

Bucknell University

Bucknell Digital Commons

Faculty Journal Articles

Faculty Scholarship

2015

The Quixotic Quest for Fairness: The SEC's Role in the Rise of High Frequency Trading

Jan Traflet

Bucknell University, jtraflet@bucknell.edu

William R. Gruver

Bucknell University, gruver@bucknell.edu

Follow this and additional works at: https://digitalcommons.bucknell.edu/fac_journal



Part of the [Finance and Financial Management Commons](#)

Recommended Citation

Traflet, Jan and Gruver, William R.. "The Quixotic Quest for Fairness: The SEC's Role in the Rise of High Frequency Trading." *Essays in Economic and Business History* (2015) : 144-189.

This Article is brought to you for free and open access by the Faculty Scholarship at Bucknell Digital Commons. It has been accepted for inclusion in Faculty Journal Articles by an authorized administrator of Bucknell Digital Commons. For more information, please contact dcadmin@bucknell.edu.

This article was published on-line on April 29, 2015.

Essays in
**ECONOMIC &
BUSINESS
HISTORY**

The Journal of the Economic & Business History Society



Editor

Jason E. Taylor
Central Michigan University

Copyright © 2015, The Economic and Business History Society. This is an open access journal. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles in this journal without asking prior permission from the publisher or the author.



<http://creativecommons.org/licenses/by/4.0/>

ISSN 0896-226X
LCC 79-91616
HC12.E2

THE QUIXOTIC QUEST FOR FAIRNESS:
THE SEC'S ROLE IN THE RISE OF HIGH
FREQUENCY TRADING

Janice Traflet
School of Management
Bucknell University
jtraflet@bucknell.edu

William R. Gruver
School of Management
Bucknell University
gruver@bucknell.edu

This paper examines the complex factors facilitating the rise of high frequency trading (HFT) from a historical perspective. Over the course of several decades, various stock market regulations and reforms, championed by the Securities and Exchange Commission (SEC), created room for HFT to develop and flourish. While advancements in technology initially may appear to be the primary cause of HFT, in fact, HFT could not exist (or at least, not to the extent it does today) if certain rules and older ways of doing business on the exchanges were still in place, and if other regulations did not support its existence. This paper identifies multiple factors contributing to the eventual rise of HFT: decimalization, the decline of the specialist system, market fragmentation, rate deregulation, the repeal of the uptick rule, demutualization of the stock exchanges, and the institution of Regulation National Market System [NMS]. Moreover, it seeks to position these developments within the broader context of long-standing aims and themes embraced by the SEC.

Introduction

Detailing the stunning rise of high frequency trading (HFT) in his 2014 best-seller *Flash Boys*, Michael Lewis argues that high frequency traders have rigged the stock market to the disadvantage of many retail and institutional investors.¹ Making a similar contention in their own book, *Broken Markets*, Sal Arnuk and Joseph Saluzzi (2012) lament that markets are “broken” due in part to the rapid proliferation of HFT. Such criticisms have helped spark widespread debate about the effects and legitimacy of HFT, as well as its causes.² At first glance, advancements in technology may appear to be the primary cause of HFT, but technological innovation does not happen in a vacuum; often, it is a response to market opportunities. Lewis, Arnuk, and Saluzzi all trace the genesis of HFT to changes in market structure driven by the Securities and Exchange Commission (SEC), and they focus on developments that have occurred roughly over the past fifteen years.³ Indeed, various market reforms championed by the Securities and Exchange Commission (SEC) over *many decades* created room for HFT to develop and flourish. This essay explores those factors that facilitated and contributed to the rise of HFT from a broad historical perspective. HFT could not exist (or at least, not to the extent it does today) if certain rules and older ways of doing business on the exchanges were still in place, and if other regulations did not support its existence. This paper delves into decimalization, the decline of the specialist system, market fragmentation, rate deregulation, the repeal of the uptick rule, demutualization of the stock exchanges, and the institution of Regulation National Market System [NMS] as key factors that facilitated the eventual rise of HFT.⁴ Moreover, it seeks to position these developments within the broader context of long-standing aims and themes embraced by the SEC. First, however, it is necessary to explore the concept of high frequency trading, and define this practice.

High Frequency Trading Defined

Problematically, high frequency trading has been inconsistently defined by the popular press, academics, and even its practitioners.⁵ As Andrew Kumiega at Infinium Capital Management once remarked, “High-frequency trading means everything to everyone.”⁶ The resulting

High Frequency Trading

haziness surrounding the concept adds to confusion about HFT's legitimacy as well as its root causes. It is important, therefore, to articulate clearly what is HFT (and what is *not* HFT). High frequency trading is neither synonymous with electronic trading nor algorithmic trading, although it utilizes both. Electronic trading involves placing buy and sell orders for stocks or other financial products over a computer network, typically via a broker or a stock exchange. Algorithmic trading (sometimes dubbed "algo trading" or "automated trading") goes one step further, using electronic platforms to input trading orders that depend on algorithms.⁷ Algorithms contain pre-programmed and hence automatic trading instructions, such as when to buy or sell a stock, how many shares, and at what price. Algorithmic trading utilizes program trading, which grew alongside the rise in electronic communication networks (ECNs). Electronic exchanges such as Instinet and Archipelago Exchange enabled the ultra quick matching of myriad buy and sell orders, all via computer, all absent the human touch.⁸

High-frequency trading (HFT) typically involves fast algorithmic, automated electronic trading that relies on information that is obtained electronically to make order decisions. Yet HFT entails more than this. Speed, as measured by latency, is a hallmark of high-frequency trading.⁹ However, the "F" in "HFT" does not stand for "FAST"; it stands for "FREQUENCY", as HFT darts in-and-out of positions often within milliseconds to take advantage of tiny arbitrage opportunities across exchanges. HFT relies on heavy trading volume--frequency of trades--to profit from these small differentials.¹⁰

Finally, as will be explained, HFT also often involves traders being able to glimpse other market orders – to have a valuable look or sneak peek at order flow before they place their own orders.¹¹ That look (combined with the speed to act upon it and the frequency to do so) substantially enhances the likelihood of high frequency traders making profits. The more advance a look at order flow an HFT firm enjoys, the more likely it is to outshine its competitors' performances, including that of other HFT firms.

In acquiring a millisecond or microsecond information advantage over other traders, computing speed is a key asset, as is "co-location" near an exchange's computers. Testifying before Congress in June 2014,

Senator John McCain described co-location as a “key tactic used by high-frequency trading firms.” He explained, “This practice involves trading firms literally renting space for their computers in the same room as the computers that run the stock exchanges so that they can receive market information directly from the exchanges’ computers as fast as possible.”¹² Close physical proximity to an exchange’s computers is one way to reduce impedance by shaving milliseconds off the time it takes data transmission lines to relay critical order information.¹³

In addition to relying on co-location, HFT firms¹⁴ also try to peek into exchanges and detect orders as they initiate from a broker’s order router. HFT firms often place small orders (which they sometime cancel) to try to flesh out buying or selling pressure, perhaps particularly from those wanting to move large, block orders.

By whatever means they obtain the look or sneak peek at order flow (or even potential order flow), the ability of HFT firms to access and act upon valuable knowledge in advance of other market participants potentially could disadvantage other traders. As Georgetown scholars James Angel and Douglas McCabe (2013, p. 589) explain, “So-called ‘predatory’ algorithms, or ‘algos,’ figure out that a large order is in the process of execution and jump in front of it.” While Angel and McCabe view this as one of HFT’s “predictive strategies,” critics allege that HFT (or, more precisely, the look aspect of HFT) is a form of front-running.¹⁵

Generally, front running involves someone who is privy to order flow knowledge and then acts upon it for his or her own profit by jumping ahead of customers to trade (buy or sell) for his or her own account.¹⁶ Front-running in most cases is illegal, as it confers an unfair advantage to the person who engages in the practice.¹⁷ Although some are quick to deride HFT as front-running,¹⁸ Angel and McCabe are more circumspect, noting, “While it is clear that brokers who front run their own customers are violating their ethical duties to their customers, it is not clear that there is anything wrong with investors using information that is publicly available to everyone to make their trading decisions.” Yet, as they note, there is the complicating factor that “some investors have access to faster computers than others.”¹⁹

Seeing things more black and white, Michael Lewis has sharply criticized HFT, blaming it for devolving the U.S. stock market into “a

High Frequency Trading

class system, rooted in speed, of haves and have-nots. The haves paid for nanoseconds; the have-nots had no idea that a nanosecond had value. The haves enjoyed a perfect view of the market; the have-nots never saw the market at all.” Lewis laments, “What had once been the world’s most public, most democratic, financial market had become, in spirit, something more like a private viewing of a stolen work of art.”²⁰ Lewis’ incendiary charges of a rigged stock market have heightened pressure on the SEC (that already had been investigating HFT) to issue new regulations to eliminate, or at least mitigate, the practice.

Before regulators rush to fix the perceived problem of HFT, however, it is worthwhile to examine closely the true root causes of HFT in order to form effective solutions, if solutions are indeed needed. In ferreting out the underlying causes of HFT, it becomes clear that the SEC in many ways and over several decades ironically helped create an environment conducive to HFT, the very practice it now seeks to curb. Before discussing some of the specific actions that ultimately catalyzed HFT, it is helpful to understand the original intentions underlying the SEC’s creation in 1934, and certain assumptions that have long guided the SEC. As will be seen, the SEC, in its quest to make markets a better place for small, ordinary investors, actually wound up fostering an HFT-friendly environment.

Creation of the SEC and Core Assumptions Guiding Its Actions Over the Years

On June 6, 1934, President Franklin D. Roosevelt signed into law the Securities and Exchange Act, which momentarily brought the nation’s stock exchanges under federal regulation.²¹ The SEC’s mission has been “to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation.”²² Notably, the NYSE historically also has placed enormous importance on ensuring “fair and orderly” markets.²³ Yet arguably, the NYSE considered “fair” and “orderly” to be closer to synonymous than did the SEC. The NYSE interpreted a “fair and orderly” market in part to mean one that did not wildly fluctuate. Like the SEC, the NYSE also had a notion that fairness meant making sure that small and big investors alike had equal opportunity to achieve investing success. The SEC’s notion of fairness led to the agency

championing various market reforms, many of which yielded positive impacts, but sometimes also led to largely unforeseen consequences such as HFT.

The very creation of the SEC stemmed from the perceived need to correct unfairness in the markets and the belief by some that the NYSE and other exchanges were not up to the task of doing so themselves. The legislation emanated from more than three years of Congressional investigations into stock market practices following the devastating Great Crash of 1929. Frustrated that the NYSE too often seemed to look the other way when it came to stock manipulations such as pools²⁴, critics of Wall Street contended that the NYSE and other stock exchanges needed to be brought under external control to ensure fairness. A compromise between government reformers and moderate factions on Wall Street, the Securities and Exchange Act, though, left the exchanges as primarily self-regulatory organizations (SROs). The Securities and Exchange Commission (SEC), created in section 4 of the Act, was only supposed to act when self-regulation failed. The drafters of the legislation²⁵ intended that the SEC would help protect investors *if the exchanges failed to act on their own*. They also hoped that the very existence of a cop on the corner of Wall Street (in the form of the SEC) would inspire greater public trust in the integrity of the markets.

