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CHAPTER 10
Using the Market to Manage Proprietary Algorithmic Trading

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Even before Michael Lewis[1] published his popular and controversial[2] book on high-frequency trading (HFT), traditional traders and regulators were asking what they should do about this new evolution in financial market trading technology in which traders use algorithms—computerized trading programs—to automatically trade securities in financial markets. But what exactly about high-frequency trading do traders and regulators wish to see controlled, and can these issues be regulated away? Or are there better, more market-based solutions to address the issues associated with evolving market technology?

The intent of this chapter is to broadly discuss categories of concerns about algorithmic and, more specifically, proprietary algorithmic trading based on issues regulators and legislators themselves have given as rationale for market intervention, but not to explore in detail every possible issue that might be raised. The chapter defines algorithmic and proprietary trading and describes how the technology and regulatory environments have gotten us to today's financial market structure. I present some of the broad concerns algorithmic trading technologies have created for regulators, legislators, the public, and other stakeholders, then

explore one proposed legislative solution, financial transaction taxes (FTTs), and the outcomes of five cases in which an FTT has been implemented. The chapter concludes with market-based solutions that work toward cooperative rather than regulatory resolutions to concerns about market integrity and fairness, including how competition and a self-reporting system for human and technology errors may help manage the concerns some have with computerized trading and proprietary algorithmic trading (PAT) in particular.

TYPES OF ALGORITHMIC TRADING

Algorithmic trading uses computer programs with complex mathematical formulas to analyze internal and external market data to determine trading strategies and place trades. Hasbrouck and Saar divide algorithmic trading into two broad categories: (1) agency algorithms (AA) and (2) proprietary algorithms (PA). The properties of each are unique. AA are "used by buy-side institutions as well as the brokers who serve them to buy and sell shares"[3] with the goal of minimizing the cost of executing trades. These types of algorithms break up large orders into smaller ones to be distributed across multiple trading venues and are generally used by portfolio managers with longer-term investment horizons than those utilizing PA.

Those using PA are attempting to profit from the trading environment itself rather than from investments in securities. PA can be subdivided into two broad categories of users: (1) electronic market making and (2) statistical arbitrage trading. Electronic market makers "buy and sell their own account in a list of securities,"[4] carry low inventories, and profit from small differences between bid and ask prices and liquidity rebates.

Statistical arbitrage trading "is carried out by the proprietary trading desks of large financial firms, hedge funds, and independent specialty firms."[5] They analyze the historical data of stocks and asset groups for trading patterns and compare them with current patterns to identify deviations that can be turned into short-run profit opportunities. PA also look for changes in market behavior that indicate a large order is being executed that creates temporary price imbalances that can be capitalized on. It is important to note that market making and arbitrage trading are not new; they existed in nonautomated markets and were historically executed by specialists. The difference today is the speed with which these strategies can be executed due to automation.

The term "high-frequency trading" is generally associated with proprietary algorithms that operate in the millisecond environment and post and cancel orders frequently as they look for market-making and arbitrage opportunities. I use the term proprietary algorithmic trading in this chapter whenever possible and high-frequency trading when necessary due to context, such as when I am discussing what someone else has said. The two terms should be considered synonymous within this chapter.

CONCERNS ABOUT PROPRIETARY ALGORITHMIC TRADING

Analyzing the goals regulators themselves state as reasons why they seek to regulate PAT finds they generally fall into two broad categories: market integrity and "fairness."[6]

Market Integrity

When it comes to market integrity, most stakeholders are in agreement that markets should be secure, reliable, and orderly to enable effective price discovery and limit market manipulation and abuses. No one ultimately has anything to gain in a chaotic and unstable financial market, and no market participant wishes to compete in such an environment.

