBUSINESS (July 22, 2013), <http://www.bloomberg.com/news/2013-07-22/panther-coscia-fined-over-high-frequency-trading-algorithms-1-.html> (last visited Mar. 16, 2016) (Panther and Coscia agreed to pay \$4.5 million to U.S. and U.K. regulators to resolve the allegations that they used high-frequency trading algorithms that manipulated commodities markets.).
- 170 Press Release, U.S. Attn'y's Office N. Dist. of Ill., High-Frequency Trader Indicted for Manipulating Commodities Futures Markets in First Feral Prosecution for Spoofing (Oct. 2, 2014), available at <http://www.fbi.gov/chicago/press-releases/2014/high-frequency-trader-indicted-for-manipulating-commodities-futures-markets-in-first-federal-prosecution-for-spoofing>.
- 171 Brian Louis & Janan Hanna, *Swift Guilty Verdict in Spoofing Trial May Fuel New Prosecutions in U.S.*, BLOOMBERGBUSINESS (Nov. 3, 2015, 10:27 PM), <http://www.bloomberg.com/news/articles/2015-11-03/commodities-trader-coscia-found-guilty-in-first-spoofing-trail>.
- 172 The private, self-regulatory organization established by the exchanges and authorized by Congress to assist in the regulation of the securities industries. FIN. INDUS. REGULATORY AUTH., www.finra.org (last visited Mar. 16, 2016).
- 173 See News Release, Fin. Indus. Regulatory Auth., FINRA Sanctions Trillium Brokerage Services, LLC, Director of Trading, Chief Compliance Officer, and Nine Traders \$2.26 Million for Illicit Equities Trading Strategy (Sept. 13, 2010), <http://www.finra.org/Newsroom/NewsReleases/2010/P121951> (last visited April 9, 2016).
- 174 *Id.* “In addition to the nine traders, FINRA also took action against Trillium’s Director of Trading and its Chief Compliance Officer. The 11 individuals were suspended from the securities industry or as principals for periods ranging from six months to two years. FINRA levied a total of \$802,500 in fines against the individuals, ranging

from \$12,500 to \$220,000, and required the traders to pay out disgorgements totaling about \$292,000.”; *see also* PATTERSON, *supra* note 21, at 286-87.

- 175 *See* Press Release, Sec. and Exch. Comm'n, SEC Charges NY-Based Brokerage Firm With Layering (Sept. 25, 2012), http://www.sec.gov/News/PressRelease/Detail/PressRelease/1365171484972#.VOayCPnF_pN.
- 176 *Id.*
- 177 *See* Fin. Indus. Regulatory Auth., *supra* note 173; *see also Whac-A-Mole Is Manipulation*, *supra* note 109 (graphically explaining the trading strategy employed by Hold using data from proprietary exchange data feeds).
- 178 Visionary Trading LLC, Lightspeed Trading LLC, Andrew Actman, Joseph Dondero, Eugene Giaquinto, Lee Heiss & Jason Medvin, Exchange Act Release No. 71871, 2014 WL 1338258 (Apr. 4, 2014).
- 179 “By engaging in the layering scheme, Milrud violated ... Sections 9(a)(2) and 10(b) of the Securities Exchange Act of 1934 ... and Rules 10b-5(a) and 10b-5(c) thereunder.” Complaint at ¶ 4, Sec. Exchange Comm'n v. Aleksandr Milrud, No. 15CV00237-KN-SCM, *available at* <http://www.sec.gov/litigation/complaints/2015/comp-pr2015-4.pdf>.
- 180 *See* Scott Redler, *Trillium Fine Nothing to do with High Frequency Trading (HFT)*, T3 LIVE (Sept. 14, 2010, 1:22 PM), <http://www.t3live.com/articles/blog/1435-trillium-fine-nothing-to-do-with-high-frequency-trading-hft.html>; *see also* In FINRA vs. Trillium, Score One For John Henry, TABB FORUM (Sep. 16, 2010), <http://tabbforum.com/opinions/in-finra-vs-trillium-score-one-for-johnhenry>.
- 181 Matt Levine, *Spoofers Tricked High-Frequency Traders by Hitting Keys Fast*, BLOOMBERG VIEW (Jan. 13, 2015, 5:06 PM), <http://www.bloombergtview.com/articles/2015-01-13/spoofers-tricked-high-speedtraders-by-hitting-keys-fast>.
- 182 Latour paid a \$16 million fine without admitting or denying wrongdoing. Scott Patterson & Bradley Hope, *High Frequency Trading Firm Latour to Pay \$16 Million SEC Penalty*, WALL ST. J. (Sept. 17, 2014, 6:51 PM), <http://online.wsj.com/articles/high-frequency-trading-firm-latour-agrees-to-pay-16-million-penalty-sec-says-1410964917>.
- 183 Press Release, Sec. and Exch. Comm'n, SEC Charges NY-Based High Frequency Trading Firm With Violating Net Capital Rule For Broker-Dealers (Sept. 17, 2014), http://www.sec.gov/News/PressRelease/Detail/PressRelease/1370542972403#.VOaWO_nF_pM (“The rule requires that broker-dealers at all times have and maintain minimum net capital as specified in the rule. Accordingly, high-frequency trading firms that are registered as broker-dealers must have and maintain the required minimum net capital to support the dollar volume of both their end-of-day and intra-day positions; the speed with which these broker-dealers trade in and out of positions does not change this requirement. As part of its net capital calculations, a broker-dealer is required to make prescribed percentage deductions from the market value of its proprietary securities and other positions. In general, these deductions, referred to as haircuts, are designed to account for the market risk inherent in these positions and create a buffer of liquidity to protect against other risks associated with the securities business. Failure to calculate proper haircut deductions may have the effect of improperly inflating a broker-dealer's net capital, resulting in an inaccurate net capital calculation.”); Latour Trading LLC and Nicolas Niquet, Exchange Act Release No. 73125, 2014 WL 4640375 (Sept. 17, 2014).
- 184 *See* Athena Capital Research, LLC, Exchange Act Release No. 73369, 2014 WL 5282074 (Oct. 16, 2014).
- 185 *See* Alan Pyke, *Company Accused of Committing Fraud Will Pay Just \$1 Million To Settle-- Without Admitting Anything*, THINK PROGRESS (Oct. 17, 2016, 2:35 PM), <http://thinkprogress.org/economy/2014/10/17/3581297/sec-high-frequency-trading-settlement/>.
- 186 Levine, *supra* note 181.

