J Financ Serv Res (2015) 47:135–152
DOI 10.1007/s10693-013-0184-0

Into the Breech: The Increasing Gap between Algorithmic Trading and Securities Regulation

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Received: 14 June 2013 / Revised: 23 July 2013 / Accepted: 4 October 2013 /
Published online: 31 October 2013

Abstract A seismic shift is taking place in the United States securities markets. The fault lines have been present for quite some time; however, it is only now, in the last few years that the ramifications of these displacements have been felt. The traditional approach to investing has gone from a focus on investing – namely examining companies to determine whether they will be a good long-term investment – to examining the markets as a whole. Nowhere is this shift more apparent than in the rise and increasing prevalence of quantitative trading models. As a result, there is now a disconnect between the markets themselves and the companies that are traded on the markets. Oftentimes, what a company does or does not do matters very little to whether that company's stock should be bought or sold. Instead, whether that company's stock is a good "buy" amounts more to how that *stock* is doing and how the *market* is behaving. This shift has broad implications for retail and institutional investor behavior, regulatory structures and the role of government in oversight and, if unchecked, the global economy at large. The ever-changing advances in computer technology have fostered a new breed of trading that is much more reliant on quantitative mathematics than on corporate analysis. This article explores algorithmic trading and assesses the impact of its dominance on regulation of the securities markets and their stability in the global economy.

Keywords Algorithmic trading · Computer trading · High frequency trading · Securities regulation

JEL Classifications G11 · G18 · G2 · G28

1 Introduction

These computer-driven investors couldn't care less about a company's "fundamentals," amorphous qualities such as the morale of its employees or the cut of its chief executive's jib. That was for the dinosaurs of Wall Street, the Warren Buffets and Peter

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> *Lynches of the world…Quants were agnostic on such matters, devoting themselves instead to predicting whether a company's stock would move up or down based on a dizzying array of numerical variables….* From "The Quants," by Scott Patterson

The traditional stock market paradigm, grounded in the intrinsic value of the stocks (and thus the company) traded on the exchanges, has shifted to a new model that computes stock values based on algorithmic modeling and equations– and therefore has nothing to do with the value of the underlying company itself. In essence, there has been a decoupling between the stock's value and the stock's price. What marks this as an even more fundamental shift is that it is now moving beyond the "quants" and into a more fundamental practice, to the extent that traditional brokerage firms, institutional traders (such as pension fund managers) and even retail investors are engaging in this behavior (Hendershott et al. 2011).

This presents new challenges for securities regulators. Traditionally, officials at the Securities and Exchange Commission (SEC) have been much more focused on regulation of the corporations that issue securities rather than the securities themselves. Drawing on the foundational premise of disclosure as the means of regulation, the SEC, in both its regulatory and enforcement activities, has spent much of its time and resources focusing on the disclosure obligations of corporations. Regulating the market itself is something that the SEC, by and large, has left alone.[1]

This paper is organized into four sections. In part one, we discusses the advances in algorithmic trading and the regulatory environment that encouraged it to flourish. Part two details the mechanics of algorithmic trading and its impact on the markets as a whole. We explore the current regulatory structure and the challenges algorithmic trading presents to this regulatory framework in part three. Finally, in part four, we offer our suppositions on how this advancement will affect the future of regulatory oversight and advance some preliminary theories on alternative regulatory structures. It is not our intention here to weigh in on the merits of the forms and methods of algorithmic trading. Rather, we argue that the rules of the game – evaluating the viability of a company for investment purposes based on the fundamentals and intrinsic value – have been replaced by computational models that trigger large-scale purchases and sales. As a result, the very nature of "the market" has fundamentally changed, leaving regulators struggling to keep pace.

2 I robot: the rise of algorithmic trading

The exponential advances in technology over the past several decades have revolutionized research and trading fundamentals as well as the exchanges themselves. "Every step of the trading process, from order entry to trading venue to back office, is now highly automated" (Hendershott et al. 2011, p. 2). One of the ways this is most clearly illustrated is in the rise of algorithmic trading.

Algorithmic trading can refer to a number of electronic trading practices, all of which use computerized models to analyze data and effect large volume transactions in exchange and

[1] The Securities Act and the Securities Exchange Act are the bedrock of securities regulation in the United States. As numerous commentators have recognized, most of the laws and regulations that form these two statutes are related to disclosure (Perino 2010; Seligman 2003). Section 9 of the Exchange Act provides one counter example- in that it focuses on markets rather than corporations. Nonetheless, Section, while a step in the right direction, is by and large indispositive to the issues here. First, it is rarely used by the SEC. Second, while Section 9 focuses on market behavior (and prohibits market manipulation), the legal basis for action is out of step with modern trading practices. As one commentator wrote "modern market manipulation is accomplished through methods that are more subtle and harder to detect" (Sarkar nd).

off-exchange markets. For purposes of this discussion we use this term interchangeably with various practices that fit within this taxonomy including black box, quantitative and high frequency trading (HFT), the specifics of which are detailed in the following section. The growth of these forms of electronic trading and the ways in which their use has changed the development, interpretation and dissemination of research and trade execution have been documented in academic articles, media reports and contemporary non-fiction (Hendershott and Riordan 2011; Rameriz 2011; Angel et al. 2010; Chordia et al. 2011; Patterson 2010; Narang 2009). Over the last decade computer trading practices have been embraced by small private equity firms and hedge funds as well as established global investment banks such as Goldman Sacks, Merrill Lynch and (the former) Lehman Brothers (Patterson 2010; Wall Street Letter 2005). Even individual retail investors may now participate in algorithmic trading due to increased access to and advantages in computer software. [2]

Technological innovation is the dominant factor in the exponential growth of algorithmic trading, as illustrated in several ways: (1) enormous amounts of numbers can be computed in a fraction of a second, (2) increased software sophistication software allows for more and more complicated calculations, and (3) there is greater access to and ability to process vast amounts of data from disparate sources (Angel et al. 2010). As a result, data analyses that would have been nearly impossible a few decades ago (and even then only with a number of supercomputers) can now take place on one's iPad with a few swipes. In addition, the rise of financial engineering as a recognized discipline and sought after degree has created a new breed of market analysts that uses innovative equations to process, employ and distribute market data (CNN Money 2012). These advancements in and focus on technology have also had considerable impact on market institutions.