While every day 5 billion to 6 billion equity shares are efficiently and effectively traded with an extremely low failure rate,[7] concerns that a major market-disrupting event is inevitable continues to drive calls for increased regulation of both PAT and computerized trading more broadly. Since the 1970s regulators have looked for regulatory solutions to solve the same perceived market failures they believe threaten market integrity today. Among them are market fragmentation and price synchronization across venues, information dissemination problems (including market technology problems), and previous policy failures. Yet these issues persist with only the regulatory targets changing over time. The current target is PAT.[8]

To understand how PAT became the current market integrity concern, it is important to understand some of the history of market structure, regulation, and the concerns of critics. In the early 1970s the US Securities and Exchange Commission (SEC), concerned about increased market fragmentation and the resulting challenges with price synchronization across exchanges, began

pursuing a national market system. The purpose was to develop a consolidated communication and data processing network to synchronize price quotations.[9] It was implemented in 1975.

Regulators were happy with this system until Black Monday of October 19, 1987. Several factors caused stress in the markets in the days leading up to Black Monday, including a higher-than-expected federal budget deficit and new proposed legislation to eliminate the tax benefits associated with corporate mergers. This news led to dollar value declines. Actions taken by the Federal Reserve in the months leading up to the crash had also led to rapidly rising interest rates. These factors together were creating downward pressure on equity prices and generating higher trading volumes. The high volumes were greater than the system technology could handle and technical pricing problems developed. On the day of the crash there was so much sell pressure that some market makers postponed trading for an hour after opening. They simply refused to answer their phones. Doing so meant market indexes had become stale, which led to difficulties pricing securities accurately. The chaotic market environment with impaired and disorderly trading ultimately led to the crash.[10]

Black Monday of 1987 was viewed as a failure of the market structure established by the national market system. To modernize and strengthen it, the Regulation National Market System (NMS) was implemented to correct the previous policy's failures.[11] The goals of Regulation NMS were to improve the dissemination of market information, reduce computerized technical problems, and better synchronize prices across exchanges. Prior to Regulation NMS, most trading was taking place on the New York Stock Exchange (NYSE) and the NASDAQ because the scale of their operations meant there was significant liquidity available and little incentive to trade elsewhere. With the implementation of Regulation NMS and its Order Protection (Trade Through) Rule—which requires trading centers to make price quotations immediately and automatically accessible to ensure orders are executed at the best price, regardless of which exchange it resides on—price competition and liquidity increased across trading venues, creating incentives for other venues to enter the marketplace. It was this competition that led to the improved liquidity, reduced spreads, and lowered transaction costs seen in markets today.

However, there were a couple of new problems created under this market structure. It was assumed, but not required, that all prices would be synchro-

nized within the Securities Information Processor (SIP), however the technology driving it quickly became too old and too slow to keep up with the speed of trading. Prices from the SIP generally lag well behind the actual price present in the market, creating problems for traders who could trade faster than the quotes could update. The benefit of Regulation NMS to resolve technological price synchronization and information dissemination problems was short-lived as trading technology quickly outpaced centralized quoting. So traders adapted by purchasing direct feeds to market data that was closer to real-time. Instead of having access to SIP-processed output quotes, these firms had access to the data at the same time it was input into the SIP, eliminating significant delays. However, it is worth noting that prices change so rapidly in markets that displayed prices, even through direct feeds, are never a complete and accurate reflection of the prices securities are actually trading at in the market. There is always some delay.

Critics like Arnuk and Saluzzi[12] have blamed the increased market fragmentation created by Regulation NMS as leading to the proliferation of PAT. Yet there is little empirical evidence to support a link between Regulation NMS and the emergence of PAT specifically. In a speech before the Economic Club of New York in June 2014,[13] SEC Chair Mary Jo White points out that multiple countries have seen the same levels (or higher) of HFT growth in their markets even though they are not subject to Regulation NMS or similar types of regulation. Even highly centralized markets that like the Chicago Mercantile Exchange have similar levels of HFT activity in their E-mini trading as more fragmented markets that are subject to Regulation NMS. Another example is Japan, where 90 percent of all stock trading is centralized on the Tokyo Stock Exchange and there are no maker/taker fees and rebate payments for order flow, yet in 2014 HFT accounted for as much as 72 percent of trades.[14] The cause of HFT is more likely simply the evolution of market technology.