- 187 Press Release, Sec. and Exch. Comm'n, SEC Charges NY-Based High Frequency Trading Firm With Fraudulent Trading to Manipulate Trading Prices (Oct. 16, 2014), http://www.sec.gov/News/PressRelease/Detail/PressRelease/1370543184457#.VOar1fnF_pN (last visited Mar. 7, 2016).
- 188 Levine, *supra* note 181.
- 189 See 17 C.F.R. § 240.15c3-5 (2011) (sometimes referred to as the Sponsored Access Rule); see also Risk Management Controls for Brokers or Dealers with Market Access, 17 C.F.R. § 240, SEC Release No. 34-63241 (Nov. 3, 2010), available at <http://www.sec.gov/rules/final/2010/34-63241.pdf>; see also Client Memorandum from Willkie Farr & Gallagher LLP on Recent SEC Market Structure Initiatives, 1 (Nov. 22, 2010), available at <http://www.willkie.com/~media/Files/Publications/2010/11/Recent%20SEC%C20Market%C20Structure%20Initiatives/Files/RecentSECMarketStructureInitiativespdf/FileAttachment/Recent-SEC-Market-Structure-Initiatives.pdf>.
- 190 Risk Management Controls for Brokers or Deals with Market Access, *supra* note 189, available at <http://www.sec.gov/rules/final/2010/34-63241.pdf> (“Among other things, Rule 15c3-5 requires broker-dealers with access to trading securities directly on an exchange or alternative trading system (“ATS”), including those providing sponsored or direct market access to customers or other persons, and broker-dealer operators of an ATS that provide access to trading securities directly on their ATS to a person other than a broker-dealer, to establish, document, and maintain a system of risk management controls and supervisory procedures that, among other things, is reasonably designed to systematically limit the financial exposure of the broker-dealer that could arise as a result of market access, and ensure compliance with all regulatory requirements that are applicable in connection with market access The required financial risk management controls and supervisory procedures must be reasonably designed to prevent the entry of orders that exceed appropriate pre-set credit or capital thresholds, or that appear to be erroneous. The regulatory risk management controls and supervisory procedures must also be reasonably designed to prevent the entry of orders unless there has been compliance with all regulatory requirements that must be satisfied on a preorder entry basis, prevent the entry of orders that the broker-dealers or customer is restricted from trading, restrict market access technology and systems to authorized persons, and assure appropriate surveillance personnel receive immediate post-trade execution reports.”).
- 191 SEC Release No. 34-64748 (June 27, 2011) (“It has been reported that sponsored access trading volume accounts for 50 percent of overall average daily trading volume in the U.S. equities market In addition, sponsored access has been reported to account for 15 percent of Nasdaq volume.”).
- 192 Press Release, Sec. and Exch. Comm'n, SEC Adopts New Rule Preventing Unfiltered Market Access (Nov. 3, 2010), <http://www.sec.gov/news/press/2010/2010-210.htm> (last visited Mar. 8, 2016).
- 193 Knight Capital Americas LLC, Exchange Act Release No. 70694, 107 SEC Docket 2303 (Oct. 16, 2013), available at <http://www.sec.gov/litigation/admin/2013/34-70694.pdf>.
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- 195 Knight Capital Americas LLC, *supra* note 193 at 5.
- 196 Marc D. Cahn et al., *Knight Capital Settles Rule 15c3-5 Violations With SEC, Agrees to Pay \$12 Million*, WILMERHALE (Oct. 22, 2013), <https://www.wilmerhale.com/pages/publicationsandnewsdetail.aspx?NewsPubId=10737422462> (last visited Mar. 8, 2016).