2.1 Technological advancements in on- and off-exchange trading platforms

The birth in 1967 of Instinet, the first off-exchange trading platform designed to compete with the New York Stock Exchange (NYSE), marked the beginning of automated financial markets. Over a decade later, the NASDAQ, originally designed as a computer bulletin board system, was founded by the National Association of Securities Dealers (NASD)[3] and ultimately became the first electronic stock exchange. The NYSE embraced automation at a much slower pace, becoming the largest and first global exchange through its acquisition of Euronet in 2007. More recently, the proposed purchase of the NYSE by the Intercontinental Exchange (ICE) would enable the venerated exchange to better keep pace with rapid and rapidly-changing electronic trading and expand its reach into futures and derivatives, also in demand by high-frequency traders (David 2012). Similarly, the Chicago Mercantile Exchange (CME), the largest futures market worldwide and the strongest competitor to ICE in the futures and derivatives markets, acquired the Kansas City Board of Trade and is eying

[2] 2. The 2nd edition of *Day trading for Dummies* (2011), by Ann C. Logue, MBA, contains a section entitled, "How to Use Fibonacci Numbers and the Elliot Wave when Day Trading." See www.dummies.com/how-to-use-fibonacci-numbers-and-the-elliot-wave-.html

[3] "The National Association of Securities Dealers, Inc. (NASD) formerly ran the NASDAQ stock exchange and NASD Regulation, Inc., which was Wall Street's self-regulating agency. The NASDAQ became a public corporation in 2005, and the NASD sold its ownership share in 2006. In July 2007, the NASD merged its regulatory functions with the enforcement arm of the New York Stock Exchange to form the Financial Industry Regulatory Authority (FINRA)." http://law.lexisnexis.com/infopro/zimmermans/disp.aspx?z=1728. FINRA is a non-profit organization whose membership is comprised of investment firms and which is funded by member fees. Like its predecessor, the NASD, FINRA is responsible for auditing and enforcing member compliance with SEC regulations. This quasi-regulatory "fox guarding the hen house" structure serves to enable the SEC's limited approach to trading oversight.

several other targets, including Nasdaq and Eurex, a group of European derivatives exchange, while developing a London futures exchange from scratch (Marek 2013).

The same technological progress that spurred consolidation within the big boards also fostered the growth of additional trading platforms, providing supplemental sources of liquidity to "exchanges and non-exchange trading venues, such as alternative trading systems (ATS) in the United States and Canada, multilateral trading facilities (MTFs) in Europe, and brokers' internal crossing networks" (IOSCO 2011, pp. 13). The result of this proliferation is that equity markets "for which on-exchange trading was prominent, have become more fragmented and, in some instances, less transparent. With the further development of multiple trading venues, liquidity in a particular share is often split amongst different pools of liquidity" (Hendershott et al. 2011).

> For example, large traders once used floor brokers to hide the full sizes of their orders. The brokers displayed size only to traders that they trusted would not unfairly exploit the information. Now large traders use the hidden order facilities of electronic exchanges and dark pools to control the exposure of their orders. These facilities generally are more reliable than floor brokers and much less costly to use. The traditional NYSE floor was the forerunner of today's electronic "dark pools" that only disseminate information to trusted traders. (Angel et al. 2010, p.2)

Trading venues continue to develop new and innovative trading functionalities to attract and maintain order flow. Their "electronic systems…provide affordable remote access to investors by retaining unexecuted orders in a consolidated order book for possible matching with future orders. On automated electronic trading systems, profit-seeking value traders can closely monitor the market and become suppliers of liquidity even without a presence on the trading floor" (Jain 2005, p.2956). As a result, the use of *dark liquidity* for the trading of equities and the development of so-called *dark orders* and *dark pools,* again to facilitate liquidity while maintaining anonymity (block trades executed away from the central exchanges), have increased substantially (Angel et al. 2010).

With the scope and depth of these changes in the markets and exchange venues it would have been difficult for regulators to keep pace even under ideal circumstances. However, events over the past several decades have created less than ideal circumstances for regulators.

2.2 The regulatory component

The period from the 1980s until the financial crisis in 2008 was marked by a rise of deregulation in market oversight of traditional trading and underwriting activities (cummings 2005). The relaxed regulatory atmosphere resulting from the repeal of the Glass Stegall Act during the Clinton administration seemed to signal a new era in the relationship between the SEC and Wall Street. At the same time, new investment instruments, such as credit default swaps, were being created– often by newly minted financial engineers -that were completely foreign to regulators (CNN Money 2012). Rather than regulate, the SEC adopted a wait-and-see attitude toward these new products and funds, in large part because they did not understand them and considered them to be an insignificant piece of the market (Walter 2013). This in turn led established brokerage firms to take a look at the returns these funds were generating and start to set up similar operations of their own, spearheaded by these financial engineers or "quants." Over time there was some regulatory response to the rise in electronic trading – however the rules only further benefited the quant shops. For instance, the 1997 order-handling rules and the 2001 decimalization rules led to dramatic reductions

in transactions costs. Regulation NMS cleared regulatory impediments to electronic trading and led to increased competition between market centers (Angel et al. 2010).