A criticism of technology advances and the increased use of algorithms within markets is that PAT has caused average order sizes on the NYSE to plunge 67 percent between 2005 and 2010.[15] In 2009, the average order size on the NYSE was about 400 shares;[16] by October 2014 the average trade size was 187 shares, which represented a 22.3 percent decrease on a year-over-year basis.[17] But the question to consider is whether this is a PAT-related issue or a regulatory-initiated problem. By requiring trade price to be the primary measure of execution quality, Regulation NMS ignores other execution factors

that might be important to institutional or individual traders. In the centralized pricing requirements created under Regulation NMS, it becomes nearly impossible to execute a large order without moving the overall market price. It is this centralization and the removal of the ability to display block orders exclusively to other institutional buy-side firms under the SEC's Regulation of Exchanges and Alternative Trading Systems (Regulation ATS)[18] that has led to the proliferation of dark pools—and a lack of order transparency even among large block traders within them—as well as smaller order sizes on lit markets.[19]

With Regulation NMS and Regulation ATS as root causes, PAT has become a tool that helps the market absorb large numbers of small orders to ensure they do not become a significant problem for markets. An opinion written by investment management company BlackRock states there is little reason to be concerned about reductions in order sizes because "investors should be generally indifferent to receiving 10 fills of 300 shares vs. 1 fill of 3,000 shares provided that execution quality and aggregate liquidity are equivalent."[20] PAT and its market-making function help keep liquidity high.

Another market integrity concern is the opportunity for technical problems with trading algorithms and their related systems. In an attempt to resolve these concerns, the SEC developed Regulation Systems Compliance and Integrity (SCI), which became effective February 3, 2015, and was fully implemented in November 2015. The two primary purposes of the regulation are to ensure market participants:

> (1) have comprehensive policies and procedures in place to help ensure the robustness and resiliency of their technological systems, and also that their technological systems operate in compliance with the federal securities laws and with their own rules; and (2) provide certain notices and reports to the Commission to improve Commission oversight of securities market infrastructure.[21]

For the previous twenty-six years, the SEC relied on a cooperative set of principles outlined in the Commission's Automated Review Policy (first implemented in 1989[22] and revised in 1991[23]) and its associated inspection program to oversee the technology of the US securities markets. These policy statements were not "rules" in the formal regulatory sense, but suggestions and guidelines

for how participants could design their systems, including capacity, contingencies, and security, as well as testing policies and procedures and independent system audits. It also established guidelines for reporting significant system changes, problems, and outages to the Commission. Participants could also request an inspection from regulators to evaluate their key systems and make recommendations for improvement.

Under increased pressure by lawmakers and the public to improve Commission oversight after the Flash Crash of May 6, 2010, the SEC took what participants were already doing voluntarily and turned it into formal regulation with Regulation SCI. There is at least one downside here. Regulation SCI moves the relationship between market participants and regulators away from cooperation and toward a more punitive, adversarial relationship. Imposing formal regulation implies the desire to impose sanctions when there is a technological failure or other problem with trading systems. A punitive rather than cooperative environment may discourage innovation and expeditious self-reporting of system events to the public and regulators in order to avoid fines.

There are strong, shared market integrity goals between traders, exchanges, and regulators that make a cooperative solution preferable. As mentioned earlier, no market participant benefits from a chaotic market or technology failures, and there are significant market incentives to maintain practices that promote secure, reliable, and orderly financial markets and market systems that enable effective price discovery. The financial loss experienced by Knight Capital due to its algorithmic trading errors demonstrates one such market incentive.