Despite the compromises embedded in the Act, some members of the Wall Street community expressed deep concern about its passage. Old Guard leaders of the NYSE, such as Charles Gay and Richard Whitney, lamented the loss of their organization's complete independence and contended that outsiders could not effectively even *co-regulate* the securities markets due to their lack of understanding of the complex operations underlying the exchanges.²⁶ They worried that any SEC meddling—even with benign intentions related to the agency's fairness mission—might unleash a bevy of negative, unintended consequences. Even though President Roosevelt appointed Joseph P. Kennedy,²⁷ a former trader himself, to be the first head of the SEC, the Exchange's conservative wing remained suspicious that the SEC intended to take away the NYSE's historic power over its own house.

Kennedy's next two successors as SEC chairman (who were attorneys, not former market professionals) – James Landis (1935-1937)

High Frequency Trading

and William O. Douglas (1937-1939) – vocally supported the idea that the securities industries should mostly be self-regulated, albeit subject to SEC supervision.²⁸ As Landis reassured Wall Street at a meeting of the New York Stock Exchange Institute in the summer of 1935, “Self-government is, of course, the desirable thing. Everyone will admit that the less regulation there is, the better it will be, provided the objectives are always kept clear; and the better the self-government, the less need there is for regulation.”²⁹ Also adamant that the SEC should intervene only if and when self-regulation failed, William O. Douglas once explained that the idea was to “keep the shotgun, so to speak, behind the door, loaded, well-oiled, cleaned, ready for use, but with the hope that it would never have to be used.”³⁰

Feeling the threat of SEC intervention looming over them and anxious to avoid it, the NYSE in the Great Depression years worked to make markets more fair, in part by having its Business Conduct Committee more aggressively patrol the Exchange floor and root out such obviously detrimental practices such as pools and corners by which insiders tried to manipulate stocks. The NYSE and the SEC harmoniously agreed about the need to eradicate certain practices. Yet on larger market structure issues and how they might be modified to make markets more fair, the SEC often perceived matters differently than the NYSE, even after the Exchange underwent a pivotal internal reorganization in 1938. While the SEC’s leadership has changed hands many times since 1934, analyzing certain overarching themes in the SEC’s attitude and approach to the NYSE over the years can yield insights into what the SEC believes will make the markets more fair.

First, the SEC long has held that markets would be fairer if they were more fragmented. For most of the NYSE’s existence, the NYSE was by far the largest exchange in the country and the world, handling the vast majority of stock trades. The NYSE defensively argued that it was a natural monopoly, and hence such concentration was in the best interests of investors and the Exchange alike. Yet the SEC feared the NYSE’s dominant market share, concerned that such a concentration meant higher order execution prices for investors as well as other problems. Second, the SEC, particularly in the last half century, has had faith in the power of technology to make markets more democratic, in part because

technology could presumably reduce transaction costs. Third, as will be discussed, the SEC believed markets would be fairer if floor traders³¹ and specialists³² exerted less influence (or were abolished altogether). In fact, in the original draft of the Securities Act of 1934, Section 10 of the proposed bill would have ended the role of floor traders and would have removed specialists' ability to trade for their own accounts.³³

As will be detailed, in time the SEC largely got the environment it sought—a considerably weakened NYSE, a diminished role for specialists, enhanced technology and a reduced human factor, and much cheaper commission costs for both retail and institutional investors. Yet the SEC also got—for better or for worse—HFT. Understanding how certain SEC initiatives helped foster HFT requires carefully examining pivotal developments such as decimalization, the end to fixed commission rates, the repeal of the uptick rule, and the institution of Regulation NMS. More broadly, beyond better understanding the rise of HFT, an analysis of these developments illuminates how an increasingly activist SEC has helped shape modern securities markets and how the SEC's original notion of largely maintaining the NYSE's historic SRO status has withered away as the SEC has aggressively pursued its own ideas of how to bring more fairness to U.S. equity markets. In the process, the NYSE's fundamental nature has been transformed, along with the investing landscape.

The NYSE as an Auction Market and The Specialist System

For more than two centuries, the NYSE had been an auction market, until recently when it became a more hybrid model. In the case of an auction market (as opposed to a dealer's market in which those wishing to buy and sell have to go through a dealer), the highest bidding price for a stock is matched against the lowest asking price.³⁴ At the NYSE for more than a century, it was the job of the specialist in his agency role to bring together buyers and sellers, thereby facilitating trades. For most of the NYSE's history, every trade used to have to go through a specialist. Specialists, therefore, occupied a unique position on the NYSE floor. In recent years, however, the power of the specialists has been vastly diminished.³⁵ Understanding the historical role played by the specialists enables one to appreciate how this system, if left intact, might have

High Frequency Trading

served as a balance to the otherwise largely unchecked influence of HFT.

The position of NYSE specialist dates back to 1871. In that year the NYSE moved to continuous trading in stocks and away from the prior system (in place since 1792) of daily call auctions in individual stocks. Initially, brokers were overwhelmed by the challenges posed by continual, simultaneous trading of stocks; they had been accustomed to being able to monitor every stock as it traded. Soon, however, some floor brokers stumbled upon a solution: they could profitably specialize in working orders for a particular stock from a stationary post on the exchange floor. The specialist position thus developed.³⁶

Throughout the twentieth century, the NYSE vigorously defended the specialist position as necessary and beneficial to investors and the market as a whole. While critics pointed to the specialist's privileged position on the floor, the NYSE emphasized that in return for the advantages associated with that position, the specialist had a responsibility to provide a "fair and orderly market," which included being compelled to trade, if circumstances necessitated, against his firm's financial interest. This could entail injecting much-needed liquidity into stocks during tumultuous times by committing his firm's capital.³⁷ While the concept of a "fair and orderly market" has never been strictly defined, the NYSE historically interpreted it to mean, in part, a market that does not gyrate hugely. The specialist was supposed to act to stabilize prices, provide capital if needed, and facilitate order executions for other members.³⁸ As the NYSE once explained, "To ensure that stock trading moves smoothly, with minimal price fluctuation, the specialist will step in against the market trend. Specialists buy and sell stock to cushion temporary imbalances and to avoid unreasonable price variations." The NYSE added, "As a dealer, the specialist will buy or sell stock from his own inventory to keep the market liquid or to prevent rapid price changes."³⁹ In a sense, specialists controlled the order flow, as they continually made judgment calls about who got to participate in trades and in what order.⁴⁰

Deeming liquidity to be "one of the most important characteristics of a good market," the NYSE has defined liquidity as "depth of market to absorb buy and sell interest of even large orders at prices appropriate to supply and demand."⁴¹ To the NYSE, liquidity and market fairness are

intertwined concepts. Because specialists enhanced liquidity, specialists, according to the traditional NYSE argument, did much to make markets more orderly.⁴²

The NYSE, however, conceded that there were some abuses of the specialist system at various junctures. Unfortunately, as Ferdinand Pecora had uncovered, some specialists in the 1920s had exploited their roles by arranging profitable pools in the very stocks in which they were making markets, such as trader Michael Meehan had done with Radio Corporation of America (RCA). Agreeing with critics that such episodes should be prevented from reoccurring, the NYSE Governing Committee in 1934 banned members from participating in stock pools, proscribed specialists from “disclosing to any person, other than certain committees of the Exchange, any information in regard to orders entrusted to [them],” and also prohibited specialists “from acquiring or granting any option in the stocks in which they specialize.”⁴³

In enacting these rules to more tightly govern the specialist system, the NYSE also hoped to prove that the NYSE indeed was capable of self-regulation, and that some type of national securities legislation was therefore unnecessary. That same year, however, the Securities and Exchange Act created the SEC. Critics of the NYSE demanded an end to the specialist function on the exchanges,⁴⁴ but the SEC at the time did not heed their calls, fearing the potential consequences of such a drastic change in stock market operations.

In subsequent decades, however, criticisms of the specialist system continued to surface. Notably, a Special Study of the Securities Markets in 1963 expressed concern about certain stock market practices, such as the freedom with which specialists seemed to act.⁴⁵ Other studies found that during periods of crisis (like the assassination of President Kennedy on November 12, 1963), the specialist system did not always stabilize the market in the way it was intended, because certain specialists sometimes acted to protect their own interests or were inadequately capitalized and, thus, were simply overwhelmed by disproportionate volume on one side of the market. Similar to what transpired after the Pecora Investigation in the 1930s, the NYSE’s Board of Governors in 1964 modified and expanded its own rules concerning the specialists, in an effort to thwart additional SEC involvement. The NYSE instituted several procedural

High Frequency Trading

changes, such as more detailed policies concerning liquidation of positions.⁴⁶ The NYSE President at the time, Keith Funston, along with Chairman of the Board Henry Watts, were quick to emphasize, however, that these revised procedures did not alter the core of the specialist system—nor should it, since the specialist system was designed so as to maintain a healthy auction market for securities.⁴⁷

Despite enduring criticisms, the specialist system remained basically unaltered until the 21st century when, as will be discussed, certain developments occurred that catalyzed action.⁴⁸ By that time, other transformations of the securities markets already had taken place such as rate deregulation, the creation of a national market system, demutualization of the exchanges, the enactment of Regulation NMS, and the repeal of the uptick rule. All of this created a “perfect storm” of sorts.⁴⁹ Once the technology became available and once entrepreneurs imaginatively envisioned the possibilities of exploiting nearly de minimis arbitrage opportunities through extensive rapid trading, HFT could develop with few roadblocks in the way of its growth.

Rate Deregulation and the Creation of a National Market System (1975)

In the 1960s and 1970s, the SEC focused on the need to lower trading costs for investors and relatedly, the necessity of encouraging more broker competition. In the aftermath of the 1963 Special Study, the SEC in 1968 mandated the end of minimum, fixed commission rates on all US stock exchanges—a practice that had been in place at the NYSE since its founding in 1792.⁵⁰ The NYSE for a time fought the move to negotiated rates, but eventually capitulated. Exchange President Robert Haack gradually came to the conclusion that fixed rates were actually harming the NYSE, causing the organization to lose too much business to cheaper competitors and fostering “inept management” at several member brokerage firms.⁵¹ While Haack was expressing his personal views, eventually the NYSE Board also became convinced of the need to jettison fixed rates and the futility of fighting the SEC on the issue.

By May 1975, the move to negotiated rates was fully implemented. While much has been written about “May Day 1975” and the subsequent rise of discount brokerage firms,⁵² the long-term impacts of rate

deregulation still are not well understood. For example, it is not well appreciated how the resulting revenue loss impelled member firms to embrace more heavily a higher risk activity, proprietary trading (i.e., trading solely for their own gain), in an attempt to replace the lost revenue from their traditional brokerage and block trading operations (i.e., facilitating customer trades to earn commissions and buy/sell spreads).⁵³ Prior to 1975, proprietary trading on the part of member firms was extremely limited. Inspired by May Day to brainstorm about potential alternative revenue streams, some member firms such as Goldman Sachs honed in on the idea of expanding their small arbitrage desks into what later became known as algo trading. Trading algorithms that today are at the heart of successful HFTs were first used in the 1980s and 1990s amidst these expanding proprietary trading operations.