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- 198 Bodek, *supra* note 75.
- 199 “Mr. Bodek filed his concerns with the SEC’s enforcement division in July 2011, working through the Hagens Berman law firm.” Scott Patterson & Judy Strasburg, *For Superfast Traders, a Way to Jump Ahead in Line*, WALL ST. J. (Sept. 19, 2012, 5:59 PM), <http://www.wsj.com/news/articles/SB10000872396390443989204577599243693561>.
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- 203 “The SEC does not allege that there was anything inherently inappropriate about the order type functionality. Rather, the SEC alleged that the price sliding functionality was not completely and accurately disclosed in Direct Edge’s rules.” *BATS to Pay \$14mn SEC fine in wake of order-type scandal*, AUTOMATED TRADER (Jan. 12, 2015), http://www.automatedtrader.net/headlines/152932/batstopay14mnsecfineinwakeoforder_typescandal; *see also* BATS EXCH., *supra* note 202.
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- 205 SEC, *supra* note 68, *In the Matter of New York Stock Exchange LLC, and NYSE Euronext, Exchange Act Release No. 67857, 2012 WL 4044880* (Sept. 14, 2012).
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- 210 McCrank, *supra* note 155; Mary Jo White, Chair, Securities and Exchange Commission, Speech at Sandler O’Neill & Partners, L.P. Global Exchange and Brokerage Conference, *Enhancing Our Equity Market Structure* (June 5, 2014) (transcript available at <https://www.sec.gov/News/Speech/Detail/Speech/1370542004312>).
- 211 Until it really, really doesn’t, of course, which is the purpose of those requirements in the first place.

- 212 “Rule 17a-25 codified the requirement that broker-dealers submit to the Commission, upon request, information on their customer and proprietary securities transactions in an electronic format.” 17 C.F.R. § 242, <http://www.sec.gov/rules/final/2012/34-67457.pdf>.
- 213 *Id.* (For example, “data collected by FINRA pursuant to FINRA’s Rule 7400 series (“OATS data”) does not provide a complete picture of the market because though OATS collects data from FINRA members with respect to orders and trades involving NMS stocks, OATS does not include trade or order activity that occurs on exchanges, or at broker-dealers that are not FINRA or Nasdaq members. Nor does OATS include exchange quotes, principal orders submitted by FINRA members registered as market makers, or options data.”).
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- 215 See Sec. & Exch. Comm’n & U.S. Comm. Fut. Trading Comm’n, *Findings Regarding the Market Events of May 6, 2010* (2010), available at <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.
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- 217 Sec. and Exch. Comm’n, *Market Data Solution* (Nov. 30, 2011), https://www.fbo.gov/index?s=opportunity&mode=form&id=84871ef59db821d202750b26a5bfc2f9&tab=core&_cview=0.
- 218 Nathaniel Popper & Ben Protess, *To Regulate Rapid Traders, S.E.C. Turns to One of Them*, N.Y. TIMES (Oct. 7, 2012), <http://www.nytimes.com/2012/10/08/business/sec-regulators-turn-to-high-speed-tradingfirm.html?pagewanted=all>.
- 219 Sec. & Exch. Comm’n, *Market Information Data Analytics System (MIDAS)*, SEC.GOV, http://www.sec.gov/marketstructure/midas.html#.VPOIPnF_pM.
- 220 Popper & Protess, *supra* note 218.
- 221 Elisse Walter, Chairman, Securities and Exchange Commission, Speech at the American University School of Law: *Harnessing Tomorrow’s Technology for Today’s Investors and Markets* (Feb. 19, 2013) (transcript available at http://www.sec.gov/News/Speech/Detail/Speech/1365171492300#.VPOEafnF_pN); see Sec. & Exch. Comm’n, *Market Information Data Analytics System (MIDAS)*, *supra* note 219.
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- 224 *SEC Rule 613: Consolidated Audit Trail*, CATNMSPLAN, <http://catnmsplan.com/>.
- 225 Letter from parties to the National Market System Plan Governing the Consolidated Audit Trail to SEC, Brent K. Fields, Secretary, Sec. and Exch. Comm’n (Sept. 30, 2014), available at http://www.catnmsplan.com/web/groups/catnms/@catnms/documents/appsupportdocs/cat_nms_plan_020816.pdf.
- 226 Walter, *supra* note 221.
- 227 *Sexy and Seventeen! (New SEC Equity Market Structure Advisory Committee)*, THEMIS TRADING BLOG (Jan. 14, 2015), <http://blog.themistrading.com/2015/01/sexy-and-seventeen-new-sec-equity-market-structure-advisory-committee/>.
- 228 Maureen O’Hara & Mao Ye, *Is Market Fragmentation Harming Market Quality?* (2009), <http://web.law.columbia.edu/sites/default/files/microsites/capital-markets/Market%20Fragmentation%20Paper.pdf>.
- 229 See *Summary of the Consolidated Audit Trail Initiative 8* (2015), <http://www.catnmsplan.com/web/groups/catnms/@catnms/documents/appsupportdocs/p571933.pdf>.