Fairness

The compatible interests of stakeholders diverge once regulators begin to discuss the imposition of "fairness" on markets. These policies are usually based on normative value judgments about what market outcomes *should* be, based on the subjective ideals of individuals or regulators about social optimality. For example, the ability of proprietary algorithms to rapidly analyze internal and external market data, allowing them to quickly identify profitable trades, has been criticized. Economist Joseph Stiglitz believes the use of HFT should be discouraged through financial transaction taxes because, in part, there is no social value and only personal reward in obtaining information before

someone else does, and personal rewards fail to provide the greatest value to society as a whole.[24]

Others, like British professor John Kay, believe the strategy employed by PAT of holding stocks only in the short term should be discouraged, while owning stocks over the long term should be encouraged. His rationale is that trading decisions that maximize a trader's utility in the short run cannot possibly reflect the trader's long-term financial interests or the interests of society.[25]

While these arguments may seem somewhat extreme, they are resonant with concerns that many others, including more moderate commentators, have about the challenges associated with competition within financial markets. As markets become faster and more competitive, can everyone compete? Or, as Lewis suggests, have markets become "rigged"?

When discussing issues of market fairness related to PAT, I think it is prudent to mention some relevant philosophical and factual points that counter the arguments made by Stiglitz and Kay. First, attempts to control "fairness" of market outcomes in the pursuit of "social optimality" is challenging at best. There is no all-knowing, neutral third party in society who has all information, past, present, and future, and who can decide what the moment-by-moment or long-run socially optimal outcome should be. It is this ignorance that requires us to rely on markets to determine that outcome. In this way markets are indifferent to whether participants are behaving as fully rational "social" optimizers or as "individual" utility maximizers, provided they are making the best choice possible in response to the decision-making of others. The individual profit maximizers can reach an outcome in which no other market participant will be better off by unilaterally changing his or her strategy, implying the socially optimum outcome is being moved toward.[26] Even if individuals are not making the best choice possible, the market is indifferent; it simply reflects their suboptimal choice.

Regarding concerns about the ability of all to compete in the marketplace, it is important to note significant competitive forces have always been present in financial markets. Professional institutional investors have always had more time, information, and resources at their disposal than individual investors or even smaller firms. One market solution to this problem was the creation of mutual funds so that all investors could benefit from the advantages of institutional investors.[27] Mutual fund ownership has risen from 5.7 percent of US households in 1980 to 46.3 percent of households including 96.2 million

individuals in 2013, with 93 percent held in retirement funds, primarily in employer pension programs.[28] These trends indicate that an increasing number of investors are receiving the benefits of institutional investor knowledge and trading.

On an institutional investor level, while increased market fragmentation created by Regulation NMS has added additional competitive forces to markets, markets remain procedurally fair in the sense that the same rules apply to PAT as to other traders. One example is that all traders are permitted to buy a computer, colocate it in an exchange data center, and develop or purchase computer programs to execute trades.[29]

While individuals like Stiglitz and Kay believe there are no social benefits associated with the improvements in information dissemination, competition, and shorter hold times associated with PAT, there have been empirically demonstrated benefits to investors. HFT has improved liquidity by lowering spreads; has reduced trading costs, making markets accessible to a greater number of people; has improved price synchronization of related securities; performs a stabilizing function during extreme market price movements; has increased direct price improvements for retail investors; and in some cases has made pricing more efficient. Market makers make a fraction of what they used to make per trade, and the savings have been passed on to investors. While markets and market competition are not perfect, they remain the best ways to maximize efficiency.[30]

HFT is also not taking over the markets as some have claimed.[31] While PAT had some advantages early on, as others have figured out their trading strategies, they have been better able to compete with PAT in the marketplace, reducing both the market share and profits of PAT. At its peak in 2009, HFT represented 61 percent of US equity volume,[32] but its market impact was reduced dramatically to 49 percent of volume by June 2016, as reported by the Tabb Group.[33] In 2009 profits from HFT were $7.2 billion; by 2014 profits had declined to an estimated $1.3 billion.[34]

One of the great challenges in imposing regulation is that often by the time a new market structure regulation is proposed or implemented, the market has already evolved beyond the identified problem. The perceived problem of the proliferation of PAT within the market making it difficult for others to compete is one example. While for a brief period around 2009 HFTs held a technological and competitive position in equity markets that made competing with

them challenging—primarily because others lacked an understanding of their methods—market forces have reduced their competitive position as non-PAT firms improved their knowledge of PAT and executed new competitive and technological strategies. One of the first competitive strategies was the software program called Thor, developed by Brad Katsuyama when he was at the Royal Bank of Canada, which competed directly with the order routing speed of PAT.[35]