In the same year as rate deregulation, Congress passed the Securities Acts Amendments of 1975, also known as the National Exchange Market System Act. It amended Section 11A of the Securities Exchange Act of 1934⁵⁴, which mandated that the SEC propel forward the creation of a national market system (NMS) — which would “link together the multiple individual markets that trade securities.” As the SEC recounts, “Congress intended the Commission [through Section 11A] to take advantage of opportunities created by new data processing and communication technologies to preserve and strengthen the securities markets.” According to the SEC, the NMS was “designed to achieve the objectives of efficient, competitive, fair and orderly markets that are in the public interest and protect investors.”⁵⁵

The creation of a national market system enables thousands of listed stocks today to be (in the words of the SEC) “traded simultaneously at a variety of different venues that participate in the NMS, including national securities exchanges, alternative trading systems [ATSS]..., and market-making securities dealers.”⁵⁶ The creation of the NMS was also an attempt to reduce the power of the NYSE, in part by fragmenting the market and inspiring the creation of many new stock exchanges. This fragmentation, in turn, created arbitrage opportunities from what at first seemed to be insignificant price differentials between the multiple markets.

High Frequency Trading

At the time of the creation of the national market system in the 1970s, the NYSE still was indisputably the most powerful exchange in the country, boasting the highest market share. Congress and the SEC, concerned that such market concentration was not in the best interests of investors, contemplated effective ways to diffuse that power, hoping that doing so would make the markets more fair. Both the SEC and Congress possessed great faith that if only the equity markets would tap into newly available data processing and communications technologies, they could become much more competitive, efficient and fair than if the exchanges continued to rely on human judgment to facilitate trades.

In the ensuing decades since 1975, the Commission, endeavoring to keep abreast of evolving market conditions (some of which the SEC's actions bred), periodically has revised the rules governing the national market system. As will be explored, Regulation NMS, first proposed in 2004 and then approved in 2005, is part of that long history.⁵⁷

First, however, it is important to examine how another landmark transition prodded by the SEC, the decimalization of stock prices, further reduced the profitability of member firms. This propelled some firms to embrace riskier activities in order to compensate for the reduced revenue stream.

Decimalization of Stock Prices (2001) and the Repeal of the Uptick Rule (2007)

In 2001, the NYSE adopted the practice of quoting stocks in decimals, meaning pennies, rather than fractions. As CNBC senior editor John Carney recalled, "Beginning in the 1990s, the SEC began a campaign to undermine the old [fractional] system."⁵⁸ In a 1994 report, the SEC staff blamed the then-current dollar tick size of 1/8th for "caus[ing] artificially wide spreads and hinder[ing] price competition" and in the process, engendering excessive profits for market makers.⁵⁹ Reducing the tick size and changing to decimal pricing, contended advocates like Arthur Levitt (SEC Chairman, 1993-2001), would help investors by resulting in smaller spreads on trades.⁶⁰ This might benefit especially small retail investors, since large institutions were already able to get better net prices by negotiating commission rates on block trades. According to SEC Commissioner Steve Wallman, if the NYSE and other

exchanges were forced to reduce their minimum tick size, decimalization would save retail investors roughly \$1.5 billion a year.⁶¹ The idea was that “smaller trading increments would intensify competition among all sorts of limit order traders. Market makers, day-traders, hedge funds, and arbitrageurs would all try to better each other’s quotes, leading to price improvement for the customer,” as Peter Chapman at *Traders Magazine* explained in a 1999 cover story on pending decimalization.⁶² Average investors might also find stock prices quoted in dollars and cents easier to understand than if they were quoted in fractions. Converting to decimals, therefore, purportedly would make markets more fair. The SEC also believed that decimalization would make markets more fair by impeding market makers from making so much money on the spreads.

Many also derided fractional pricing as anachronistic, and indeed, the practice dated back to the 17th century colonial custom of using Spanish coins, which were called “pieces of eight” because they could be broken into eight “bit” pieces. As Representative Michael Oxley, an ardent proponent of decimalization, complained in 1997, “When organized stock trading began in New York in 1792, stock prices were quoted in bits, or eighths. We don’t use Spanish coins today--but the tradition of pricing stocks based on these coins is still with us, in the form of SRO rules.”⁶³ Advocates of decimalization further noted that in many exchanges in other countries, decimalization was already the standard practice. As SEC Chairman Levitt said, “The U.S. securities markets must adopt the international convention of decimal pricing in order to remain competitive.”⁶⁴

Consequently, in March 1997, Representatives Michael Oxley (R-Ohio) and Edward Markey (D-Mass) introduced HR 1053, the “Common Cents Stock Pricing Act,” which sought to require decimalization as soon as the SEC could make it possible. The purpose of the proposed Act was “To amend the Securities Exchange Act of 1934 to eliminate legal impediments to quotation in decimals for securities transactions in order to protect investors and to promote efficiency, competition, and capital formation.”⁶⁵ As Oxley contended, “A modern decimal system is better for small investors...People are being eighth-ed and sixteenth-ed right out of their stock profits.”⁶⁶ As Oxley further explained, “The Common

High Frequency Trading

Cents Stock Pricing Act will eliminate regulatory obstacles that stand in the way of competitive forces.”⁶⁷ Seeing the handwriting on the wall, the NYSE just three months after the introduction of HR 1053 voted to shift to decimals, and other exchanges like Nasdaq soon did so as well. As a result, Oxley and Markey withdrew the bill, which never was enacted.⁶⁸ The SEC continued to play a large role in propelling the adoption of decimal pricing, ordering the NYSE and other exchanges to submit phase-in plans outlining how and when they were going to implement the necessary rule changes.

With the SEC watching with approval, the exchanges converted to decimals in calculated stages, with the NYSE first reducing its minimum tick size from one-eighth to one-sixteenth. By April 2001, in compliance with the SEC’s mandate, all the exchanges had completed their shift to decimalization, and stocks therefore now moved in increments of pennies.⁶⁹ Decimalization struck another blow to the profitability of traditional Wall Street block trading desks⁷⁰ and furthered the importance of both proprietary trading and automation of trading – the two ingredients of HFTs.

More than a decade since the implementation of decimal pricing, there is still strong debate about its effects and whether the benefits exceeded the costs.⁷¹ As Greg Ghodsi of Raymond James contended in 2009, “...decimalization is a negative because it narrowed the spreads. On the surface you would think it would be better for the markets but narrower spreads mean less profit for market makers. Less profit leads to less capital and less capital leads to less liquidity [and more volatility].”⁷² Concurring, Jeffrey Rubin, head of research at Birinyi Associates, bluntly stated, “There is a direct correlation to the decrease in market making profits and the increase in proprietary trading at the likes of GS [Goldman Sachs], C [Chase], MER [Merrill Lynch], etc.”⁷³

Decimalization may have indirectly made it easier for HFT to proliferate in that perhaps people do not notice or mind as much giving up a piece of their trade if it is a small enough piece. Decimalization also affected HFT by impacting the fate of the uptick rule (also known as the “plus tick” rule).

The SEC had designed the uptick rule to reduce short-selling on the NYSE—and in the process, slow down a potential slide in a stock.

Instituted in 1938 during the heart of the Great Depression, the uptick rule (SEC Rule 10a-1) put restrictions on short-sellers, depending on the direction of the “tick” of the stock. A tick has been defined as “the change in the price of a security from trade to trade.”⁷⁴ According to the uptick rule, if a stock were trading at a minus tick (a price below the last sale price) or a zero-minus tick (an unchanged price from the prior minus tick trade), one could not sell the stock short until it experienced a plus tick—a trade occurring at a higher price than the previous price.⁷⁵ The rule was intended in part to assuage concerns about potential bear raids on a stock. (Despite lacking evidence, some in the late 1930s continued to blame bear raiding for exacerbating the Great Crash of 1929.)

In the 1980s, program traders (as early electronic algo traders were called) and other constituents began to lobby to have the uptick rule repealed, arguing that the complexity of modern markets had made the rule out-of-date.⁷⁶ It was the conversion to decimal pricing in 2001 that put the nail in the coffin of the rule; to many observers, decimalization diluted the value of the rule to almost nothing, because a penny uptick might be “just too small an increment to stop the short.”⁷⁷ As Christopher Cox (SEC Chairman, 2005-2009) contended, “When a stock is dropping like a stone it tends to drop with...penny upticks along the way.”⁷⁸

Viewed as no longer effective, the uptick rule was repealed on July 6, 2007 with little debate. Interestingly, the question arises whether the repeal helped HFT flourish. Buy-side HFT is only a piece of the equation. The other is selling. For HFT traders who were endeavoring to jump ahead of another sell order, whether or not the uptick rule was in effect had no impact upon them if they were selling “long” (i.e., owning the stock they were intending to sell). If, however, HFT traders were intending to sell short (selling stock they had borrowed or did not own), now, after the repeal, they, like other short sellers, were no longer encumbered by any tick constraints; they could “hit the bid” (sell) on a negative tick, plus tick, or zero tick. Previously, if HFT traders were trying to front-run a sell order, and it was a minus-tick, they could not sell if they were shorting that stock; they would have to wait for the plus tick.

On February 24, 2010, roughly three years after the repeal of the uptick rule, the SEC adopted Rule 201, which the SEC described as an

High Frequency Trading

“alternate uptick rule.” As the SEC noted, the new rule “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. At that point, short selling would be permitted if the price of the security is above the current national best bid.”⁷⁹ This, however, is a far cry from the original uptick rule.

Demutualization of the NYSE

Meanwhile, in 2006, the NYSE ceased being a not-for-profit organization. Shortly after converting to for-profit status, the exchange ceased being owned entirely by its members and became a publicly traded corporation. Either of these changes was momentous in its own right; together they represented a sea change. For most of the twentieth century, the SEC had criticized the NYSE for being the equivalent of a “private club,” with members, who owned “seats” on the exchange, largely making their own rules. Since 1934, the NYSE was not free from external regulatory oversight, but Exchange leaders long resisted fundamentally changing the organization’s not-for-profit structure.

By the late 1990s and early 21st century, however, the two biggest exchanges (NYSE and NASDAQ) were in weak positions, in part due to scandals rocking them (first, a market maker quote-rigging scandal at the NASDAQ and then, in 2003, a specialist scandal at the NYSE—along with controversy surrounding the pay package awarded to the NYSE’s President at the time, Richard Grasso.)⁸⁰ As R.T. Leuchtkafer has explained, in response to the quote-rigging scandal, “NASDAQ and its parent company the National Association of Securities Dealers (now called the Financial Industry Regulatory Authority, or FINRA) were forced to implement changes allowing electronic communication networks (ECNs) into the market.” According to reformers’ rationale, “...if market makers were cheating their investor customers, then investors should just trade directly with one another, bypassing the market makers altogether [through ECNs].”⁸¹ This opened the door, however, to HFT “scalpers”.⁸² The exchanges also were vulnerable because they were feeling the effects of SEC-driven rule changes that facilitated competitors at electronic venues acquiring market share. As Arnuk and Saluzzi explain, NASDAQ and the NYSE eventually became

“publicly traded companies to access much needed capital to compete with the plethora of lightning-fast electronic trading venues.”⁸³ But first, they decided to demutualize.