- 230 Andrew Ackerman, *SEC Chief: Board Diversity Is a Priority for Agency in 2016*, WALL ST. J. (Jan. 27, 2016, 10:13 AM), <http://www.wsj.com/articles/sec-chief-board-diversity-is-a-priority-for-agency-in-2016-1453853477>.
- 231 Popper & Protes, *supra* note 218.
- 232 “The NMS plan required by the Rule, ... will improve the quality of audit trail data by, among other things: (1) identifying with a unique “Customer-ID” the account holder(s) with respect to an account at a registered broker-dealer and, if different, any person authorized to give the broker-dealer trading instructions for such account; (2) identifying the time of each key event in the life of an order according to synchronized business clocks; (3) requiring the reporting of comprehensive order lifecycle data; and (4) including all NMS securities in one audit trail.” 17 C.F.R. § 242, <http://www.sec.gov/rules/final/2012/3467457.pdf> (last visited Mar. 8, 2016).
- 233 *Supra* note 225.
- 234 *Id.*
- 235 See CAT Initiative, *supra* note 229, at 8-10.
- 236 See *id.* at 7 (requesting exemption from the requirements of reports linking trade executions and subaccounts and the granularity of the reporting of manual orders).
- 237 See discussion of Odd Lot orders below.
- 238 Even HFT proponents expect the SEC to employ CAT mainly to investigate and weed out the rule breakers. “‘The CAT will separate the bulk of speed traders from a handful of bad actors who practice manipulative strategies,’ says Peter Nabicht, a senior adviser at the Modern Markets Initiative, a highfrequency trade group. ‘I think the data will ultimately exonerate us in the minds of a lot of people.’” Matthew Philips & Silla Brush, *SEC Computer Called CAT Will Peer Into Dark Pools, Track Orders*, BLOOMBERG BUSINESS (Aug. 7, 2014, 12:24 PM), <http://www.bloomberg.com/news/articles/2014-08-07/sec-computer-called-cat-will-peer-into-dark-pools-track-orders>.
- 239 Modern U.S. markets generally all operate as continuous limit order books, meaning trades are placed and accepted on a real time basis, and prioritized based on both price and time. “We propose a simple alternative: discrete-time trading. More precisely, we propose a market design in which the trading day is divided into extremely frequent but discrete time intervals, of length, say, 100 milliseconds. All trade requests received during the same interval are treated as having arrived at the same (discrete) time. Then, at the end of each interval, all outstanding orders are processed in batch, using a uniform-price auction, as opposed to the serial processing that occurs in the continuous market. We call this market design frequent batch auctions.” Budish et al., *supra* note 129 at 1547, 1549.
- 240 *Id.*
- 241 *Id.*
- 242 *Id.*
- 243 “Should the Commission consider a ‘trade-at rule’ that would prohibit any trading center from executing a trade at the price of the NBBO unless the trading center was displaying that price at the time it received the incoming contra-side order?” Concept Release on Equity Mkt. Structure, [Exchange Act Release No. 61356, 2010 WL 148769 \(Jan. 14, 2010\)](#).
- 244 *Id.*
- 245 Sarah N. Lynch & John McCrank, *Exclusive: SEC eyes test that may lead to shift away from ‘dark pools’*, REUTERS (Apr. 11, 2014, 5:35 AM), <http://www.reuters.com/article/2014/04/11/us-sec-darkmarketsidUSBREA3A0CP20140411>.