While the technology has advanced, it appears that many of the old trading problems remain. Like most innovative practices, the growth of algorithmic trading has outpaced its original intent, with the markets slow to catch up and regulators scrambling to put guidelines into place to oversee electronic practices (Angel et al. 2010; Bone 2009). However, the growth of algorithmic trading has left an indelible mark on the investment world; it has markedly shifted the financial market structures "from a human-intermediated market to a computer-intermediated market with little human interaction or real-time oversight" (Angel et al. 2010, p.4).

3 Behind the curtain: the basics of algorithmic trading

Electronic or computer trading often refers to the broader idea of using technology to deliver market activity. Quantitative or algorithmic trading uses arithmetic calculations, or algorithms, in its creation of models whose purpose is to analyze data, identify and minimize risk and assess transaction costs in the development of a portfolio construction model. This drives the execution model, which in turn drives the portfolio model. The composite model is often referred to as the black box (Patterson 2010, pp.17–20).

The components within a basic black box are illustrated in Fig. 1. The alpha model contains the value added brought to the endeavor by the quant. "They are in essence designed to *time the selection and/or sizing of portfolio holdings.* They hold at a core the premise that no instrument is inherently good or bad, and therefore no instrument is worth always owning or perpetually ignoring." (Narang 2009, p.21, italics in original) While there are a limited number of trading strategies that can be employed, they can be implemented in a variety of ways, allowing for an enormous diversity of strategies. Further, quants tend to base development of their alpha models on either theoretical or empirical underpinnings (Narang 2009).

Risk models are used to "control the size of desirable exposures or to deal with undesirable losses or uncertainty," particularly unintentional or accidental by products of the alpha model. These models limit the size of positions by measuring the degree to which they should be limited and the way that measurement is calculated, and by identifying which positions to limit. The two primary means to measure risk are calculations of volatility and dispersion, estimates of "the level of similarity in the behavior of the various instruments within a given investment universe" (Narang 2009, p.58). A good risk-management model

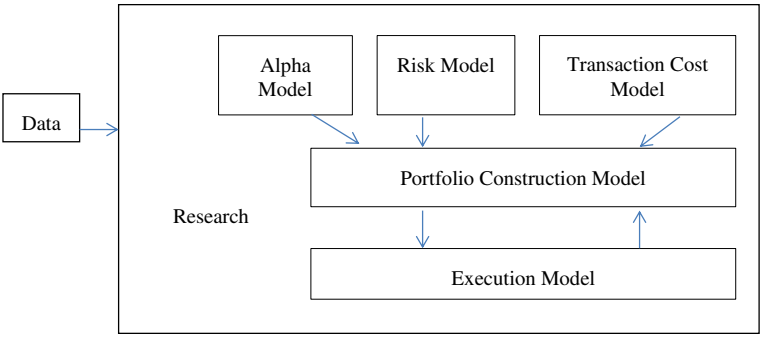

Fig. 1 The *Black Box* Revealed. From Inside the Black Box, 2010, by Rishi K.Narang

will both compartmentalize risk and create multiple levels of risk control (Waters 2013). Transaction cost models are used to calculate how much it will cost to transact a given trade. The predominant models used are "flat, linear, piecewise-linear, and quadratic" (Narang 2009, p.77).

"Flexibility and adaptability are key factors in driving the effectiveness of algorithms." To be successful for any length of time they should be self-adjusting and be "based on rolling benchmarks that are updated daily with real-time tick data and market data analytics" and be configured to support "on-the-fly" changes (Waters 2013, p.7). The need to revise and tune algorithmic models is never-ending. Hendershott and Riordan (2011, p.2) note that

> institutional investors utilize AT [algorithmic trading] to trade large quantities gradually over time, thereby minimizing market impact and implementation costs. Liquidity demanders use algorithms to try to identify when a security's price deviates from the efficient price by quickly processing information contained in order flow and price movements in that security and other securities across markets. Liquidity suppliers must follow a similar strategy to avoid being picked off. Proprietary algorithms are often referred to as high-frequency traders (HFT).

Unlike conventional investing, an investment position with a high-frequency trader may be held for seconds or fractions of a second, and these electronic programs trade in and out of positions thousands or tens of thousands of times a day. As advancements in the exchanges increase quants' electronic access, increasingly consolidated liquidity sources (i.e., ICE's acquisition of the NYSE) will allow for increasing advancement and sophisticated in algorithmic models, which, in turn will expand access to dark pools (Wall Street Letter 2005).

4 And now? Impacts and implications of computer trading

The use of quantitative trading methods has increased exponentially over the past two decades, to the point where it is commonplace in traditional brokerage firms. But to what extent does it account for market activity? By 2009, algorithmic and high-frequency trading dominated trading volume. The use of electronic order flow and fulfillment systems had grown to represent over 60 % of all trading volume in 2009 (Ramirez 2011). Trading volume on the exchanges increased just as dramatically. Between 2003 and 2009 the US average daily trading volume rose from approximately 3 billion shares to almost 10 billion shares, respectively. Yet market share of the NYSE for its listed equities declined over the same period from 80 % of all volume to just over 25 % by the end of 2009, illustrating a substantive shift in trade execution to off-exchange venues. Further,

> Average trade size fell substantially as computers made slicing large blocks into small pieces a cost effective means of limiting adverse costs of trading large positions. Automated traders began providing liquidity, supplementing and displacing traditional liquidity suppliers. The number of quote updates per trade, as well as the number of orders cancelled per executed trade, increased dramatically as traders employed new electronic strategies for offering and searching for liquidity (Angel et al. 2010, p. 5).