As Jennifer Elliott at the International Monetary Fund (IMF) once explained, demutualization describes “the transition from a mutual association of exchange members operating on a not-for-profit basis to a limited liability, for-profit company, accountable to shareholders.”⁸⁴ Importantly, the SEC, anxious to rely more on technology than the hands of the specialists and market makers, became proponents of the idea of for-profit exchanges.⁸⁵ With the SEC’s support, NASDAQ converted to a for-profit corporation in 2000. The NYSE, after resisting the trend, capitulated in 2006, after Richard Grasso (NYSE CEO, 1995-2003) stepped down and John Thain, former Goldman Sachs President and Co-chief Operating Officer, succeeded him as CEO of the NYSE. The NYSE went public as part of the process of acquiring Archipelago Exchange (“ArcaEx”). The fusion of Archipelago Electronic Communications Network (a pioneer ECN) and the Pacific Exchange, ArcaEx had gone public in 2004, becoming the country’s first completely electronic exchange.⁸⁶

The move to a for-profit corporation drastically changed the NYSE in many ways. With enhanced access to capital, the NYSE (like NASDAQ) now possessed the means to invest more robustly in technology and data centers.⁸⁷ But the fact that the NYSE now was for-profit also introduced new, potential conflicts of interests; some of which may have affected the NYSE’s ability to critically evaluate the opportunities and dangers presented by HFT. As will be discussed, the NYSE discovered that the organization could make money from HFT.

The Enactment of Regulation NMS

Meanwhile, the SEC had adopted a series of rules in 2005 called Regulation NMS (National Market System) that went into effect in 2007.⁸⁸ *Flash Boys* author Michael Lewis blames “Reg NMS” for causing HFT to proliferate, although as this paper discusses, HFT also had a host of other triggers. Reg NMS was the SEC’s effort to further shape the national market system, which it had created in 1975. As Lewis notes, Reg NMS held brokers to a new, seemingly higher standard

High Frequency Trading

for fulfilling customer orders, as they now were compelled by law to find the “best price” for their customers, rather than the prior standard of “best execution.” Lewis acknowledges that “Like a lot of regulations, Reg NMS was well-meaning...”⁸⁹ Yet he also shows how and why it went awry. After Reg NMS’ implementation, high-frequency traders could now much better predict the exchange(s) to which brokers would route their clients’ orders, because they knew that brokers had to obtain that best market price which was determined by a system known as the National Best Bid and Offer (NBBO).⁹⁰ A relatively slow computer program, the Securities Information Processor (SIP), calculated the NBBO. Realizing this, high-frequency traders seeking a competitive advantage soon tapped into far more sophisticated technology to create their own, faster algorithm of a best-price calculator.⁹¹ Lewis explains the results: “Reg NMS was intended to create equality of opportunity in the U.S. stock market. Instead it institutionalized a more pernicious inequality. A small class of insiders with the resources to create speed were now allowed to preview the market and trade on what they had seen.”⁹²

Moreover, Reg NMS indirectly spawned the rise of dark pools, a private stock crossing mechanism owned and operated by a brokerage firm or firms whose operations are visible only to those running it.⁹³ Some firms marketed their dark pools as a way to hide large trades from the machinations of predatory high frequency traders. Yet the lack of transparency inherent in dark pools often served the purposes of the very flash traders the pools were ostensibly designed to avoid, as HFT firms sometimes succeeded in buying the right to operate inside them.⁹⁴ In the sense, SEC regulations resulted in the look being transferred from the specialists of old to the HFT firms who have no public responsibility.

Regulators had believed this rule would make the markets fairer by clamping down on any possible front-running of orders on the exchanges. As previously discussed, front-running occurs when a trader puts his own order or his firm’s order ahead of his customer’s, and it is illegal if the order information used is not also available to the public.⁹⁵ Beginning in 2003, as Lewis recounts, the SEC investigated several specialists at the NYSE, accusing them of front-running orders, charges that were eventually settled only after the traders paid hefty fines.⁹⁶ Reg

NMS was designed in part to curb such potential front-running by specialists but ironically, it created a situation ripe for a new form of what some call front-running, in the guise of flash trading.

Transforming Specialists into Designated Market Makers

Meanwhile, in 2008, the NYSE, in consultation with the SEC, instituted some changes to its membership classes, morphing the position of specialists into “designated market makers,” or DMMs.⁹⁷ In October 2008, as the NYSE relates, the SEC “approve[d] the [NYSE’s] next-generation market model..., under which DMMs have accountability for providing liquidity, better access to capital and risk-management capabilities, and are on an even playing field with other market participants in terms of trading parity and access to information.” The NYSE noted that DMMs, like the specialists of old, retained “the obligation to maintain an orderly market in their stocks” (although one may wonder how they could effectively do so if they now are on parity with other traders). DMMs also needed to “quote at the national best bid or offer a specified percentage of the time, and facilitate price discovery at the open, close and in periods of significant imbalances.”⁹⁸ At the same time as the creation of DMMs, the NYSE also introduced the position of Supplemental Liquidity Providers or SLPs, who constituted “a new class of upstairs, electronic, high-volume members...with incentives to add liquidity on the NYSE.”⁹⁹ SLPs formalized the role of Goldman Sachs and other upstairs trading desks that since the 1960s had been supplementing and filling the void of the undercapitalized specialists. Combined with profit margins under continuous regulatory pressure, the additions of PhD-developed trading algorithms for proprietary desks and the advent of computerization, these upstairs proprietary trading desks were the forefathers of HFT.

By the end of the first decade of the 21st century, the specialist system that had been at the heart of the NYSE’s auction market was dying a slow death. Decimalization, implemented in 2001, enormously hurt specialists’ ability to make profits, and then subsequent events continued to weaken the specialists’ position. The human element on the NYSE was no longer what it had once been.

High Frequency Trading

As Michael Lewis points out, “Over the past decade, the financial markets have changed too rapidly for our mental picture of them to remain true to life.” He contends that most people still possess an image of the markets in which “a ticker tape runs across the bottom of some cable TV screen, and alpha males in color-coded jackets stand in trading pits, hollering at each other.” Lewis argues, “That picture is dated; the world it depicts is dead.”¹⁰⁰ As Lewis himself acknowledges, there are, of course, still some humans on the floor of the NYSE, but his broader point is correct concerning the automation of trading. This is the scenario that a host of securities regulators, over decades, worked to create, as they simultaneously labored to dismantle the power of the specialist system.

Flash Crash of 2010; “The Crash of 2:45 pm”

On May 6 2010, a “flash crash” jolted traders, catching them off-guard especially with regard to the speed and intensity with which it unfolded.¹⁰¹ During that crash, which was also called “The Crash of 2:45 pm”, the Dow Jones Industrial Average (DJIA) plunged 600 points in the span of just five minutes—a historic fall in such a compressed time period. Then, however, equally surprisingly, the DJIA rapidly recovered most of that loss by 3:07 pm. Such extreme intraday volatility stands in contrast to the type of “fair and orderly” market that the NYSE has hailed as critical to maintain. Initial theories varied regarding what caused the mysterious crash. High frequency trading was considered as a possible factor—if not in causing the Crash, at least, in accelerating the market decline.¹⁰²

The SEC, in conjunction with the U.S. Commodity Futures Trading Commission (CFTC), examined the actions of high frequency trading firms during the turmoil as a part of their general investigation into the Flash Crash. Yet in the 104 page formal report issued by the SEC and the CFTC on September 30, 2010, HFT comprised relatively little of their discussion. Interestingly, though, especially with respect to this paper’s earlier discussion of the repeal of the original uptick rule, the Report did find that the HFT firms were net sellers during the Flash Crash.¹⁰³

After concluding their analysis of what had transpired during the Flash Crash, the lawyers and politicians leading the SEC did not aggressively pursue their investigation into HFT. Lewis suggests that the dilatory response stemmed in part from the fact that over two hundred former SEC staffers after the passage of Reg NMS had defected to work for HFT firms or firms lobbying for HFT interests; thus, some previously connected with the agency had a vested interest in maintaining the status quo.¹⁰⁴

Conceivably, too, SEC leaders and staff members might delay additional regulatory action on the HFT front in the desire to avoid blame for the situation. The imposition of new regulations (or the eradication of some older ones) might suggest prior mistakes committed by the SEC. Edward Kane, propounding the concept of a “regulatory dialect” in the 1980s, once explained that “The dialectical view portrays regulation as a game of strategy with sequential moves.” He elaborated, “In responding to changes in technology or regulation, individual moves are generally freer and executed more quickly for regulated players and whatever less regulated competitors exist than they are for the regulators themselves.”¹⁰⁵ Kane concluded that among regulators, self-regulators react more quickly and with more freedom as compared to government regulatory agencies.¹⁰⁶

While some might suggest that, with respect to HFT, the SEC has succumbed to a case of blame avoidance¹⁰⁷ or regulatory capture, another possibility is simply that government regulators lacked an intimate understanding of how Wall Street was actually working. The SEC chairmanship position has been overwhelmingly occupied by lawyers, professors and politicians; only three of the 29 chairs since Kennedy have come from the investing community, and a mere one of those possessed actual trading experience.¹⁰⁸ If the SEC had a former stock market insider as chair and if that chair brought more market savvy professionals to work at the SEC, one wonders whether the agency would have acted upon the concerns about the opacity of HFTs sooner and more efficiently.

Concluding Thoughts

Government regulators often are perceived as being slow and late in addressing challenges posed by new technologies, and so to casual observers, HFT might seem like another such case of regulatory lag. Certainly, as Richard Scribner presciently noted in the mid 1980s, “By increasing the speed, dispersion, and complexity of the marketplace, ...[technological] developments have introduced new challenges for the regulator...” Scribner raised the question then of whether regulation could “keep up” with “the technological revolution in securities trading,” and the same question reverberates even more strongly today.¹⁰⁹ As Scribner also noted, while technology has “sped trading” and impacted the markets in many other ways, regulators also can resort to technology to help them better monitor the evolving marketplace.¹¹⁰

Lewis’ book has spurred calls for increased securities regulations to prevent (or at least, more tightly control) high frequency trading. Yet that is ironic, given that it was regulatory action, not lag, that helped *create* the current state of affairs that is conducive to HFT. Perhaps that is one of the key lessons here--that when well-intentioned regulators strive to fix a perceived problem (in this case, the need to modernize the capital markets and make them more fair), the remedy is often worse than the disease. As Louis Kohlmeier Jr. explored in his 1969 seminal book *The Regulators*, regulatory agencies in the United States have sometimes erred as they have attempted to fulfill their tasks of protecting and prioritizing the public interest.¹¹¹

In the case of the SEC, the agency promoted numerous regulations, like Reg NMS, that have had often negative consequences. While “unintended consequences” are a much-discussed problem stemming from regulation, it has been theorized that perhaps the likely outcomes of Regulation NMS *had* been understood by some and had been propelled forward nevertheless by those who stood to benefit from the rise of HFT. As Arnuk and Saluzzi speculate, “You can’t help but wonder whether the changed market structure [over the last fifteen years] is less the result of ‘unintended consequences’ and more of a well-executed plan.”¹¹²

Surprising at least some observers, high frequency trading proliferated after Reg NMS went into effect in 2007. Soon afterwards, some market professionals and others sensed that HFTs were gaming the

market. As Lewis notes, it was 2009—five years prior to the debut of Lewis’ book and one year prior to the Flash Crash—when Senator Charles Schumer formally complained to the SEC about flash trading.¹¹³ In 2010, high frequency trading gained some negative attention in the aftermath of the flash crash, but then the story somewhat faded from popular view until the publication of Lewis’ book in 2014 catalyzed concern.

