David Lauer

President and Managing Partner, KOR Group LLC

Testimony on "The Role of Regulation in Shaping Equity Market Structure and Electronic Trading"

The Committee on Banking, Housing, and Urban Affairs

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Good morning Chairman Johnson, Ranking Member Crapo and members of the committee. Thank you for inviting KOR Group to testify this morning.

I'm here today on behalf of KOR Group and the Healthy Markets Initiative. KOR Group is a market structure research and consulting firm focused on data-driven analysis. We help firms in the industry understand market structure through research, web-based analytics and monthly reports. We also help buy-side firms navigate this complex market and reduce transaction costs. Healthy Markets is a non-profit initiative seeking to build consensus on substantive market structure reforms and to lead a coalition of firms to advocate for these reforms. Our platform is centered on five key concepts: Transparency, Metrics, Data Freedom and Technology, Displayed Liquidity and Competition. The coalition we are building consists of firms from across the industry, including exchanges and ATS's, buy-side firms, broker/dealers, investment banks and HFT market makers.

My name is David Lauer and I am the President and Managing Partner of KOR Group. My background is in technology, high-performance computing and the application of both to market structure. I have experience designing high-performance, low-latency trading platforms, engaging in quantitative analysis and high-frequency trading, and in public advocacy for market structure reform. This includes tenures with Allston Trading, Citadel Investment Group and Tervela and consultation for IEX Group. I have a Master's Degree in International Economics and Finance from Brandeis University. I grew up in Southern New Jersey.

Introduction

In our industry, we're used to hearing that "past performance is not indicative of future returns." Certainly, the same could be said about past technology and structural failures. As much as we like to think we're learning from our mistakes, these failures may tell us very little about the next crisis on the horizon.

"If a regulator cannot regulate a complex system, then what can it do? Will a regulator always be caught behind the curves of self-organization and emergence, holding a bag of obsolete rules that came from less evolved systems? … Rather than a regulator, complex systems should have a co-evolver/counter-evolver. This must be an organization that has the requisite variety not only to have an idea of the complexity of the operational organization (and thus has to co-evolve with how that organization evolves). It should also have requisite variety to counter-evolve."

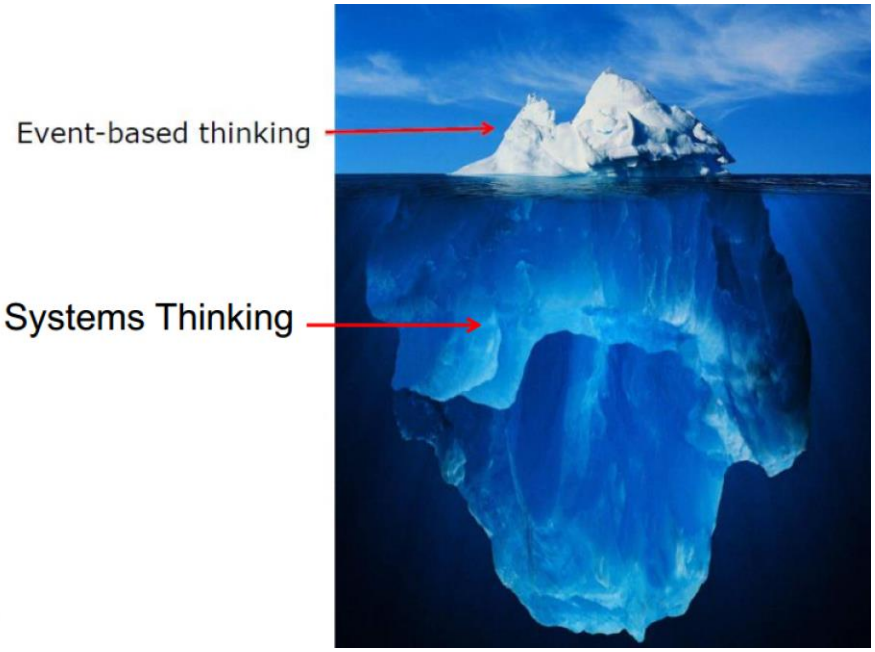
Sidney Dekker, Drift Into Failure

Today's markets bear little resemblance to those that existed and flourished in the United States in the latter part of the 20th Century. We operate under the terms of the Securities Acts, including the Securities Act of 1933, the Securities Exchange Act of 1934 and the Amendments of 1975 that established the National Market System. Few things about our markets function as they did then, or even as they did fifteen years ago.