Even though market share and profit potential for PAT has diminished over time, it remains a predominant topic for politicians and regulators particularly as it relates to issues of fairness. As Maureen O'Hara in a Cambridge University interview stated, HFT has become politicized because fast trading sounds bad to the average person and the media promotes this fear.[36]

PROPOSED FINANCIAL TRANSACTION TAXES

While basic rules and regulations associated with organized financial markets are necessary, it is difficult for regulators and legislators to stay ahead of technology, foresee all possible market disruptions, or determine what a socially optimal market outcome might look like. Regulators and legislators also generally lag behind market forces in correcting market inequities and either end up creating ineffective policies or disrupt a functional market-based solution. Even with these challenges, globally a plethora of existing and proposed regulations are designed to disrupt market modernization through computerized algorithmic trading and PAT. Among them are policies that require market makers to provide liquidity regardless of market conditions, controls on direct market access, minimum hold times, maximum order-to-trade ratios, circuit breakers, algorithm approval processes, standardized system testing, reduction in order types, batch auctions, and eliminating maker/taker fees.[37] While the limited space of this chapter does not allow me to address each of these proposals in depth, these resolutions do have second and third order consequences that may have negative consequences on markets overall; therefore the costs and benefits of these market interventions must be carefully considered.

A FTT has been proposed recently in the United States. The current "high-roller fee" proposed by Chris Van Hollen—a top Democrat on the House Budget Committee—and similar actions supported by presidential candidates Hillary Clinton[38] and Bernie Sanders[39] are being proposed as a way to "raise tens

of billions of dollars each year" to give back to "workers" in the form of tax relief and to eliminate computerized high-speed trading. The congressman claims there will be no adverse consequences from the tax because the European Union (EU) and others already have or are imposing trading fees and these fees will be "imperceptible" to high-rolling investors.[40] Others like Nobel Prize–winning economists Joseph Stiglitz and James Tobin, and former Treasury Secretary Lawrence Summers, have long supported a FTT as a means of reducing speculation and market "noise," thereby reducing market volatility and the risk of a market-disrupting event.[41] Yet there is empirical evidence to indicate that financial transaction taxes are harmful to markets.

The state of New York imposed a Securities Transaction Tax on all equity transactions from 1905 until its repeal in 1981. In 1932 during the Great Depression, New York doubled the transaction tax in order to increase state revenue. In 1968, the New York Stock Exchange threatened to leave the state because the tax was putting it at a competitive disadvantage compared to out-of-state exchanges; the taxes were gradually reduced until they were completely abandoned in 1981.

A study of the impacts of the transaction tax between 1932 and 1981 found that NYSE volume declined, average stock volatility and transaction costs for investors increased, volume was reduced, there were higher price impacts, and bid-ask spreads increased, thereby reducing liquidity.[42]

In 2012, Canada implemented a transaction tax based on the total number of market messages including trades and order submissions, cancellations, and modifications. A study on the impacts of the transaction tax found that while trades, quotes, and order cancellations—the "noise" some consider harmful—dropped 30 percent, bid-ask spreads increased by 9 percent. The researchers also found that as "message-intensive" (noisy) algorithmic traders reduced their activity, retail traders' intraday returns were negatively impacted—with limit order returns having the greatest decrease—while large institutional traders' returns from market orders increased.[43]

In a related issue, Canadian brokers who wish to avoid fees and take advantage of maker/taker payment for order flow are routing about 40 percent of Canadian retail trade orders to the United States—about half of all Canadian interlisted trading.[44] Regulators who wish to remove the maker/taker model because they believe it will discourage HFT need to consider that it also attracts capital.

Sweden's experiment with a financial transaction tax actually caused the government to lose tax revenue rather than create new revenue sources that could be redistributed to working Swedes. Sweden introduced a 1 percent tax on equity transactions in 1984 that was later raised to 2 percent in 1986. A study found that when the tax was raised in 1986 volatility failed to decline, but average equity prices did decrease. The most damaging outcome from the tax was that 60 percent of the trading volume of the eleven most actively traded Swedish trade classes migrated to London to avoid paying the tax.