Popular trust in the U.S. securities markets, perennially in short supply, continues to be low, even as the stock market has rebounded from the crash of 2008 and the flash crash of 2010.¹¹⁴ Revelations of HFT, along with other opaque practices like dark pools and the selling of retail order flow to clandestine trading firms, have certainly stoked additional mistrust and suspicion.¹¹⁵ When such practices come to light, these revelations shake people’s faith not just in brokerage firms, but also in the market as a whole and in the capacity of the regulators to protect the small, retail investor from such abuses. The public would be more likely to trust the system if they trusted the regulators.¹¹⁶ If the SEC were led by someone not beholden to the system, and with the vision and courage to breathe new life into an agency so it can better interpret and enforce the laws we already have in place, instead of introducing new ones, the staff jobs would start to attract premier talent. And with better, not more, regulation, the public’s trust would be reestablished.

Anxious to accrue public trust in the market, New York State Attorney General Eric Schneiderman has sensed the urgency of investigating high frequency trading. While he readily acknowledges that “High-frequency trading is with us. It’s not going away...,” he emphasizes, “we have to make sure we have a set of laws and regulations that send a message that everyone still has a fair shot to compete.” He notes that “...the constant arms race of people having the incentive, which they have now, to try untested methods to gain those extra milliseconds of speed—that is a danger to the markets.”¹¹⁷

Perceiving a potentially simple solution to the problem, the founders of alternate trading system IEX came to the realization that it would be fairer if everyone had to go through a time delay before their trades were placed in IEX’s matching engine. They contended that this would put everyone on an equal footing and would eliminate the issue of some

High Frequency Trading

possessing more timely market information than others.¹¹⁸ Michael Lewis, in his book and in interviews, has hailed IEX's innovative approach.¹¹⁹ Regardless of whether or not other trading venues could similarly remove the time advantage currently enjoyed by high frequency traders, the larger point here is that the solution to the HFT issue might indeed emanate from the private sector, not the SEC.

In the meantime, HFT continues to wield enormous influence and represent comparable risk, at least partly through its use of high leverage.¹²⁰ Decrying HFT, Michael Lewis has lamented the deterioration in what "once been the world's most public, most democratic, financial market."¹²¹ Ironically, as this paper evidences, in the SEC's endeavor to make the stock market more fair by making it more public and more democratic, a largely unforeseen outcome arose—the birth of high frequency trading—the antithesis, to some, of a fair, transparent, and open market.

ACKNOWLEDGEMENTS

The authors wish to thank for their keen insights Randall Burkert, James Cramer, M. Kraighton Stack, the two anonymous referees for this journal, as well as the associate editor and editor. While the above were enormously helpful, the opinions and conclusions reached are those of the co-authors alone.

NOTES

¹ Even more bluntly than in his book, Michael Lewis, in a 60 Minutes Interview (2014) stated, "Stock market's rigged. The U.S. stock market, the most iconic market in global capitalism, is rigged."

² For another negative critique, see Scott Patterson, 2013. Notably, however, there are defenders of both HFT and the overall fairness of markets today. SEC Chair Mary Jo White, 2014, emphasized, "the current market structure is not fundamentally broken, let alone rigged."

³ See Arnuk and Saluzzi, 2012, pp. 18-20; note especially their blunt appraisal that "...the SEC is the creator of our Franken-Market." p. 20. See also Lewis, 2014, especially pp. 96-101, on Regulation NMS.

⁴ While we hail these factors as key, there are even more SEC-driven factors also at play here driving HFT, such as the imposition of Regulation ATS (alternate trading systems) in 1999 (mandating the public display of quotes) and the elimination of Rule 390 in 2000 (which meant member firms could now conduct transactions in NYSE-listed stocks away from the floor of an organized exchange). On Rule 390's repeal, see Thomas Mulligan (1999). The NYSE eliminated Rule 390 with the SEC's encouragement.

⁵ Definitions of HFT vary widely. See, for example, Edgar Perez, 2011, pp. 2-4; also Arnuk and Saluzzi, 2012, especially pp. 24-26; Matthew Philips (2013).

⁶ Kumiega quoted in Perez, p. 4.

⁷ In the 1970s, an early pioneer of algorithmic, computer-based trading was Dean LeBaron at BatteryMarch Financial Management in Boston. See Jason Zweig (2014).

⁸ See "Electronic trading platform," "Algorithmic trading," "Program trading." On ECNs, see R.T. Leuchtkafer (2012a, 155-158). When ECNs debuted in 1997, the SEC encouraged the development, as the SEC liked the idea of ECNs providing competition to especially the two biggest exchanges, the NYSE and NASDAQ. (p. 155).

⁹ Latency has been defined as "the time it takes from when a trade is started to when it's executed" (Philips, 2012).

¹⁰ For more on HFT tactics, see Angel and McCabe, 2013, pp. 585-595.

¹¹ Angel and McCabe (2013, p. 589), however, challenge this notion that HFT allows certain privileged investors to acquire an advance look at other traders' orders without their knowledge or permission. If it is not a look at actual order flow, however, it certainly does seem to us that HFT traders, through various techniques, frequently obtain a look at *potential*, *likely* order flow, through their predictive, anticipatory strategies.

¹² See John McCain, S. Hrg. 213-413, Congress Session 113-2, June 17, 2014.

¹³ In other words, physical proximity reduces latency. As Philips (2012) explains, “The farther a signal has to travel, the higher the latency, which is why a shorter cable is a faster cable.”

¹⁴ Several of the big HFT players are GETCO, Infinium, and Optiver. Arnuk and Saluzzi, p. 24.

¹⁵ One such critic is brokerage firm founder Charles Schwab. See Nancy Folbre, *New York Times*, April 7, 2014). Also see Charles Schwab Corporation (2014); Kathleen Pender, *San Francisco Chronicle*, April 25, (2014).

¹⁶ In a sense, front running is a type of insider trading – insider trading on order flow.

¹⁷ See also Angel and McCabe’s discussion of front-running (2013, p. 589).

¹⁸ According to Columbia University professor and Nobel laureate Joseph Stiglitz, high-speed trading “results in sophisticated versions of front running,” and hence has created “an unlevel playing field,” quoted in Steve Matthews (2014). However, some disagree that HFT always, by its inherent nature, constitutes front-running. See Caleb Johnson (2014).

¹⁹ Angel and McCabe (2013, p. 589).

²⁰ Lewis (2014, p. 69).

²¹ After much intense debate, the final enacted bill was significantly diluted from the Fletcher-Rayburn proposal. “Exchange Bill Passed...” (1934, pgs. 1, 3). “Roosevelt Signs Curb Bill” (1934, p. 7).

²² SEC, “The Investor’s Advocate...”

²³ Angel and McCabe (2013, p. 585) have insightfully inquired into the meaning of “fair markets.”

²⁴ Stock pools should not be confused with “dark pools.” Unlike dark pools, which will be discussed later in this paper, stock pools are today illegal. In a stock pool, a group of insiders grouped their money together and tried through rumor spreading, “painting the tape,” and other techniques to influence the price of the stock upward or downward, agreeing to split the proceeds with each other after they pulled the plug on the pool. For an interesting discussion of pools and how perhaps they were not manipulatory, see Paul G. Mahoney, 1999, pp. 343-369.

²⁵ Felix Frankfurter assembled a team to craft the legislation that included Benjamin Cohen, Thomas Corcoran, James Landis, and others.

²⁶ NYSE President Richard Whitney, the leader of the Old Guard, virulently opposed the proposed National Securities Act of 1934, contending that the bill would seriously impair and possibly destroy the market for stocks. See Whitney, various Statements February 22-February 23, 1934, February 29, 1934, March 22, 1934, NYSE Archives. See also “Exchange Supervisory Body Urged” (1934).

²⁷ On Joseph Kennedy’s role as first chairman of the SEC, see Ralph DeBedts, 1964; Ralph DeBedts, 1961, pp. 165-178; Joel Seligman, 1995.

²⁸ For a discussion of the rationale underlying keeping the securities industries primarily self-regulating, see Joel Seligman, 2004, p. 1347; also see Seligman, 1995, p. 439.

²⁹ Landis, June 19, 1935, quoted in Thomas McGraw, 1984, pp. 192-193. See also *SEC, First Annual Report*, 1935, p. 38.

³⁰ Douglas quoted in Chris Welles, 1975, p. 12.

³¹ Floor traders trade for their own accounts on the floor of the exchange; specialists, tasked with making a market in each stock, under certain conditions trade for their own accounts as well. In the 1970s, reporter John Brooks (1999, pp. 91, 94-95) once described floor traders as “those exchange members who play the market with their own money on the floor itself, deriving from their membership the unique advantages over nonmembers of being at the scene of action and of paying no commissions to brokers.” Critical of the floor traders’ role, the 1963 Special Study of the Securities Market recommended (to no avail) that floor traders “be legislated right out of existence through the interdiction of their activities,” as Brooks explained. At roughly the same time, the NYSE commissioned a study of floor trading which concluded that eliminating floor trading would hurt liquidity and heighten stock volatility.

³² Acting as a catalyst to bring buyers and sellers together is one of the five key functions a specialist performs, according to the NYSE. The other functions are “manage the auction process,” “execute orders for floor brokers,” “provide capital,” and “stabilize prices.” NYSE,

www.nyse.com. For simplicity sake, this paper consistently uses the term “specialists,” though since 2008, the proper term is “designated market makers” or DMMs, the new title reflecting some changes in the position. See “Specialists are Transformed into Designated Market Makers (DMMs),” (2008).

³³ As Seligman (2004, p. 1350) explains, “Indeed, section 10 invited the exchanges to go further and replace the specialists altogether with exchange officers or employees who could perform ‘the functions of specialists’ but would have no rights to trade for their own accounts.” Also see Seligman, 1995, pp. 85-86.

³⁴ “The NYSE and Nasdaq: How They Work,” *Investopedia*. Also see “Auction Market,” *Investopedia*.

³⁵ For a solid discussion of the historic role of specialists and market makers and the lack of such intermediaries in the new electronic crossing networks (ECNs) and HFT environment, see Leuchtkofer, 2012a, pp. 155-159.

³⁶ Jay F. Coughneour and Daniel N. Deli, 2002, pp. 843-844. Also see NYSE, *Report of the Committee to Study the Stock Allocation System*, 1976.

³⁷ NYSE, www.nyse.com.

³⁸ Maintaining a position in a stock, a specialist stands “prepared to buy and sell from and to other members” and to the public, as stock market historian Robert Sobel (1975, p. 16) once explained. See also Sobel, pp. 17-18. On the role of the specialist, also see Nicholas Wolfson and Thomas A. Russo (1970, pp. 707-746); Kenneth M. Morris and Virginia M. Morris (1999, p. 63); NYSE, www.nyse.com.

³⁹ NYSE, www.nyse.com.

⁴⁰ Specialists were essentially referees, although their calls were then refereed by floor officials and potentially by the SEC.

⁴¹ NYSE Euronext quoted in Andrew Haigney (2010).

⁴² Interestingly, HFT defenders also invoke the same argument—that they add to liquidity and hence perform a critical function. However, HFT may add to the sheer volume but not necessarily to the depth of the market, particularly since these traders often only hold a position for

milliseconds. Importantly, the idea that greater liquidity benefits all seems to be one of the enduring points of agreement among government, industry, and the public, yet the perennial question has been how to achieve real liquidity. The NYSE's historical and controversial answer to that question has been a designated responsible intermediary—i.e., the specialists. For a discussion of why HFT does not contribute “genuine liquidity” to the market, see Haigney (2010).