While it is positive and fortunate that we have enjoyed such a rapid advance of technology, our regulatory framework has been left behind. The rules have been changed many times over the last fifteen years, most importantly with limit order display, decimalization, Reg ATS and Reg NMS, in an attempt to maintain pace or force changes in behavior. Our capacity for understanding the results of these rule changes and technology advances remains woefully dated. Out-of-date regulatory tools and inconsistent data availability and access for academics have prevented us from attaining a clear understanding of the impact of rule changes and technology.

Our markets are increasingly complex and the technology driving them increasingly sophisticated. By contrast, regulators have failed to embrace the language of Complexity or Systems Theory and the thoughts and principles behind it. Regulators are too focused on events, on short-term fixes and on a narrow view of the industry. Regulators and exchanges treat issues in isolation, whether the issue is order type complexity or SIP infrastructure failures, but all of these things are inextricably linked. This is well illustrated by William Young's (MIT) diagram on Systems Thinking[1]:

[1] http://psas.scripts.mit.edu/home/wp-content/uploads/2013/04/Leveson-tutorial-intro.pdf



The issues that I will address in the written portion of my testimony aim to broaden the way that we collectively perceive the challenges of reforming market structure. The ideas expressed here are informed by the Complexity and Systems Theory, which recognize the interconnected nature of systemic failure and which consequently calls for a reconsideration of our current top-down approach to regulation. This calls for a strategy of addressing system-wide flaws, misaligned incentives and improper transparency/disclosure, rather than reacting to each technology failure with an endless sequence of fixes. Complex systems are not susceptible to ordinary cause-and-effect analysis, and each attempt to impose this type of analysis will mislead regulators into a false sense of security over having solved the most recent problem.

Regulators need to better define how they can use available tools to cope with this complexity. So do other market participants. Included here are two broad recommendations, the details of which I will discuss in my remarks. First, we need to revamp the SRO structure to make it more efficient, less conflicted and more data-driven. Second, we need to make data about what is taking place in the markets widely available and subject to scrutiny from a variety of sources. In combination, these changes will bring about better markets.

As such, this testimony recommends, and identifies as critical, the following priorities:

- Improved academic and regulatory understanding of market quality and improved access to data for study;

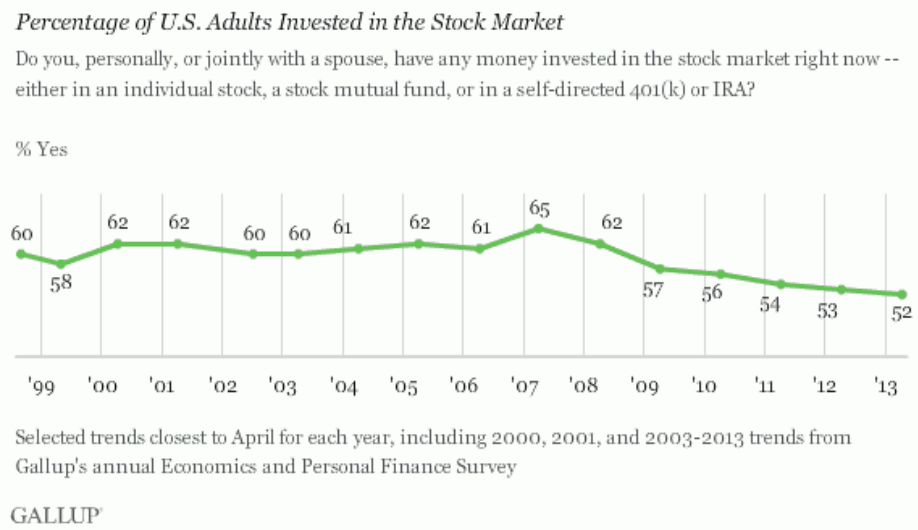
- Confrontation of massive market fragmentation;
- Regulatory oversight of dark pools;
- Stronger Best Execution requirements;
- Implementation of a trade-at rule; and
- Strengthening and improving surveillance capabilities at the regulatory level.