Assuming US markets will not be impacted similarly because EU markets are also implementing FTTs is shortsighted. Unless all world markets have the identical tax, there remains incentive for other countries to compete globally for capital by lowering or eliminating taxes.

In the United States, one of the goals of proposed FTTs is to reduce the high frequency of trades; however, the Swedish experience provides an additional warning against reducing turnover rates. In Sweden, significant turnover rate reductions caused revenues from capital gains taxes to decline to a level offsetting any gains from taxes raised from the financial transaction tax in 1988.[45]

Shortly after financial transaction taxes were implemented in Italy and France, their shares of European equity turnover plummeted. Within six months after Italy introduced its tax, equity turnover dropped from €101 billion in 2012 to €50 billion for the same time period in 2013. This drop happened even as overall European volumes increased 7 percent.

In 2012, France implemented a package of financial transaction taxes. The first tax, designed to eliminate HFT by making it unprofitable, was a 0.01 percent "nontransaction" tax on modified or canceled stock orders exceeding 80 percent of all orders transmitted in a month. HFTs are subject to the tax if they transmit, modify, or cancel their orders within a half second. Additionally, a 0.20 percent transaction tax on purchased shares of French companies with market capitalizations of at least €1 billion was included in the package.[46]

The consequences for France have been significant decreases in market liquidity. France's share of European equity turnover was reduced from 23 percent in 2011 to an estimated 12.85 percent in 2013.[47]

Based on theorists' and regulators' own policy proposals, the goals of financial transaction taxes worldwide appear to be to generate revenue for the

government, redistribute wealth, reduce trading and its perceived market integrity risk, eliminate HFT, or engineer an unknown "socially optimal" market outcome.[48] Yet it is important to consider second and third order consequences of such actions including reduced liquidity, higher transactions costs, volatility and spread increases, and market flight.

The International Monetary Fund (IMF) warns that because FTTs are not well targeted but "levied on every transaction, the cumulative, 'cascading' effects of an FTT . . . can be significant and non-transparent"[49] with costs falling primarily on final consumers rather than financial institutions. These costs include, but are not limited to, reduced returns on savings, higher costs of borrowing, or increases in final commodity prices. A study has concluded that a 0.5 percent financial transaction tax leads to a 1.33 percent increase in the cost of capital.[50] A higher cost of capital initiated by a financial transaction tax could "reduce the flow of profitable projects, shrinking levels of real production, expansion, capital investment and even employment," according to the study.[51]

A speech by former SEC Commissioner Daniel M. Gallagher speaks to the long-term consequences of regulation on US capital markets:

> Legislators and regulators are layering on law after law, regulation after regulation—strangling entrepreneurs, their enterprises, and of course their employees and customers. We are not even resting on our laurels—we are actively throwing those laurels on a bonfire.[52]

Commissioner Gallagher goes on to describe how since 2007 the United States has been steadily losing market share to other international financial centers due, in part, to an "increasingly costly regulatory environment and the burdensome level of civil litigation," loss of economic freedom, and failure to respond to global competition. He cites multiple studies that indicate the United States is losing its position in the world as a leader in capital markets as other countries find ways to modernize and enhance their markets. Places like Dubai, Qatar, Singapore, Turkey, Tokyo, China, Brazil, Mexico, and even Moscow are all trying to reduce their impediments to capital formation in their markets through modifications in regulation, taxes, or fees.[53]

TOWARD MARKET-BASED SOLUTIONS

More than forty years of regulatory efforts to deal with issues of market fragmentation and price synchronization, information dissemination and market technology problems, and previous policies have failed to eliminate these issues. In the current market environment PAT is the focus. However, it is important to understand that issues like information dissemination and price synchronization will never be perfect and there will always be market technology problems that crop up; they are inherent in markets. The key is to find cooperative market-based solutions that minimize competition between regulators and market participants on the development of market structure and the monitoring of market integrity. While markets are already managing the proliferation of HFT in financial markets, there are a couple of other market-based solutions to managing PAT.