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- 247 *Thoughts on Trade-At Rule*, *supra* note 246.
- 248 See *id.*; Policy Brief: *See also Trade-At Rules in Australia and Canada*, Chartered Financial Analyst Institute, available at <http://www.cfainstitute.org/ethics/Documents/Policy%20Brief%20Trade-at%20Rules.pdf>.
- 249 Telis Demos, *Traders do not anticipate 'trade at' rules*, FINANCIAL TIMES (Mar. 3, 2011), <http://www.ft.com/cms/s/0/06caa75c-4455-11e0-931d-00144feab49a.html#axzz48s29X8yM>.
- 250 Nina Mehta, Whitney Kisling & Jesse Hamilton, *SEC May Risk Harming Investors With 'Trade-At Rule' for Stocks*, BLOOMBERG BUSINESS (Feb. 19, 2011, 12:01 AM), <http://www.bloomberg.com/news/articles/2011-02-18/stock-markets-require-limit-up-limit-down-system-sec-cftc-advisers-say>.
- 251 See Andre E. Owens, Bruce H. Newman & Cherie Weldon, *SEC Requests Comment on NMS Plan to Implement Tick Size Pilot Program for Small Cap Stocks*, WILMERHALE (Dec. 15, 2014), <https://www.wilmerhale.com/pages/publicationsandnewsdetail.aspx?NewsPubId=17179875711>.
- 252 “On [October, 15 2012], Canada introduced the first broad-based trade-at rule, requiring all dark markets to provide meaningful price improvement when executing dark orders. Australia followed suit less than a year later, introducing a version applicable to all dark markets in that country on [May 26, 2013] [T]he rules in both countries required that ‘dark trades below block size’ had to have at least one full tick of price improvement--half a tick if the spread was one tick or less Under the revised Markets in Financial Instruments Directive (MiFID II), which was passed into law in June 2014 [in Europe], dark pool ‘reference price’ systems will be required to match orders at the mid-point of the quoted spread on a reference market (such as the primary exchange). Accordingly, these systems will be subject to a price-improvement requirement” Policy Brief, *supra* note 248, at 2-3, 5.
- 253 *SEC Delays Tick-Size Pilot*, MARKETS MEDIA (Mar. 4, 2015), <http://marketsmedia.com/sec-delays-tick-size-pilot/>.
- 254 [Order Granting Exemption from Compliance with the National Market System Plan to Implement a Tick Size Pilot Program](http://www.sec.gov/rules/exorders/2015/34-76382.pdf), Exchange Act Release No. 34-76382, 2015 WL 6777085 (Nov. 6, 2015), available at <https://www.sec.gov/rules/exorders/2015/34-76382.pdf>.
- 255 “In 2012, France introduced a 0.2% tax on transactions in large stocks, and a 0.01% tax on HFTs penalizing them for a high rate of order cancellations within a half-second. Similarly, in Italy, a tax of 0.02% on orders issued and then cancelled within half a second, once above a threshold, has been introduced. The Deutsche Börse introduced a tax in 2012 that charges HFTs for high ‘order-to-trade’ ratios as does the London Stock Exchange. Norwegian regulators[,] too[,] consider taxing traders who submit a large number of orders relative to their actual executions. The CME Group, the world’s largest futures exchange, has had for a number of years message volume caps, designed to prevent excessive numbers of orders from being placed, while Nasdaq and DirectEdge, two of the largest US stock exchanges have introduced fines to discourage excessive order placement. Canadian regulators, too, began increasing the fees charged to HFTs that flood the market with orders, while Indian regulators are studying ways to curb HFTs. On the other hand, Brazil appears to welcome the influx of HFTs. Australian regulators want HFTs to implement a ‘kill switch’ to prevent future flash crashes, and are considering a tax charge, although they appear to take a more benevolent view of HFTs than some of their counterparts in Europe. In January 2013, European Union finance ministers approved a transaction tax in Germany, France, Italy, Spain, and seven other Eurozone countries; the UK, concerned about the impact on the City, is opposed. It seems unlikely at present that the initially far-reaching package will get implemented as proposed, if ever. The German government has advanced legislation that would, among other things, force HFTs to register as such with the government and limit their ability to rapidly place and cancel orders. The European Parliament

has voted to require HFTs to honor the quotes they submit for at least half a second; imposes a minimum half-second delay on executing orders in a bid; possible use of circuit breakers to interrupt a sudden market plunge; and fee structures that would discourage excessive algorithmic trades. These rules could potentially apply to all 27 member states of the European Union if governments were to give their approval. In the US, the SEC and CFTC are discussing similar kinds of regulatory actions, while transaction tax legislation has been introduced in the Senate, although with little prospects of passage. Not surprisingly, many trade associations representing trading firms are opposing these proposals.”). Yachine Ait-Sahalia & Mehmet Saglam, *High Frequency Traders: Taking Advantage of Speed* (Nat'l Bureau of Econ. Research, Working Paper No. 19531), 37-383828, available at <http://www.nber.org/papers/w19531.pdf>.