In 2005 algorithmic trading made up between 5 and 17 % of all trading volume and, at an estimated growth rate of 7 % per year, it was seen as the largest growth area in electronic trading. At that time, hedge funds made up approximately 90 % of electronic trading and intuitions comprised about 65 %; algorithmic trading was thought to make up only 10 %, but

was expected to comprise 30 to 40 % of volume within a year (Wall Street Letter 2005). By 2012 estimates of volume share varied. Some claimed that high-frequency trading firms accounted for 73 % of all equity orders in the United States, 40 % in Europe, and 5 to 10 % in Asia (Elias 2012). Data from the NYSE indicated that the daily trading volume of "traders using complex mathematical programs to automatically execute buy and sell orders… skyrocketed 164 % between 2005 and 2009…. These traders were competing for pennies in millions of transactions and accounted for 61 % of the trading volume on the NYSE in 2009" (Bell 2013, p.1). On the other hand, the New York Times (2012) reported declines of algorithmic trading by about 75 % from their peak of $4.9 billion in 2009, and decreases in HFT volume of approximately 10 %, to a market volume share of just over 50%. These declines appear to correspond to overall volume declines for the broad financial markets over the same periods. Despite these varying estimates, it is undisputable that quantitative trading now makes up a significant portion of market activity. As such, what is needed is an honest assessment of the practice.

4.1 The pros and cons of algorithmic trading

As with all innovation, there are pros and cons to the advancement and impact of quantitative trading. In some cases they are one and the same. In the plus column, quantitative trading enables economies of scale (Bortoli et al. 2004), more efficient securities prices which provide for order routing and pricing stability, more efficient trading and more efficient markets (i.e., pairs trading and arbitrage) (Chordia et al. 2011). It also reduces the cost of capital (Jain 2005). As noted, it diminishes trading costs and investor commissions, adds liquidity to the markets and enhances the informativeness of quotes (Hendershott and Riordan 2011; Gűndűz et al. 2007; Bortoli et al. 2004). It also appears that algorithmic trading "improves linkages between markets, generating positive spillover effects in other markets. For example, when computer-driven trading is made easier, stock index futures and underlying share prices are likely to track each other more closely. Similarly, liquidity and price efficiency in equity options probably improve as the underlying share price becomes more informative" (Hendershott and Riorden 2011).

Conversely, a variety of challenges have plagued the success of computer trading, from complex algorithms malfunctions to more mundane issues such as router failure (Elias 2012). Further, the extreme activity generated by algorithmic models has the potential to overwhelm markets and data providers, requiring all involved to constantly and often significantly upgrade infrastructure (Hendershott et al. 2011).

> Upgrading such systems is expensive and requires many resources to successfully implement. The high frequency trading firms with many resources have an advantage over smaller firms in that they are able to have newer technologies implemented sooner and successfully. Another issue … is that eventually HFTs will encounter the speed of light barrier… [which will] eventually limit the speed at which HFTs execute trades (Rameriz 2011, p.11).

The use of dark pools to facilitate order confidentiality is also a cause for concern; while it increases liquidity, it also diminishes transparency. Individual investors consider high-frequency traders to have an unfair advantage and argue that increased liquidity threatens market stability (Rameriz 2011). And the consolidation of exchanges and large-scale trading venues threatens market viability. Interconnections between markets, which may be amplified by algorithms programmed to operate on a cross-market basis, may allow for a shock to pass rapidly from one market to another, potentially increasing the speed at which a systemic

crisis could develop. This was illustrated by the Flash Crash event of May 2010 (IOSCO 2011, Kirilenko et al. 2011)

The greatest cause for concern then, from both individual and quantitative perspectives, is the potential for extreme reactions within the markets to what would be a minor effect in traditional trading practices. In 2012 "alone Knight Capital, Facebook, BATS, the Madrid Stock Exchange, the New York Stock Exchange and the Tokyo Stock Exchange have all suffered at the hands of technology as outages and flash crashes traverse the world's exchanges" (Ellias 2012). More recently, in April 2013 a phony Twitter report of explosions at the White House

> sent the Dow Jones Industrial Average into a tailspin, shaving 150 points, or about 1 %, in the blink of an eye. The fake Tweet dealt a hammer blow to other markets as well: The S&P 500, the NASDAQ and crude oil all dropped 1 %. The S&P 500′s losses alone wiped out about $136.5 billion, according to Reuters; the broader market lost nearly $200 billion in value, USA Today reported. At the same time, the yield on the 10-year US Treasury note fell 4 basis points, and the CBOE Volatility Index – the so-called 'fear index' – surged 10 % (21st Century Wire 2013, p.1).

This is of particular interest as algorithmic trading is increasing applied to a broader range of investment products and international trading venues, often targets of hacking (PBS News Hour 2013, Baker Institute Blog 2011) and intertwined with social media such as Facebook and Twitter (Moore and Roberts 2013).

> As algorithmic models are increasingly used with foreign exchange and derivatives products, the opportunity for errors to be significantly larger than those that could occur in equity markets is a strong likelihood. There will be a greater ripple effect on the underlying asset (equity) market due to the linkage between the derivative and its underlying equity, should trading errors or systems shocks such as the Flash Crash occur" (Waters 2013, p.6).