The first is competition. While market fragmentation has been a criticism associated with Regulation NMS, US stock market ownership is not highly fragmented. Of the eleven exchanges, four are owned by BATS, three each by Intercontinental Exchange and NASDAQ, and one by the Chicago Stock Exchange.[54] Off-exchange dark pools do compete with the "lit" markets and add fragmentation, but there is competition there as well.

As public concerns about HFT emerged, so did several competitive solutions. The one most people are familiar with is the Investors' Exchange (IEX), the dark pool featured in Michael Lewis's book *Flash Boys*. The intention of IEX is to equalize the speed of transactions to eliminate any speed advantage experienced by HFTs.[55] In June 2016, IEX's application to become a national stock exchange was approved and a target date of September 2, 2016, was set for implementation.[56] IEX adds a fifth competitor within the US marketplace.

Responding to the challenges of executing large block trades and concerns that HFT activity is not always being disclosed in dark pools has motivated fund managers at nine large firms—including majority holder Fidelity in cooperation with BlackRock, T. Rowe Price, and JPMorgan, and others—to develop a new dark pool called Luminex that specializes in large stock trades.[57] Luminex Trading & Analytics began trading on November 3, 2015, with eighty-four investment management firms subscribed to the platform.[58] As of June 2016, Luminex was reporting a subscriber base of 132 clients trading an average block size of 32,000 shares and volume in excess of 155 million shares.[59]

A similar effort is under way by Europe-based Plato Partnership Ltd.—a consortium of asset managers and broker dealers—designed to increase transparency, simplify markets, and trade large blocks of stock without detection by HFTs.[60] The consortium would be organized as a not-for-profit trading utility.[61] No launch date has been set as of this writing.

Aequitas Neo Exchange (ANE), a new stock exchange in Canada, intends to equalize the speed of transactions much like IEX does, but also plans to waive market data fees for some investors. Retail investors will not be charged for "real-time displayed market data for securities listed on the primary and venture TSX [Toronto Stock Exchange] exchanges." Professional investors will have fees waived on the ANE until their volumes reach 5 percent of market share.[62]

ANE launched in March of 2015 and as of April 2016 was averaging over 6 percent of Canadian securities market share by volume traded in 2016. For the month of April 2016 ANE's average trade size exceeded that of all other Canadian marketplaces in the most actively traded securities.[63]

Whether these competitors are arising due to real concerns about HFT or investor sentiment, as long as there is demand for competing trading venues the market will provide them. If the competitors offer a superior service for the majority of investors, HFT will be eliminated through market forces as it falls out of fashion.

Additional competition is available in the form of self-learning, predictive algorithms[64] and software that detects HFT strategies[65] that will allow retail investors to be more competitive with HFT. For regulatory intervention to be necessary, a market failure must exist, such as HFT holding a monopoly position within the market, not just being highly competitive. The rapidly rising direct competitors indicate an HFT monopoly does not exist and that market forces are keeping HFT in check.

As concerns have increased that technology problems may lead to major market events like a Flash Crash, regulators have responded by formalizing testing and system integrity protocols under Regulation SCI. However, there are no rules that can eliminate human/technology interface errors. The best alternative is to look for patterns of errors that might indicate a need for preventive measures. For example, on May 6, 2010, markets were stressed due to negative political and economic news, including the European debt crisis, and significantly reduced buy-side liquidity. Contributing to the market stress

was a UK trader named Navinder Singh Sarao who was, according to the US Department of Justice, engaging in aggressive "spoofing" activity in an effort to move market prices in a direction favorable to his trading strategy[66]—the potential for which is another criticism of PAT and a practice already illegal under US and European law. However, the tipping point of the Flash Crash of 2010 was reached during a human/technology interface error[67] when a large firm chose to execute an algorithm that was inappropriate for the current market conditions.