256 See Staff of the Div. of Trading and Mkts., EQUITY MARKET STRUCTURE LITERATURE REVIEW PART II: HIGH FREQUENTS TRADING 29 (Mar. 17, 2014) (“Malinova, Park and Riordan (2013) use a regulatory dataset with trader identifiers and a proprietary dataset of retail trader transactions to examine the effect of iATs (intensive algorithmic traders--which they note include high frequency market makers) on retail traders and institutional traders in the Canadian equity markets After the fee change [on message traffic], iATs reduced their total messages by over 30%. The authors find that quoted and effective spreads rose significantly with the decline in iAT message rates and that realized spreads (a measure of profitability for passive traders) decreased significantly. The authors suggest that, after the fee change, passive traders were hampered by their inability to manage their market exposure through limit order cancellations.”); Hagstromer & Norden, *supra* note 41, at 1 (“The findings indicate that, e.g., the financial transaction tax proposed by the European Commission, which would render most HFT strategies unprofitable, would primarily hit market makers and increase market volatility.”); Charles M. Jones, *What Do We Know About High Frequency-Trading?* 1 (Columbia Bus. Sch. Research Paper No. 13-11, 2013), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2236201 (“Many of the regulatory issues associated with HFT are the same issues that arose in more manual markets. Now regulators in the US are appropriately relying on competition to minimize abuses. Other regulation is appropriate if there are market failures. For instance, consolidated order-level audit trails are key to robust enforcement. If excessive messages impose negative externalities on others, fees are appropriate. But a message tax may act like a transaction tax, reducing share prices, increasing volatility, and worsening liquidity. Minimum order exposure times would also severely discourage liquidity provision; *but see* Ait-Sahalia & Saglam, *supra* note 255, at 3-4 (“Finally, we analyze the possible impact of three widely discussed HFT policies: imposing a transaction tax on each trade, setting minimum-time limits before orders can be cancelled, and taxing the cancellations of limit orders. We find that, in the context of our model, imposing minimum time-limits and cancellation taxes induces the HFT to quote more on both sides of the market, whereas transaction taxes do not improve this measure of liquidity. One important finding is that when minimum time-limits are in effect, the fill rate of LFTs' market orders by the HFT does not decrease substantially in the presence of higher volatility, unlike the situation without minimum resting times.”).

257 See Staff of the Div. of Trading and Mkts., *supra* note 256, at 20 (“Hagstromer and Norden (2013) examine changes in HFT that are associated with tick size changes. On the OMXS, tick sizes are determined by stock price level, with wider tick sizes kicking in at specified higher price levels. They find that tick size increases have a strongly negative effect on the market share of aggressive HFTs, while tick size increases have a positive effect on the market share of passive HFTs.”); Robert P. Bartlett, III & Justin McCrary, *Shall We Haggle in Pennies at the Speed of Light or Nickels in the Dark? How Minimum Price Variation Regulates High Frequency Trading and Dark Liquidity* 2 (unpublished draft), available at http://www2.warwick.ac.uk/fac/soc/economics/intranet/calendar/justin_mccrary.pdf (“We demonstrate empirically how recent proposals to modify the penny-based system of stock trading may have simultaneous and opposite effects on the incidence of high frequency trading (HFT) and the trading of undisplayed (or “dark”) liquidity. We do so by exploiting the fact that the existing ban on sub-penny quotations (Rule 612 of Regulation NMS) only applies to equity orders (bids or asks) priced at or above \$1.00 per share, thus creating a sharp distinction in tick size regulation between those orders that are just above \$1.00 and those just below it. Using a regression discontinuity design, we find that permitting subpenny orders for stocks priced below \$1.00 per share is associated with a sharp increase in the incidence of HFT and a sharp decrease in the trading of undisplayed liquidity (i.e., dark pools and broker internalization). Changes in market quality are mixed, with both quoted spreads and depths declining significantly for stocks priced just below the \$1.00 cut-off These results are strongly suggestive that ... Congress' mandate in Section

106(b) of the JOBS Act for the SEC to investigate increasing tick sizes for emerging growth companies can be expected to erode further the amount of trading that occurs on conventional stock exchanges while potentially reducing the incidence of HFT.”); *but see* Chen Yao & Mao Ye, *Tick Size Constraints, High-Frequency Trading, and Liquidity* 2 (Jan. 20, 2015) (“Proponents of widening the tick size argue that increasing the tick size would control the growth of HFT and increase liquidity (Weild, Kim and Newport (2012), but we find that an increase in the tick size harms liquidity and encourages HFT liquidity provision.” “[S]tocks with a smaller relative tick size are associated with higher incidences of non-HFTs establishing best quotes relative to that of HFTs.”).