Most alarming is the markets' vulnerability to breaking news in the age of social media, particularly given the impact of the phony Twitter report (Moore and Roberts 2013), and the fact that social media can be used to create "shocks" in the market which then create disturbances in the economy, adding to national and global "financial fragility" (Calomiris 1995, p.1). In addition, the Twitter report "also raised new questions over Twitter's security procedures" (Moore and Roberts 2013). The ability of hackers to use Facebook, Twitter and other social media sites to affect global markets and economies presents altogether new and unforeseen needs for controls on algorithmic trading.

What does this mean for the markets? Clearly, the structure of the financial markets has changed as a result of electronic trading. As noted above, mergers and acquisitions have resulted in the replacement of territorial exchanges with global markets. Algorithmic and high-frequency trading have changed the functionality of the markets as well in a number of ways. As trading volumes grew exponentially, liquidity also increased. Also electronic systems and algorithmic equations allowed for the division of large block trades into smaller lot orders, often through the use of dark pools, which in turn enabled more effective order executions. Further, the volume of quote traffic rose in tandem with that of order volume, and with the proliferation of off-exchange trading platforms, competition between exchange and off-exchange venues intensified. These conditions resulted in lower trading fees and encouraged innovation as platform operators competed to attract liquidity (IOSCO 2011; Angel et al. 2010).

Electronic trading has also had a dramatic impact on market quality. For the most part, the impact has been positive: spreads and commissions have declined substantially, as did

execution speeds, which allow retail investors to monitor execution quality. Bid-ask spreads spiked during the financial crisis in 2008 because of market and economic volatility but have otherwise remained low; in fact, studies indicate that US trading costs are among the lowest in the world (IOSCO 2011). Volatility remains an issue: the flash crash of May 2010 and April 2013 may not have been caused by high-frequency traders but their large volume trades certainly exacerbated the crisis (Kirilenko et al. 2011, Moore and Roberts 2013) as the selling ban implemented after the 1987 market crash required traders to shift strategies and even sell short to offer liquidity or manage the risks of their trading (Angel et al. 2010).

5 A word to regulators: adapt or die

The SEC's regulatory philosophy is based on a traditional disclosure model. In a disclosure-based system, the SEC takes no specific position on the underlying substance of the company. Rather it simply requires corporations to disclose the substance of their operations so that investors themselves can make the best decision regarding whether the company is worth the investor's money. For almost seven decades, this regulatory model was the primary means of regulation for the SEC. In the wake of a wave of corporate scandals at the beginning of the century, Congress passed the Sarbanes-Oxley Act. The Act took the most significant steps ever to supplement the traditional disclosure-based model. For instance, rules promulgated under the Act require companies to include, among other things, "management's assessment of the effectiveness of the company's internal control over financial reporting" and requires management to "evaluate any change in the company's internal control over financial reporting." (Securities and Exchange Commission US 2008)

More recently, The Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank) enacted a number of reforms that were designed to address the causes of the 2008 financial crisis. Many were optimistic about the potential impact the Act would have on markets. However, Dodd-Frank mainly provided additional disclosure legislation rather than an overhaul of regulatory oversight for market trading. In essence then, the failings in both traditional and more contemporary securities regulation are its focus – rather than examine *all* market participants, the SEC has relegated its role to one that eschews a large amount of market regulation in favor of a myopic approach of (ironically) disclosure. And that is what is creating the breech.

If in fact, 75 % of the market is being taken up by computer trading that encompasses very little actual corporate data (either fundamentals or otherwise) then the SEC's continued focus on this company data will, as a matter of sheer math, affect very little of what is happening in the markets. If the SEC's mission then is in part to "protect investors" and "maintain fair, orderly and efficient markets" (Securities and Exchange Commission 2013) then the current tool that it is using to do so is largely out of step with the times.

It appears that at last regulators may be recognizing their lack of oversight. For instance, in the last 2 years, the SEC has undertaken a number of steps to familiarize itself with various computerized trading platforms. In 2010, it issued a Concept Release soliciting feedback regarding high-frequency trading (Securities and Exchange Commission US 2010). The review, which was done in response to the Dodd Frank Act, called for an in-depth study of the practice, (Section 967(2)(D)) and is designed to provide "an assessment of whether market structure rules have kept pace with, among other things, changes in trading technology and practices" (Securities and Exchange Commission US 2010:1) Similarly, the Commodities Futures Trading Commission (CFTC) "has created a high frequency trading

technology advisory committee to address the development of high frequency trading. Talk of regulation on HFT has already begun" (Brogaard 2010). In tandem with US efforts, the International Organization of Securities Commissions, in response to concerns of the G8 Finance Ministers, have been reviewing US and European and Australian efforts to identify problems and develop corrective structures, particularly in relation to high frequency trading, noting that in the US, reliance on disclosure and self-regulatory paradigms continue to prevail (IOSCO 2011, p.32). There is a significant lag, however, between the recognition of the problems and the actions initiated to consider and possibly even address these challenges.

5.1 What is taking so long?

There are many reasons why regulators have not yet adapted to these trading changes. The bureaucratic process is cumbersome and time consuming. Once a problem is identified, extensive study is necessary to develop an effective corrective action. This "rule" is then sent to out for comment; these comments, particularly those from industry members, help to determine whether the rule is implemented as is, edited, or shelved. This process is exemplified in the SEC's extended efforts to regulate money market funds (Lynch 2013). Further, the ideological perspectives of politicians and the financial industry have not favored government regulation. Litigation by the Chamber of Commerce, lobbying efforts by Wall Street and significant budget limitations contained in Congressional appropriations since the turn of the century[4] have derailed the SEC's efforts to increase investigative, enforcement and oversight activities. These last two issues are evident in efforts to write regulations for the Dodd Frank Act; it has been industry executives, rather than regulators, who have dominated the process (Rivlin 2013).