One solution is to develop a database for confidentially self-reporting human and technology errors for research. The purpose is to gather data on human and technology errors in order to analyze the data for patterns and prevent major market events, through awareness, training, and if all else fails, specific regulatory intervention.[68] The goal is to move toward a cooperative approach between traders and regulators to solve issues related to human errors and technology glitches by encouraging self-reporting without punishing recovered errors.

Human errors would include issues like selecting the wrong or inappropriate algorithm for market conditions, accidentally deleting computer code, entering the wrong quantity, or entering a sell order when it was supposed to be a buy. An example of a technology failure is when the algorithm does not work as intended and/or is stopped during its operation due to a problem.

The airline industry uses a similar self-reporting system that is administered by NASA as a neutral third party. NASA removes any identifying information from the reports and the data is compiled, analyzed, and reported on.[69] Human error is a significant factor in aviation incidents, but like errors in finance, they rarely lead to a major event like a crash. However, between June 2009 and July 31, 2015, there were 31,045 human factor errors reported to NASA.[70] The vast majority of these airline incidents were not required to be reported to a regulating body, yet analyzing this data for patterns of errors has led to measures designed to minimize potential major aircraft incidents. The database is also made public, so companies, academics, and agencies can also analyze the data and propose solutions.

A suitable neutral third party would need to be established for the financial sector to encourage reporting.[71] Advisory committees could also be formed to work with trading firms and venues to establish action plans, develop performance improvement reporting, and when cooperative solutions are

inadequate or unsuccessful, propose regulatory solutions to improve the human-automation interface.

CONCLUSION

US financial markets have a long history of cooperation and self-regulation,[72] and the SEC has repeatedly maintained "that competition and innovation in the provision of trading services should be encouraged." This includes using competition as a means of technological advances. The statement by the SEC upon release of the Market 2000 Report in 1994 also asserts that "competition would drive the evolution of the markets," that "the Commission [should] cultivate an atmosphere in which innovation is welcome, without dictating a particular structure," and that it should allow "competitive forces to shape market structure within a fair regulatory field."[73]

Even though there is evidence that competition is containing PAT in financial markets, we are moving away from allowing markets to move through their evolution. This has created a market environment that pits market participants against regulators in a contentious battle to shape market structure, technological advancement, and oversight. This is an outcome that calls into question the social optimality of introducing additional regulatory intervention in financial markets rather than approaching the evolution of markets from a cooperative perspective through competition and the reporting and analysis of human and technology errors to form cooperative solutions.

NOTES

1. Lewis, *Flash Boys*.
2. For one comprehensive criticism, see Kovac, *Flash Boys*.
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4. Ibid., 13.
5. Ibid.
6. Bell and Searles, "Analysis of Global HFT Regulation."
7. Berman, "Trading Stocks in America."
8. Jarrow and Protter, "Dysfunctional Role of High Frequency Trading"; Zhang, "High-Frequency Trading"; Boehmer, Fong, and Wu, "International Evidence on Algorithmic Trading."
9. Seligman, "Rethinking Securities Markets."

10. Carlson, "Brief History of the 1987 Stock Market Crash."
11. US Securities and Exchange Commission, Regulation NMS, 17 C.F.R. Parts 200, 201, 230, 240, 242, 249, and 270 (August 2005).
12. See chapter 1 in Arnuk and Saluzzi, *Broken Markets*, 7–21.
13. White, "Intermediation in the Modern Securities Markets."
14. Nakamura and Hasegawa, "Humans Lose Out."
15. Grant, "Average Trading Order Size Falls by Half."
16. Skeete, *Future of the Financial Exchanges*, 6.
17. Mondo Visione, "October 2014 FIF."
18. US Securities and Exchange Commission, "Regulation of Exchanges and Alternative Trading Systems," 17 C.F.R. Parts 202, 240, 242 and 249 (1998).
19. Blume, "Competition and Fragmentation in Equity Markets"; Bunge, "Suspect Emerges in Stock-Trade Hiccups"; Foley, "How Reg ATS Destroyed Buy-Side Price."
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