- 258 *See* Staff of the Div. of Trading and Mkts., *supra* note 256, at 29 (“Malinova, Park and Riordan (2013) use a regulatory dataset with trader identifiers and a proprietary database of retail trader transactions to examine the effect.”), <http://www.futuresindustry.org/ptg/downloads/The-Diversity-of-HFT.pdf>; Hagstromer & Norden, *supra* note 41; Yao & Ye, *supra* note 257, at 10 (“This paper uses three main datasets: a NASDAQ HFT dataset, the NASDAQ TotalView-ITCH with a nanosecond time stamp, and Bloomberg. CRSP, Compustat and I/B/E/S are also used to calculate stock characteristics.”).
- 259 *Supra* note 254.
- 260 *See* Regulation NMS, Exchange Act Release No. 34-51808, 2015 WL 1364545, <https://www.sec.gov/rules/final/34-51808.pdf>.
- 261 *See* *What is a SIP and What Role Should it Play?*, MODERN MARKETS INITIATIVE (Jan. 16, 2014), (“Surprisingly, the United States is pretty much the only country that has a SIP. For example, Europe, Japan and Australia-- which have competing markets--do not have SIPs.”).
- 262 *See* Bradley Hope, *Nasdaq Cancels Deal to Operate News Feed*, WALL ST. J. (Jan. 14, 2014), *available at* <http://www.wsj.com/articles/SB10001424052702304549504579320754286900>.
- 263 *See* Ivy Schmerken, *Are the Exchanges Running the SIPs on Outdated Technology?*, WALL ST. & TECH. (Dec. 18, 2013), *available at* <http://www.wallstreetandtech.com/data-management/are-the-exchanges-running-the-sips-on-outdated-technology/d/d-id/1268625> (“News that the securities information processor that failed in August and caused a three-hour halt in trading of Nasdaq-stocks is running on Windows 2003, a decade's old operating system, has triggered a firestorm of criticism from industry observers. Although the Windows operating system was not blamed as the reason for the SIP outage, some Wall Street observers believe exchanges have underinvested in the critical market infrastructure that supplies market data vendors, brokers and media sites with access to consolidated trades and quotes.”).
- 264 *See* Hope, *supra* note 264 (“Nasdaq said it would ... reduce the time it takes for the SIP to process quotes and trades to just 25 microseconds in 2017. Tape C processed quotes and trades by an average of 58 microseconds and 59 microseconds respectively in the third quarter [of 2014], according to statistics on its website. A microsecond is one millionth of a second.”).
- 265 Letter from Kevin M. Carrol, Managing Director & Associate Gen. Couns., Sec. Industry and Fin. Mrkts. Ass'n to Michael A. Macchiaroli, Associate Director, Sec. & Exch. Comm'n (Oct. 14, 2014), *available at* <http://www.sifma.org/issues/item.aspx?id=8589950908> (“The Securities Industry and Financial Markets Association (SIFMA) brings together the shared interests of hundreds of securities firms, banks and asset managers. SIFMA's mission is to support a strong financial industry, investor opportunity, capital formation, job creation and economic growth, while building trust and confidence in the financial markets. SIFMA, with offices in New York and Washington, D.C., is the U.S. regional member of the Global Financial Markets Association (GFMA).”).
- 266 *Id.*
- 267 *See* Dave Michaels, Sam Mamudi & Matthew Philips, *Market Outages Highlight Exchanges' Conflicts Over Data Streams*, BLOOMBERGBUSINESS (Sept. 26, 2013), <http://www.bloomberg.com/news/articles/2013-09-26/market-outages-highlight-exchanges-conflicts-over-data-streams>; Schmerken, *supra* note 126.
- 268 Regulation NMS, *supra* note 260, at 358-60, *available at* <https://www.sec.gov/rules/final/34-51808.pdf>.