Another reason for regulators' failure to address the substantive problems is the structural make-up of the regulatory framework. As Fig. 2 demonstrates, there are a number of different agencies within federal and state government that have shared responsibilities for many of the products and players that impact the markets. A lack of coordination among these agencies makes it more difficult for any one agency to respond when a new and creative platform emerges. Nor is there any provision for oversight of hedge funds or similar entities that engage in atypical market activity. This combination of shared responsibility and poor communication leads to an almost 'who's on first' mentality, in which investment firms are rarely audited, and when they are, the regulatory agency is often unfamiliar with and not responsible for a portion of the firm's products and activates. This virtually ensures that oversight of newer products and activities fall through the cracks. Unfortunately, the very same products that are sparsely regulated are also the most lucrative and therefore the most heavily traded (Walter 2013).

5.2 Challenges to adapting to a new market paradigm

In addition to the more traditional challenges to our existing regulatory structure, algorithmic trading introduces a number of unique regulatory quandaries. One issue for consideration is

[4] There are numerous cases of the Chamber of Commerce vs. the SEC in the last decade alone. For example, in Business Roundtable and Chamber of Commerce vs. SEC, the US Appeals Court (Case No. 10–1305) decided against the SEC, finding the proposed SEC rule arbitrary and capricious. Further, Open Secrets notes that investment firms an average of approximately $100 million per year between 2009 and 2012 on lobbying efforts (se http://www.opensecrets.org/lobby/indusclient.php?id=F07). And finally, SEC budget data is available in the Historical Tables of the Budget of the US Government, at www.omblgov.

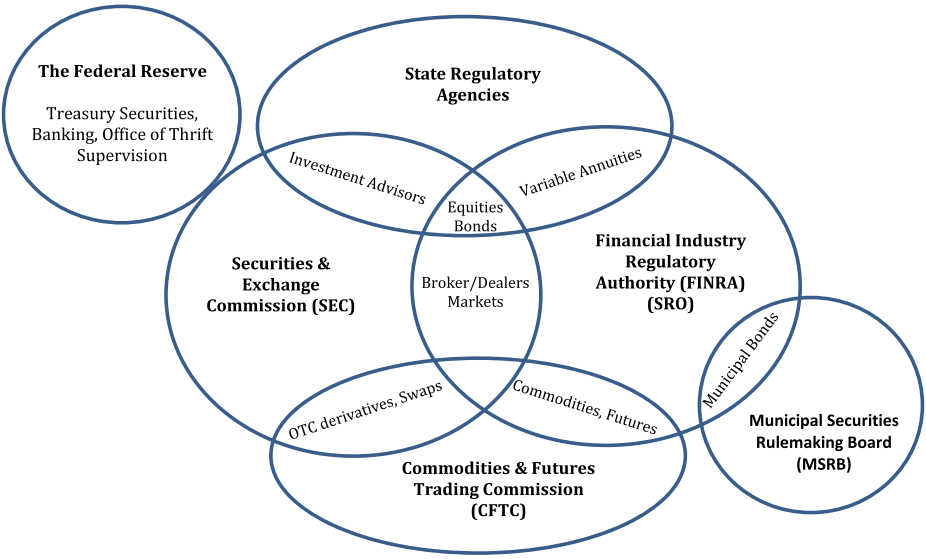

Fig. 2 Market regulatory oversight

whether the trading stabilization effects touted by proponents of high frequency trading are actually a form of market manipulation. If so, it is unlikely that Section 9 of the Exchange Act or any other current rule actually prohibits the activity. So the question then becomes, should it be regulated? If so, how and by whom?

At what point do high frequency transactions trade ahead of traditional trades? This question has particular salience as the new owners of the NYSE move the exchange to a completely computerized model. A related concern is how large, managed order flow, such as that used by HRT, will impact small, individual investors.

How will the "make or take" pricing of exchange access fees impact best execution practices? "In the make or take model, trading platforms charge access fees to traders who 'take' liquidity with marketable orders and pay rebates to limit order traders that 'make' liquidity by placing standing limit orders. Current best execution standards require brokers to take the "best" price without regard to the access fees and liquidity rebates." These standards do not take into consideration the ways in which algorithmic trading adds liquidity to the markets (Angel et al. 2010, p. 6).

Trading issues include "naked access," which opens up new risk management concerns, particularly as "no market-wide risk management systems are in place that would deal with a computer-generated meltdown in real-time." The flash crashes this year and last were previews of how quick and catastrophic the effects could be. Front running, although illegal, is a more real possibility within the realm of algorithmic trading. "For example, buying S&P 500 futures contracts while holding a large open customer buy order in an S&P 500 ETF (to profit from the expected price impact of the customer order) should be illegal since arbitrageurs will quickly shift the price impact of the broker's order in the futures market to the ETF market where it will increase the cost of filling the customer's order" (Angel et al. 2010, p.6).

Finally, there are concerns about disruptions from non-financial sources. The 2013 flash crash, triggered by a phony Twitter message that was immediately picked up and disseminated by national wire services, illustrated the need for regulators to address the potential impacts of social media. In that instance, the message originated from a hacked Twitter

account. Allegations of Chinese hacking of US government agencies and US corporations' China operations (Anderlini 2013) indicate how easily financial markets and firms (CNBC 2007) could be hacked. Again, with markets shifting to all-electronic platforms, the potentially catastrophic effects of hacking become a more critical concern.