⁴³ Quoted in Sobel (1975, p. 18).

⁴⁴ As Sobel (1975) notes, some aspects of the specialist's job had been scrutinized and criticized in the early 1900s, well before the 1929 crash, especially the specialists' ability to buy and sell for their own accounts. The NYSE's standard defense was that, as Sobel explains, “the specialist had to buy and sell for his account in order to maintain his inventory of the stock, and this was necessary so as to maintain an orderly market in the shares” (Sobel, p. 17). The NYSE argued that tampering with the specialist system would wreak havoc on the stock market.

⁴⁵ Among other issues raised were concentration in stock exchange operations and the high fixed rate of brokers' commissions. The second installment of the 1963 SEC Special Study, issued in July 1963, also heavily criticized the floor traders. On the SEC's Special Study of 1963, see Brooks (1999, pp. 91-92).

⁴⁶ NYSE, NYSE Press Release: Specialist System, September 24, 1964, www.sechistorical.org.

⁴⁷ Ibid.

⁴⁸ Due primarily to mergers and acquisitions, the number of specialist firms had, though, already sharply declined, plummeting from approximately 230 firms in 1933 to 50 by 1983, to only 10 by 2001. Arnuk and Saluzzi, 2012, p. 26; see also footnote 3, p. 43: Brian C. Hatch and Shane A. Johnson, 2002, pp. 139-67.

⁴⁹ Historian Maury Klein (2001) once applied the “perfect storm” metaphor to describe the factors that coalesced to cause the 1929 Crash.

⁵⁰ For a discussion of the events leading to rate deregulation (“Mayday” 1975), see Marshall E. Blume, Jeremy Siegel, and Dan Rottenburg, 1993, pp. 14-17, 23-24, 50, 52, 68, 107-109, 115, 128-142, 161-163. Also see

Janice Traflet and Michael P. Coyne, 2007, pp. 131-141.

⁵¹ Robert Haack, November 17, 1970, NYSE Archive.

⁵² On the rise of discount brokerage firms post rate deregulation, see John Kandor, 2002.

⁵³ While some may argue that the perpetual quest for higher revenue and profits may have led member firms eventually to expand their proprietary trading activities even in the absence of rate deregulation, banks would have been highly reluctant to take on the additional risk of proprietary trading when they still had the safety net of the fixed commission umbrella.

⁵⁴ On the original Section 11A of the 1934 Securities Act, see Securities Act of 1934, No. 291, 73rd Congress, HR 9323, Section 11a, pp. 12-13. For the full text of amended Section 11A of the 1934 Securities Act, see Securities Act of 1934, as amended 2012, pp. 101-111.

⁵⁵ Securities and Exchange Commission Release No. 34-51808, File No. S7-10-04, “Regulation NMS,” September 29, 2005, p. 6.

⁵⁶ *Ibid.*

⁵⁷ The SEC contends that the NMS helps not just the investing public, but also listed companies by helping to reduce their cost of capital. SEC, “Regulation NMS,” p. 6.

⁵⁸ John Carney, February 4, 2013.

⁵⁹ SEC, “Market 2000: An Examination of Current Equity Market Developments,” (1994), quoted in SEC, “Report to Congress on Decimalization...,” July 2012.

⁶⁰ David Serchuk, 2009.

⁶¹ Oxley discusses Wallman’s projection in Michael G. Oxley, Introduction of “The Common Cents Stock Pricing Act of 1997.”

⁶² Peter Chapman, 1999.

⁶³ Oxley, Intro. of “The Common Cents Stock Pricing Act of 1997.”

⁶⁴ Levitt quote is from Serchuk (2009).

⁶⁵ H.R. 1053 (105th): Common Cents Stock Pricing Act of 1997.

⁶⁶ Oxley is quoted in Chapman (1999).

⁶⁷ Oxley, Intro of “The Common Cents Stock Pricing Act of 1997.”

⁶⁸ See H.R. 1053, which eventually died, as did S. 838. See S. 8283 (105th): Common Cents Stock Pricing Act of 1997. For more on S.838, see <http://www.gpo.gov/fdsys/pkg/BILLS-105s838is/pdf/BILLS-105s838is.pdf>.

⁶⁹ For a historical overview of the move to decimalization, see the section on the regulatory history of decimalization in SEC, “Report to Congress on Decimalization...” July 2012, esp. pp. 4-6. See also Serchuk (2009).

⁷⁰ Block trading desks historically earned revenues not just from commissions but also from the buy sell spread, the latter of which dropped significantly after the implementation of decimalization.

⁷¹ For example, studies have been done concerning the effects of decimalization on initial public offerings as well as smaller capitalized companies. See SEC, “Report to Congress on Decimalization...”

⁷² Quoted in Serchuk (2009).

⁷³ *Ibid.*

⁷⁴ “Tick,” *Investopedia*.

⁷⁵ There were some exceptions to the uptick rule, but for the sake of simplicity, they are not included here.

⁷⁶ Cynthia Crossen, 1988. On the uptick rule, see also Kevin Crisp, 2007-2008, pp. 136, 144-145, 151, 156.

⁷⁷ Serchuk (2009) is describing former SEC chairman Christopher Cox’s argument.

⁷⁸ Cox quoted. in Serchuk (2009).

⁷⁹ SEC Press Release 2010-26, February 24, 2010. See also SEC, 17 CFR Part 242, Release No. 34-61595, File No. 27-08-09, “Amendments to Regulation SHO”, Final Rule.

⁸⁰ While Richard Grasso eventually was vindicated and won a lawsuit regarding his pay package, part of the argument brought forward by Attorney General Eliot Spitzer was that Grasso’s pay package allegedly violated New York’s Not-For-Profit Corporation Law that mandated that CEOs of not-for-profit corporations be given “reasonable” pay. “Spitzer v. Grasso: Greed is Bad,” 2004. On the NASDAQ quote-rigging scandal, see Leuchtkeper in Arnuk and Saluzzi, 2012, p. 156.

⁸¹ Leuchtkafer (2012a, p. 156).

⁸² Leuchtkafer, 2012a, pp. 156-158. Leuchtkafer notes that HFT traders (or “market-maker scalpers”) discovered “there was a good business on the ECNs if they didn’t have to obey the same rules as the NYSE specialists or the NASDAQ market makers, and they didn’t.” (p. 156-157).

⁸³ Arnuk and Saluzzi, 2012, pp. 56-57.

⁸⁴ Jennifer Elliott, 2002.

⁸⁵ Arnuk and Saluzzi, 2012, p. 57. They further note that many of the SEC-driven regulations around this time were aimed at heightening trading efficiency, and they cite Regulation ATS and Regulation NMS, along with updated order-handling rules and decimalization, as examples.

⁸⁶ “The Institution of Experience: S.R.O.s in the Securities Industries, 1792-2010,” esp. the section on “Reorganizing the NYSE,” www.sechistorical.org.

⁸⁷ Arnuk and Saluzzi, 2012, p. 57. As they note, the NYSE purchased Archipelago immediately after becoming a publicly traded company.

⁸⁸ SEC, “Regulation NMS.” Also see Seligman, 2002, pp. 636-680.

⁸⁹ Lewis, 2014, p. 97.

⁹⁰ Ibid. Also on Reg NMS, see Arnuk and Saluzzi, 2012, pp. 76-80.

⁹¹ Lewis, 2014, p. 98. On SIP and the NBBO, also see Arnuk and Saluzzi, 2012, pp. 30-31.

⁹² Lewis, 2014, p. 98.

⁹³ For Lewis’ description of dark pools, see Lewis, 2014, p. 42. On the birth and evolution of dark pools, see Arnuk and Saluzzi, 2012, pp. 127-137. Also see Patterson, 2013.

⁹⁴ See Lewis, 2014, p. 54 on Royal Bank of Canada (RBC) debating opening a dark pool and potentially charging HFT firms for the privilege of operating within it; RBC eventually declined to go down this path. For more on dark pools, see Lewis, pp. 42-44; pp. 85-87. Notably, in 2014, several dark pools, including one run by Barclays and another by Goldman Sachs, came under investigation for some of their opaque tactics. Also in 2014, as Reuters reports, Liquidnet, a dark pool operator, was accused of using confidential subscriber trading information for

marketing purposes, a charge it settled with the SEC for \$2 million. See “Fidelity, Other Major Fund Managers to Launch Stocks Dark Pool,” (2015).

⁹⁵ “Front Running: CNBC Explains” (2014).

⁹⁶ As Lewis (2014, p. 96) notes, the case was settled only after the specialists agreed to pay a \$241 million fine. See also “N.Y.S.E. Denies Investigation,” 2003; Greg Ip and Susanne Craig (2003); Kate Kelly and Susanne Craig (2003); “N.Y.S.E. Specialists ‘Front-Running’ Trial Begins,” 2006.

⁹⁷ As Arnuk and Saluzzi (2012, p. 26) note, four of the largest DMMs conducting trading on the NYSE are Goldman Sachs, Knight Capital, Barclays, and GETCO – the “four horsemen” who are also “HFT powerhouses.” Arnuk and Saluzzi go on to criticize DMMs for not providing genuine liquidity, unlike the traditional specialists (pp. 27-28 and p. 55).

⁹⁸ “Specialists are Transformed into Designated Market Makers (DMMs),” NYSE Timeline.

⁹⁹ Ibid.

¹⁰⁰ Lewis, 2014, p. 3.

¹⁰¹ For an excellent discussion of the Flash Crash, R.T. Leuchtkafer (2012a, 2012b) which are guest chapters in Arnuk and Saluzzi (2012)

¹⁰² For more recent thoughts regarding HFT’s possible role in exacerbating the Flash Crash, see Andrei A. Kirilenko, Albert S. Kyle, Mehrad Samadi, and Tugkan Tuzun, 2014.

¹⁰³ SEC and CFTC, “Findings Regarding the Market Events of May 6, 2010,” September 30, 2010, especially pp. 45-46. The report did not, however, specify to what extent HFT firms sold short during the 2010 Crash, which would be more relevant to assessing the impact of the uptick rule’s removal. Notably, the Amendment to Regulation SHO was in place when the Flash Crash occurred.

¹⁰⁴ In discussing the defection rates, Lewis points to a study conducted by RBC. Lewis (2014, p. 106) concludes, “The SEC, like the public stock exchanges, had a kind of equity stake in the future revenues of high-frequency traders.”

¹⁰⁵ Kane (1986, pp. 188, 190) defines regulatory dialectic as “a conception that underscores the inherent conflict between attempts to regulate and attempts of regulated parties to lessen the burden of whatever regulations apply to them.”

¹⁰⁶ Kane, 1986, p. 190.

¹⁰⁷ On “blame avoidance,” see Kane, 1986, pp. 190-191.

¹⁰⁸ William R. Gruver, 2010. Gruver further notes that the SEC, due to “inadequate” resources and “misplaced” incentives, has not evolved as quickly as the securities markets it supervises. As he explains, the SEC has suffered from being “so myopically obsessed with discovering and pursuing relatively minor technical violations” that they miss the bigger picture and larger problems.

¹⁰⁹ Richard O. Scribner, 1986, p. 19.

¹¹⁰ Scribner, 1986, pp. 20, 19-24.