- 269 See Michaels et al., *supra* note 267.
- 270 *Id.*
- 271 One commenter noted that “[n]ot only would [the proposed formula] increase the potential unnatural trading and quoting behavior, it signifies a desire to use market structure regulation to micro-manage market participant behavior” (alteration in original). Regulation NMS, *supra* note 260.
- 272 *Id.*
- 273 Yao & Ye, *supra* note 257.
- 274 See Reg NMS, at 256-57.
- 275 “All too often academics attempting to research the markets run into the worst of all roadblocks: insufficient data. Researchers do an extraordinary job considering their limited access to data. Quality data sets are rarely available and when they are it tends to be a one-time-only release. It is remarkable that there has been such quality research with so little available data. The academic community simply does not have the data they need in order to deliver the highest impact. The data that [are] readily available, such as historical market data, is costly for researchers and is not as rich as is often needed. And exchanges are naturally cautious about disseminating data.” <http://modernmarketsinitiative.org/sound-regulation-make-data-available-researchers/>.
- 276 See Yao & Ye, *supra* note 257, at 11-12.
- 277 Maureen O’Hara, Chen Yao & Mao Ye, *What’s Not There: The Odd Lot Bias in TAQ Data*, 69 J. OF FIN. 2199, 2202-03 (Sept. 12, 2014), available at <http://www.afajof.org/details/journalArticle/6614261/Whats-Not-There-Odd-Lots-and-Market-Data.html>.
- 278 *Id.*
- 279 *Id.*
- 280 *Id.*
- 281 *Id.*
- 282 *Id.*
- 283 SEC, *Odd Lots Rates in a Post-Transparency World*, DATA HIGHLIGHT (Jan. 9, 2014), available at <https://www.sec.gov/marketstructure/research/highlight-2014-01.html> (“The data also revealed that higher-priced stocks tended to have higher odd lot trade rates, with the top price decile averaging over 30%.”).
- 284 O’Hara et al., *supra* note 277.
- 285 *Id.*
- 286 See Order Approving Amendment No. 30 to the Joint Self-Regulatory Organization Plan Governing the Collection, Consolidation and Dissemination of Quotation and Transaction Information, Securities Act Release No. 34-70793, 2013 WL 5870026 (Oct. 31, 2013); see also Order Approving the Eighteenth Substantive Amendment to the Second Restatement of the CTA Plan, Securities Act Release No. 34-70794, 2013 WL 5870027 (Oct. 31, 2013); see also SEC, *supra* note 283 (concluding that no immediate decline occurred in odd lot trading after reporting to the public tape became mandatory).
- 287 O’Hara, Yao & Ye estimated that “[o]n that day, 17.5% of trades and 2.9% of volumes were odd lots. Odd-lot trading was most pronounced on NASDAQ, where 25% of trades and 5.5% of volumes were odd lots, and on BATS, where 21.2% of trades and 6.4% of volumes were odd lots. Odd-lot trading on the NYSE amounted to 15.5% of trades and 2.9% of volumes. Individual stocks showed wide variance in odd-lot trades. For Google, odd lots amounted to 67.5% of trades and 23.1% of volumes, for Amazon odd lots amounted to

53.9% of trades and 12.5% of volumes, and for Apple 45.7% and 13%, respectively.”; Kapil Phadnis & Gary Stone, *Introducing ... The Top Odd Lot Stocks Awards*, BLOOMBERG TRADEBOOK (Jan. 10, 2014), <http://www.bloombertradebook.com/blog/introducingthe-top-odd-lot-stocks-awards/>.

- 288 Press Release, Sec. and Exch. Comm'n, SEC Staff Publishes Private Funds Statistics Report (Oct. 16, 2015), available at <http://www.sec.gov/news/press/2010/2010-26.htm>.
- 289 Press Release, Sec. and Exch. Comm'n, Richard H. Walker, Director of Enforcement to Leave SEC, available at <https://www.sec.gov/news/press/2001-68.txt>.
- 290 Richard H. Walker, Dir., Div. of Enforcement, U.S. Sec. & Exch. Comm'n, Speech at the Bond Market Association's 6th Annual Legal and Compliance Seminar: Regulation vs. Enforcement in an On-Line World (Oct. 25, 2000), available at <https://www.sec.gov/news/speech/spch413.htm>.
- 291 *Id.*
- 292 *Id.*
- 293 *Id.*
- 294 See Mary L. Schapiro, Chairman, Sec. & Exch. Comm'n, News Conference Call: Statement Concerning Agency Self-Funding (Apr. 15, 2010), available at <https://www.sec.gov/news/speech/2010/spch041510mls.htm>; Ronald D. Orol, *Five SEC chairmen and Schumer push for self-funded SEC*, MARKETWATCH (Apr. 15, 2010), <http://www.marketwatch.com/story/five-sec-chairs-and-schumer-want-self-funded-sec-2010-04-15>.
- 295 Dina ElBoghdady, *Congress Slashes SEC's Funding for Technology Upgrades*, WASH. POST (Jan. 16, 2014), https://www.washingtonpost.com/business/economy/congress-slashes-secs-funding-for-technology-upgrades/2014/01/16/15ffacaa-7ebc-11e3-9556-4a4bf7bcbd84_story.html.

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