6 Choosing to adapt: how the SEC might change its approach

Should the SEC choose to adapt, there are a number of aspects to consider. Of primary importance is the question of who, or what, is being regulated. The model currently in place emphasizes oversight of corporate disclosure, which allows for easy identification of who is being regulated, but it limits oversight to a very narrow spectrum of market participants and seems to ignore the "what" portion of the equation. Any meaningful attempt at acclimating to this new trading environment must involve a seismic shift in the nature of regulation itself. To this end we identify three possible perspectives of viable regulatory paradigms that warrant further discussion and analysis. The first is of a regulatory structure that focuses exclusively on markets. The second is of a regulatory structure that focuses on the market participants, and the final consideration is of a regulatory structure that treats securities themselves as separate products from their corporate producer and regulates them as such. In upcoming work we will provide a much more in-depth analysis of these options; however, we provide a brief preview of the pros and cons here. Table 1 compares the advantages and disadvantages of algorithmic trading to the pros and cons of the three regulatory models.

6.1 Market regulation

One alternative to the current regulatory structure involves regulating the market as a whole. This would involve a sweeping change to the nature of regulation but could be accomplished within the current administrative structure. In essence, market regulation would involve a focused approach that looks at regulation with the exclusive goal of stabilizing markets. The SEC made minor strides in that direction after the 1987 "market break" with the implementation of circuit breakers to halt trading in the event of a crash and initiation of programs to regularly test the capacity of the market's automated systems (Lindsey and Pecora 1998), but these efforts have failed to prevent subsequent crashes. As former Senator Edward Kaufman Jr. and current Senator Carl Levin (2011) note,

> After the flash crash, the Securities and Exchange Commission moved quickly to apply a Band-Aid in the form of circuit breakers to limit daily price moves. Then it proposed a long-overdue consolidated audit trail, to plug the gaps in reporting requirements that prevent the efficient tracking and policing of orders and trades. It spent months painstakingly using antiquated methods to reconstruct and study the trading data during the flash crash.

Under a market-focused model, additional regulatory systems would be put in place to maintain market stabilization at all costs; for example, a potential regulation could involve shutting the market down if it gained or lost more than an agreed-upon number of percentage points in a day. Another potential regulation would limit the amount of shares that could be bought or sold in any one security on any given day in order to preclude a runoff that could lead to further market instability.

The advantages of this model are that SEC regulation could be much more efficient and effective. It potentially could require less resources as the SEC could use sophisticated

Table 1 The pros and cons of algorithmic trading and implications of alternative regulatory structures

	Algorithmic trading		Alternative regulatory structures					
			Markets		Participants		Products	
	Pros	Cons	Pros	Cons	Pros	Cons	Pros	Cons
Trading structures	Increases pricing and order routing stability	Equipment and supporting infrastructure maintenance	Controls market movement and number of shares traded	Increases potential for market manipulation	Disregards markets and products	Increases potential for market manipulation	Pricing and market stability based on product supply and demand	Shifts oversight away from transaction and market oversight
Trading practices	Increases trading and market efficiency	Use of dark pools						
Investor safeguards	Reduces costs of capital and trading costs	Advantages quants over individuals	Increases cost efficiencies	Shifts focus away from investor protection orientation	Levels playing field among participants	One-size-fits-all training and regulation	Treats investors as consumers	Caveat emptor
	Reduces information asymmetry	Reduces transparency	Increases transaction transparency		Increases investor sophistication		Increases information and consumer protection	
Market stability	Adds liquidity	Added liquidity threatens market stability	Maintains stabilization	Increases potential for market manipulation	Encourages stability through educated investors	Disregards regulation of markets	Encourages stability through consumer protection oversight	Focus on product quality, not market stability
	Improves market linkages	Increases vulnerability of interconnected markets	Supports market and platform consolidations					
			Prevents market failure					

software to monitor markets to ensure stabilization in lieu of the manpower expended to comb through filings of individual corporations. For those in favor of deregulation this provides an additional advantage in that companies would no longer be investigated by the SEC, which tends to reduce the value of investors' holdings. A final benefit would be additional oversight of changing and consolidating markets and expanded off-exchange activity. The underlying basis for this model would be caveat emptor, with the SEC merely acting as a backstop against total market failure.

This new framework would involve wholesale change to the current philosophical approach to regulation that has been in place since 1933. Protecting investors would no longer be a part of the SECs mission; instead the revised mission would focus solely on maintaining market stability and preventing market failure. In essence, the SEC's efforts to control the markets and ensure stability would, by definition, become a form of market handling.

Accomplishing this therefore could only be done with complete buy-in from all constituents and an acceptance of the underlying implications, including the potential for wide spread corporate fraud (which would no longer be regulated), the complete asymmetry of information that would be possessed by different market participants, and the legislative and regulatory hurdles that would need to be overcome, as well as completely revised training at the SEC in order to make this shift. On a fundamental level, allowing this form of regulation would be accepting one of the tenets that the SEC has fought hard to prevent: market manipulation.

6.2 The participants

A second alternative could focus on regulating the participants. In this model all investors - retail and wholesale, large institutional investors, your grandmother, and anyone else interested in investing -would be the subject of regulation. This could happen in one of two ways. First, a proactive structure could be implemented that requires anyone wanting to invest to undergo training and licensing before doing so. A structure like this would be easy to conceive in that it could work similarly to our current driver's license system. The SEC would be involved in training investors about what to look for when buying a security and the best way to do so without becoming the victim of fraud[5] A second approach could have the SEC acting reactively by simply requiring participants to register or to have a pro forma registration with no training beforehand; this would then enable regulators to track participants after the fact should something go awry in the system. While there are variations to this approach, we find this framework to be the most problematic for a number of reasons. First, implementing this system would require enormous resources that the SEC simply does not possess. Currently, there are fifty independent state agencies nationwide that provide citizens with drivers' licenses. Imagine trying to accomplish similar activity through just one federal agency! The second disadvantage involves the training process itself. Consensus among all the participants about the composition of SEC training would be necessary before it could be implemented in order to resolve questions including, what does it means to train, what essentials are included in the basics of trading, how are investors trained to spot a bad investment, and how would this impact brokers and advisors?