¹¹¹ See Kohlmeier, 1969.

¹¹² Arnuk and Saluzzi, 2012, p. 14. They note that the exchanges had been “lobbying for the regulations to turn out exactly as they wanted, when they wanted it.”

¹¹³ On Senator Schumer’s letter to the SEC, see Lewis, 2014, p. 44. The aggressive (and early) anti-flash trading stance of Senator Charles Schumer (D-NY) is perhaps a little surprising, given that historically, he has been a strong supporter of Wall Street. His aversion to HFT may stem from his deep understanding of Wall Street and hence his ability to identify a danger to the public interest, and it also may reflect his desire to defend the status quo from the intrusion of interlopers (the “flash boys”).

¹¹⁴ In a survey of 1,010 adults, Harris Polls in 2011 found that 70 percent of survey respondents “do *not* believe that people on Wall Street are as honest and moral as other people” (“Massive 6-1 Majority...”). In a 2012 Harris poll (discussed in Karlyn Bowman and Andrew Rugg, 2013, p. 4), only 7 percent of those surveyed were very confident in those leading Wall Street.

¹¹⁵ This practice of selling retail order flow was pioneered by the notorious Bernie Madoff. See Linette Lopez, 2014.

¹¹⁶ Gruver, 2010.

¹¹⁷ Quoted in Bruno J. Navarro, 2014.

¹¹⁸ As Conor Myhrvold (2014) explains, “Because everyone has to go through the delayed door to trade via IEX’s matching engine, this means that no one will have more up-to-date information on the markets than IEX will already have, and the price stays fair and accurate.”

¹¹⁹ Brad Katsuyama and IEX are heavily featured in Lewis’ book. See, for instance, Lewis, 2015, Ch. 2, “Brad’s Problems,” pp. 23-55.

¹²⁰ On HFT firms’ use of heavy leverage, see Arnuk and Saluzzi, 2012, p. 16.

¹²¹ Lewis, 2014, p. 69.

WORKS CITED

“Auction Market.” *Investopedia*,

<http://www.investopedia.com/terms/a/auctionmarket.asp>. Accessed December 1, 2014.

“Algorithmic trading.” *Wikipedia*.

http://en.wikipedia.org/wiki/Algorithmic_trading. Accessed December 1, 2014.

Angel, James J. and Douglas McCabe. “Fairness in Financial Markets: The Case of High Frequency Trading.” *Journal of Business Ethics* 112 (2013): 585-595.

Arnuk, Sal L. and Joseph C. Saluzzi. *Broken Markets: How High Frequency Trading and Predatory Practices on Wall Street Are Destroying Investor Confidence and Your Portfolio*. Upper Saddle River: FT Press, 2012.

Blume, Marshall E., Jeremy Siegal, and Dan Rottenburg. *Revolution on Wall Street: The Rise and Decline of the NYSE*. New York: W.W. North and Company, 1993.

- Bowman, Karlyn and Andrew Rugg. *Five Years After the Crash: What Americans Think about Wall Street, Banks, Business, and Free Enterprise*. AEI Public Opinion Studies, 2013. Available at http://www.aei.org/wp-content/uploads/2013/09/-five-years-after-the-crash-what-americans-think-about-wall-street-banks-business-and-free-enterprise_083339502447.pdf. Accessed March 29, 2015.
- Brooks, John. *The GoGo Years: The Drama and Crashing Finale of Wall Street's Bullish 60s*. New York: Wiley, 1999, c1973.
- Carney, John. "SEC Rethinks the Penny Tick in Stock Trading," February 4, 2013, <http://www.cnn.com/id/100433013#>. Accessed December 1, 2014.
- Chapman, Peter. "A Penny for Your Troubles: On the Rocky Road to the Decimalization of U.S. Stock Trading?" *Traders Magazine*, November 1, 1999.
- Charles Schwab Corporation. "Schwab Statement on High-frequency Trading." April 3, 2014. <http://pressroom.aboutschwab.com/press-release/corporate-and-financial-news/schwab-statement-high-frequency-trading>. Accessed July 15, 2014.
- "Conflicts of Interest, Investor Loss of Confidence, an High Speed Trading in U.S. Stock Markets," Permanent Subcommittee on Investigations, S. Hrg. 113-413, June 17, 2014, <http://congressional.proquest.com/congressional/docview/t05.d06.2014-s481-42?accountid+9784>.
- Coughneour, Jay F. and Daniel N. Deli. "Liquidity Provision and the Organizational Form of NYSE Specialist Firms." *Journal of Finance*, Vol. LVII, No. 2, April 2002: 841-870.
- Crisp, Kevin. "Giving Investors Short Shrift: How Short Sale Constraints Decrease Efficiency and a Modest Proposal for Letting More Shorts Go Naked," 8 *Journal of Business and Securities Law*. 135 (2007-2008), http://msujbsl.com/sites/default/files/2007-2008_Crisp.pdf. Accessed January 20, 2015.
- Crossen, Cynthia. "Program Traders Find an Unlikely Ally in Bid to Abolish 'Uptick Rule' on the Big Board," *Wall Street Journal*, January 11, 1988, 53.

- DeBedts, Ralph. "The First Chairmen of the Securities and Exchange Commission: Successful Ambassadors of the New Deal to Wall Street." *American Journal of Economics and Sociology*. Vol. 23, No. 2 (April 1961): 165-178.
- DeBedts, Ralph. *The New Deal's SEC: The Formative Years*. New York: Columbia University Press, 1964.
- "Electronic trading platform."
Wikipedia.http://en.wikipedia.org/wiki/Electronic_trading_platform. Accessed December 1, 2014.
- Elliott, Jennifer. "Demutualization of Securities Exchanges: A Regulatory Perspective." IMF Working Paper WP/02/119, Rev. September 18, 2002,
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=879869. Accessed March 3, 2015.
- "Exchange Bill Passed by Senators, 62:13; Securities Act Eased." *Washington Post*, May 13, 1934, 1, 3.
- "Exchange Supervisory Body Urged; New Bill Attacked." *Wall Street Journal*, April 2, 1934, 8.
- "Fidelity, Other Major Fund Managers to Launch Stocks Dark Pool." Reuters, January 19, 2015,
<http://www.reuters.com/article/2015/01/20/usa-darkpool-firms-idUSL1N0UZ03620150120>. Accessed January 25, 2015.
- Folbre, Nancy. "The Front-Runners of Wall Street." *New York Times*, April 7, 2014, <http://economix.blogs.nytimes.com/2014/04/07/the-front-runners-of-wall-street/?r=0>. Accessed January 24, 2015.
- "Front running." Wikipedia. http://en.wikipedia.org/wiki/Front_running. Accessed November 15, 2014.
- "Front Running: CNBC Explains." CNBC.com, April 2, 2014, <http://www.cnbc.com/id/101549039#>. Accessed June 28, 2014.
- Gruver, William R. "'Smart Regulation: Lessons from China.'" *Directorship Magazine*, March 9, 2010.
- Haack, Robert. "Competition and the Future of the NYSE." 11/17/70, Box 10, Folder 16, NYSE Archive, New York City, New York.

- Haigney, Andrew. "High Frequency Trading: A Liquidity Hoax." *Business Insider*, December 2, 2010, <http://www.businessinsider.com/high-frequency-trading--a-liquidity-hoax-2010-12>. Accessed December 1, 2014.
- Hatch, Brian C. and Shane A. Johnson. "The Impact of Specialist Firm Acquisition on Market Quality." *Journal of Financial Economics* 66 (2002): 139-67.
- Hope, Bradley and Scott Patterson. "NYSE plan would revamp trading — acting on new CEO's critique of markets, exchange operator offers to cut costs to draw orders." *Wall Street Journal*, December 18, 2014, retrieved from <http://search.proquest.com/docview/1637390941?accountid=9784>.
- "H.R. 1053 (105th): Common Cents Stock Pricing Act of 1997," <https://www.govtrack.us/congress/bills/105/hr1053>. Accessed December 1, 2014.
- "The Institution of Experience: S.R.O.s in the Securities Industries, 1792-2010." [www.sechistorical.org](http://www.sechistorical.org/museum/galleries/sro/sro06f.php), <http://www.sechistorical.org/museum/galleries/sro/sro06f.php>. Accessed March 3, 2015.
- Ip, Greg and Susanne Craig. "NYSE's 'Specialist' Probe Puts Precious Asset at Risk: Trust," *Wall Street Journal*, April 18, 2003, <http://online.wsj.com/news/articles/SB105061280398533700>. Accessed July 1, 2014.
- Johnson, Caleb. "Is High-Frequency Trading a Form of Front-Running?" Competitive Enterprise Institute, April 4, 2014, <http://cei.org/2014/04/04/is-high-frequency-trading-a-form-of-front-running>. Accessed July 1, 2014.
- Kandor, John. *Charles Schwab: How One Company Beat Wall Street and Reinvented the Brokerage Industry*. New York: John Wiley and Sons, 2002.
- Kane, Edward J. "Technology and the Regulation of Financial Markets." In *Technology and the Regulation of Financial Markets: Securities, Futures, and Banking*, edited by Anthony Saunders and Lawrence J. White, 187-193. Lexington: Lexington Books, 1986.

-
- “Katsuyama vs. O’Brien – Who Won the Fight?” CNBC.com, April 1, 2014, <http://www.cnbc.com/id/101544772#>. Accessed July 1, 2014.
- Kelly, Kate and Susanne Craig. “NYSE ‘Front-Running Probe Involves Five of Seven Firms.” *Wall Street Journal*, April 18, 2003, <http://online.wsj.com/news/articles/SB105061361377009700>. Accessed July 1, 2014.
- Kirilenko, Andrei A., Albert S. Kyle, Mehrad Samadi, and Tugkan Tuzun. “The Flash Crash: The Impact of High Frequency Trading on an Electronic Market”, September 24, 2014, available at SSRN: <http://ssrn.com/abstract=1686004> or <http://dx.doi.org/10.2139/ssrn.1686004>.
- Klein, Maury. *Rainbow’s End: The Crash of 1929*. Oxford, 2001.
- Kohlmeier, Jr, Louis M. *The Regulators: Watchdog Agencies and the Public Interest*. New York: Harper and Row, 1969.
- Leuchtkafer, R.T. “The Flash Crash.” Guest Chapter 10, pp. 151-173, in Sal Arnuk and Joseph Saluzzi, *Broken Markets: How High Frequency Trading and Predatory Practices on Wall Street Are Destroying Investor Confidence and Your Portfolio*. Upper Saddle River: FT Press, 2012a.
- Leuchtkafer, R.T. “The Aftermath.” Guest Chapter 11, pp. 177-191, in Sal Arnuk and Joseph Saluzzi, *Broken Markets: How High Frequency Trading and Predatory Practices on Wall Street Are Destroying Investor Confidence and Your Portfolio*. Upper Saddle River: FT Press, 2012b.
- Lewis, Michael. *Flash Boys: A Wall Street Revolt*. New York: W.W. Norton, 2014.
- Lopez, Linette. “Brokerage Firms Make Millions Selling Orders to High Frequency Trading Firms.” *Business Insider*, April 7, 2014, <http://www.businessinsider.com/brokerages-make-millions-selling-orders-to-high-frequency-trading-firms-2014-4>. Accessed March 15, 2015
- Mahoney, Paul G. “The Stock Pools and the Securities Exchange Act,” *Journal of Financial Economics* 51 (1999), 343-369.