This model would also involve a fundamental regulatory paradigm shift. In addition, it raises the one-size-fits- all problem: should we really treat hedge funds that move hundreds of millions of dollars of shares every day in the same manner that we treat a young new parent who buys a few shares of Disney for his newborn? Moreover, any licensing or

[5] This model could be constructed to include the current corporate disclosure regime; the SEC could continue to collect corporate regulatory filings while also providing consumer education classes

regulation requirement of all market participants could have the effect of shutting out the smallest investors who can't afford to participate in the market with this new hurdle. Given the current national trend toward economic stratification, providing or demanding this additional regulatory hurdle would exacerbate the situation. Consequently, any advantages that could be gained, such as increased investor literacy, would be far outweighed by the negative consequences.

6.3 The investment products

The last potential alternative is admittedly the most ambitious. It would involve not only a complete change in the regulatory structure, but also a complete retooling of the market itself. In this scenario we embrace, rather than ignore, the decoupling between investing and purchasing stock. Rather, we accept the quantitative perspective that stocks no longer represent investments in individual companies that the SEC endeavors to regulate. Instead, a stock would simply be one more product that a company produces, such as a car or toaster or knife. In turn, this product would be the subject of regulation, but from a consumer protection standpoint rather than an investor perspective.[6] The changes needed to establish this new framework are more extensive than can be easily discussed here[7]; nonetheless, we believe that this model has the potential to be the most comprehensive solution to the current market trends. We are assuming that the market shift that we are now witnessing is permanent. Therefore, the primary disadvantage would be if we are wrong and what we are witnessing is in fact only transitory. Conversely, if the change is permanent, the best advantage of this model is that it provides an accurate reflection and targeted regulation of the market as it is now rather than it was in 1933. This also represents the most flexible option of the three discussed because it can accommodate any subsequent changes in market compositions and trading platforms.

7 Conclusion

Some commentators argue that we are still at risk of undergoing another financial crisis; in fact, some predict that the next financial calamity will be worse than the one in 2008 (Overdose: The Next Financial Crisis 2012). Therefore, as we contemplate the models offered above, it is now more imperative than ever that we have an honest conversation about what we are regulating, what we should be regulating and the challenges for each. We need to begin with the very concepts that form the foundation of a US and global regulatory structure, including:

- What needs to be regulated? Traditionally the SEC has focused on the corporations; leaving a version of market regulation to the NYSE, which is no longer a rule-making body. Who should fill that gap?

[6] The genesis for thinking about financial products from a consumer protection standpoint comes from Oren Bar-Gill and Elizabeth Warren's groundbreaking article "Making Credit Work" in the University of Pennsylvania Law Review, Vol. 158, No.1., which can be found at https://www.law.upenn.edu/live/files/112-bargillwarren157upalrev12008pdf. In that article, the authors applied the consumer protection analogy to a non-traditional venue: consumer credit products (such as credit cards, mortgages and payday loans). While our idea marks a substantial move forward (in that, to our knowledge, no one has previously advocated that securities regulation decouple corporations from their stock) we believe that, with some adaption to the financial markets, the analogy can be used here.

[7] This alternative is the focus of our current research. We hope to open a dialogue and encourage readers' comments and ideas.

- Who needs to be regulated? Should we shift our focus from protecting investors when it is the investors themselves who may be responsible for much of the market instability?
- What is the purpose of regulation? Do we regulate market activity or do we regulate disclosure – or both?
- If we regulate disclosure, how do we regulate information and who has the power to use information that affects entire markets?
- If we do change the way that we regulate, how will that affect those investors who still follow a more traditional analysis? (i.e., *the Buffet Way*)
- Who are the entities that need to regulate? Is self-regulation sufficient? How could the various agencies pool resources and responsibilities to more effectively audit and investigate broker-dealer activity?

The advent of algorithmic trading has changed the very essence of investing, creating a fundamental shift in how investment decisions are made and essentially decoupling a stock's value from its price. This practice is no longer limited to the financial engineers, the "quants," and the firms that employ them; now any 'dummy' with a computer can do it in the comfort of their home. The use of algorithmic trading has been growing exponentially; yet regulators have been virtually standing still. Not only have they not kept up with the changing industry, they have yet to consider what regulation of this new frontier should look like. Further, the consolidation of financial markets and the incorporation of technical advancements have allowed algorithmic trading to cross all international borders. The potential impacts of international regulation on the financial markets, such as providing systemic stability (Benink and Llewellyn 1995), have been deliberated for decades; however, quantitative trading now makes those considerations even more salient. Regulatory modernization must look beyond US markets to cooperative intergovernmental policies.

Regulating the financial markets in the United States has become an increasingly challenging affair: administrative agencies are, by their nature, slow moving and cumbersome entities and the SEC is no exception. Nonetheless, the entities, products and practices that they regulate have increasingly surpassed even the most pernicious regulation. Since many of these investment products – and now processes - are also the most dominant and lucrative in the market, circumstances are coalescing to form a perfect storm, possibly of global stature, in which regulators will be wholly unequipped to prevent another market failure. In order to avoid this, honest conversations need to happen among scholars, practitioners and regulators regarding the best ways to close the breech.

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