- “Market Fragmentation.” Lexicon.ft.com,
<http://lexicon.ft.com/Term?term=market-fragmentation>. Accessed July 1, 2014.
- “Massive 6-1 Majority Favors Tougher Regulation of Wall Street.” Harris Polls,
5/20/2011, <http://www.harrisinteractive.com/NewsRoom/HarrisPolls/tabid/447/mid/1508/articleId/783/ctl/ReadCustom%20Default/Default.aspx>. Accessed July 1, 2014.
- Matthews, Steve. “Stiglitz Calls High-Speed Trading ‘Front-Running, Suggests Tax,’” *Bloomberg News*, April 15, 2014, <http://www.bloomberg.com/news/2014-04-15/stiglitz-calls-high-speed-trading-front-running-suggests-tax.html>. Accessed July 1, 2014.
- McCain, John. Opening Statement, “Conflicts of Interest, Investor Loss of Confidence, an High Speed Trading in U.S. Stock Markets,” Permanent Subcommittee on Investigations, S. Hrg. 113-413, Congress Session 113-2, June 17, 2014, <http://congressional.proquest.com/congressional/docview/t05.d06.2014-s481-42?accountid+9784>. Accessed January 25, 2015.
- McGraw, Thomas. *Prophets of Regulation: Charles Francis Adams, Louis D. Brandeis, James M. Landis, Alfred E. Kahn*. Boston: Belknap Press of Harvard University Press, 1984.
- Morris, Kenneth M. and Virginia M. Morris. *The Wall Street Journal Guide to Understanding Money & Investing*. New York: Lightbulb Press, 1999.
- Mulligan, Thomas S. “NYSE to Repeal Rule Forbidding Off-Floor Trades.” *Los Angeles Times*, December 2, 1999, <http://articles.latimes.com/1999/dec/02/business/fi-39618>. Accessed March 15, 2015.
- Myhrvold, Conor. “A No-Nonsense Explanation of IEX, The Exchange Fighting HFT.” May 29, 2014, <http://www.fastcolabs.com/3031242/a-no-nonsense-explanation-of-iex-the-exchange-fighting-high-frequency-trading>. Accessed January 30, 2015.

-
- Navarro, Bruno J. “New York attorney general to probe high-frequency trading.” CNBC.com, March 18, 2014, <http://www.cnbc.com/id/101502570#>. Accessed July 2, 2014.
- “The NYSE and Nasdaq: How They Work.” *Investopedia*, <http://www.investopedia.com/articles/basics/03/103103.asp>. Accessed December 15, 2014.
- NYSE. NYSE Press Release: Specialist System, September 24, 1964. www.sechistorical.org, http://3197d6d14b5f19f2f440-5e13d29c4c016cf96cbbfd197c579b45.r81.cf1.rackcdn.com/collection/papers/1960/1964_0924_NYSESpecialist.pdf. Accessed February 1, 2015.
- NYSE. NYSE News Release, August 27, 2009 <http://www1.nyse.com/press/1251367637915.html>. Accessed January 25, 2015.
- “N.Y.S.E. Denies Investigation,” *New York Times*, April 23, 2003, <http://www.nytimes.com/2003/04/23/business/23PLAC.html>. Accessed July 1, 2014.
- “N.Y.S.E. Specialists ‘Front-Running’ Trial Begins.” *New York Times*, June 16, 2006, http://dealbook.nytimes.com/2006/06/16/nyse-specialists-front-running-trial-begins/?_php=true&_type=blogs&_r=0. Accessed June 28, 2014.
- NYSE. *Report of the Committee to Study the Stock Allocation System*. New York: NYSE, 1976.
- NYSE website. www.nyse.com. Accessed December 1, 2002.
- Ortega, Edgar. “NYSE Loses Market Share and Nasdaq Isn’t the Winner.” June 24, 2009, *Bloomberg*, <http://www.bloomberg.com/apps/news?pid=21070001&sid=ak5k.t8Pri4s>. Accessed July 1, 2014.
- Oxley, Michael G. Introduction of “The Common Cents Stock Pricing Act of 1997.” Capitalwords.org, http://capitolwords.org/date/1997/03/13/E471-2_the-common-cents-stock-pricing-act-of-1997/. Accessed December 1, 2014.

- Patterson, Scott. *Dark Pools: The Rise of the Machine Traders and the Rigging of the U.S. Stock Market*. New York: Crown Publishers, 2013.
- Pender, Kathleen. "Charles Schwab CEO clarifies high-frequency trading remarks." *San Francisco Chronicle*, April 25, 2014. <http://www.sfchronicle.com/business/networth/article/Charles-Schwab-CEO-clarifies-high-frequency-5430935.php>. Accessed July 15, 2014.
- Perez, Edgar. *The Speed Traders: An Insider's Look at the New High-Frequency Phenomenon that is Transforming the World*. New York: McGraw Hill, 2011.
- Philips, Matthew. "How the Robots Lost: High-Frequency Trading's Rise and Fall." *Bloomberg BusinessWeek*, June 6, 2013, <http://www.businessweek.com/articles/2013-06-06/how-the-robots-lost-high-frequency-tradings-rise-and-fall>. Accessed January 25, 2015.
- Philips, Matthew. "Stock Trading is About to Get 5.2 Milliseconds Faster." March 29, 2012, *BloombergBusiness*, <http://www.bloomberg.com/bw/articles/2012-03-29/trading-at-the-speed-of-light>. Accessed January 25, 2015.
- "Program trading," *Wikipedia*, http://en.wikipedia.org/wiki/Program_trading. Accessed January 25, 2015.
- "Roosevelt Signs Exchange Curb Bill." *New York Times*, June 7, 1934, 7. S. 8283 (105th): Common Cents Stock Pricing Act of 1997, <https://www.govtrack.us/congress/bills/105/s838>. Accessed December 1, 2014.
- Saunders, Anthony and Lawrence J. White, editors. *Technology and the Regulation of Financial Markets: Securities, Futures, and Banking*. Lexington: Lexington Books, 1986.

- Scribner, Richard O. "The Technological Revolution in Securities Trading: Can Regulation Keep Up?" In *Technology and the Regulation of Financial Markets: Securities, Futures, and Banking*, edited by Anthony Saunders and Lawrence J. White, 19-27. Lexington: Lexington Books, 1986.
- Securities Act of 1934, No. 291, 73rd Congress, HR 9323.
- Securities Act of 1934, as amended 2012. Accessed October 20, 2014, <http://www.sec.gov/about/laws/sea34.pdf>.
- SEC. *First Annual Report*. Washington: GPO, 1935.
- SEC. "The Investor's Advocate: How the SEC Protects Investors, Maintains Market Integrity, and Facilitates Capital Formation." <http://www.sec.gov/about/whatwedo.shtml#.VJMLMJODDs>. Accessed December 17, 2014,
- SEC. Release No. 34-51808, File No. S7-10-04, "Regulation NMS." September 29, 2005, <http://www.sec.gov/rules/final/34-51808.pdf>. Accessed October 20, 2014.
- SEC. Press Release 2010-26, "SEC Approves Short Selling Restrictions, February 24, 2010, <http://www.sec.gov/news/press/2010/2010-26.htm>. Accessed January 25, 2015.
- SEC. 17 CFR Part 242, Release No. 34-61595, File No. 27-08-09, "Amendments to Regulation SHO", Final Rule, <http://www.sec.gov/rules/final/2010/34-61595.pdf>. Accessed January 25, 2015.
- SEC Staff. "Report to Congress on Decimalization as Required by Section 16 of the Jumpstart Our Business Startups Act." July 2012, <http://www.sec.gov/news/studies/2012/decimalization-072012.pdf>. Accessed December 18, 2014.
- SEC and CFTC. "Findings Regarding the Market Events of May 6, 2010, Report of the Staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues," September 30, 2010, <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>. Accessed January 25, 2015.

- Seligman, Joel. "Cautious Evolution or Perennial Irresolution: Stock Market Self-Regulation During the First Seventy Years of the Securities and Exchange Commission." *The Business Lawyer*, Vol. 59, No. 4 (August 2004): 1347-1387.
- Seligman, Joel. "Rethinking Securities Markets: The SEC Advisory Committee on Market Information and the Future of the National Market System." *Business Lawyer*, Vol. 57, no. 2 (February 2002): 636-680.
- Seligman, Joel. *The Transformation of Wall Street: A History of the Securities and Exchange Commission and Modern Corporate Finance*. Boston: Northeastern Univ. Press, 1995.
- Serchuk, David. "Decimalization and Its Discontents." *Forbes*, March 10, 2009, <http://www.forbes.com/2009/03/09/decimalization-uptick-rule-intelligent-investing-volatility.html>. Accessed July 14, 2014.
- 60 Minutes Interview with Michael Lewis, by reporter Steve Kroft, March 30, 2014, <http://wtvr.com/2014/03/31/michael-lewis-stock-market-rigged/>. Accessed January 20, 2015.
- Sobel, Robert. *N.Y.S.E.: A History of the New York Stock Exchange, 1935 – 1975*. New York: Weybright & Talley, 1975.
- "Specialists are Transformed into Designated Market Makers (DMMs)." NYSE Timeline, October 24, 2008, http://www.nyse.com/about/history/timeline_trading.html. Accessed July 1, 2014.
- "Spitzer v. Grasso: Greed is Bad." *The Economist*, May 27, 2004, <http://www.economist.com/node/2709011?zid=295&ah=0bca374e65f2354d553956ea65f756e0>. Accessed March 3, 2015.
- "Tick," *Investopedia*, <http://www.investopedia.com/terms/t/tick.asp>. Accessed January 20, 2015.
- Trafflet, Janice and M.P. Coyne. "Ending a NYSE Tradition: The 1975 Unraveling of Brokers' Fixed Commissions and Its Impact on Financial Advertising." *Essays in Economic and Business History*, Vol. 25 (2007): 131-141.

- Wallman, Steven M.H. "Saving billions for investors, a penny at a time." *Business Law Today*, Vol. 7, no. 1 (Sept/Oct. 1997): 12-17.
- Welles, Chris. *The Last Days of the Club*. New York: E.P. Dutton, 1975.
- White, Mary Jo. "Enhancing Our Equity Market Structure." Talk at Sandler O'Neill & Partners, L.P. Global Exchange and Brokerage Conference New York, N.Y., June 5, 2014, <http://www.sec.gov/News/Speech/Detail/Speech/1370542004312#.VGkyA0vvZg0>.
- Whitney, Richard. Statement in Regard to H.R. 7852 February 22 – February 23, 1934; Statement in Regard to Senate Bill 2693 February 29, 1934; Statement in Regard to the "National Securities Exchange Act of 1934" as amended (HR 8720) March 22, 1934. Whitney Speeches Box, NYSE Archive, New York City, New York.
- Wolfson, Nicholas and Thomas A. Russo. "The Stock Exchange Specialist; An Economic and Legal Analysis." *Duke Law Journal*, Vol. 19, no. 4 (1970): 707-746.
- Zweig, Jason. "New Warnings from an Investing Pioneer." *Wall Street Journal*, January 17, 2014, <http://blogs.wsj.com/moneybeat/2014/01/17/new-warnings-from-an-investing-pioneer/>. Accessed March 3, 2015.