This is not to say that broker-dealers and other market participants bear no responsibility. All market participants need to self-police, need to commit themselves to fairness and transparency, and need to abide by the rules. Participants also need to be constructive in the process of upgrading and regulating our markets.

This testimony also includes follow-up commentary on the recommendations provided during my 2012 Testimony before the Subcommittee on Securities, Insurance and Investment. Briefly, this includes reiteration of my call for:

- Effective marketwide surveillance;
- Retrospective review of order type approvals; and
- Strong, clear market technology standards.

My 2012 testimony also called into question investor confidence in markets. While I will not claim that market structure, the Flash Crash or repeated technology failures are the primary causes of the waning of investor confidence, neither do these issues instill confidence nor push the public back into the market. While it is irrefutable that more funds are flowing into the stock market, those funds are coming from a smaller segment of the American population. Investor confidence is better measured by the public's participation in markets, not in the amount of capital flowing into stocks versus bonds. That measure is at a fourteen year low according to Gallup:



Investor confidence continues to be a concern. This is a direct threat to the US economy. Many of the ways to address investor confidence are outside of the scope of this testimony, but we can be sure that a stable financial market that is no longer in the news for unexplained technology failures would help. Regulators' goals should be to increase transparency, reduce conflicts-of-interest and demonstrate that they are capable of regulating and policing this new electronic marketplace.

The key issues and recommendations contained here within are informed by the same principles that guide KOR Group, the Healthy Markets Initiative and the pursuit of markets that operate transparently, fairly and efficiently.

Complex Systems Fail

Recent events have produced a tremendous and unprecedented amount of visibility for the previously obscure concept of market structure. Unfortunately visibility does not always mean clarity. In fact, if market structure was well-designed, incentives properly aligned and systems therefore built to prioritize stability, **technology and structure would remain invisible**.

While Congress, regulators and the public are now focused on the rules that govern our industry for various reasons – whether because of the financial crisis, the Flash Crash, various technology failures or portrayals in popular media – they are discovering that there are generally no easy answers for the issues that we face. While many find it easier in each of these cases to search for a "root cause" to a problem—and upon finding it fixing it—such an approach is limited in scope at best and downright dangerous at worst.

The "fallacy of the broken part" is one of the more important ideas contained within Systems Theory. Likewise, its implications for regulating and understanding the evolution of markets are profound. For example, there is broad agreement among academics and practitioners that the Flash Crash and related mini-flash crashes are symptomatic of the current market structure as a *system*, and not the result of a "broken part." In its request for testimony, the Committee prompts, "describe your view on lessons learned from past market events and what can be done to strengthen the stability and operation of the markets."

This is the imperative that I've been most compelled by as I've witnessed and taken part in the rapid changes to our market. I'm pleased to share my thoughts with you today.

The technology and structural failures of the past several years are well known, and include:

1. The Flash Crash in May, 2010.
2. Numerous instances of extreme volatility, including August 2011 and the continuing occurrence of so-called "mini flash crashes."
3. IPO glitches resulting from technology failures at Nasdaq and BATS.
4. The Knight Capital incident on August 2, 2012.
5. Goldman's options market making incident in August 2013.
6. Nasdaq's SIP failure in August 2013.

If we include the many minor incidents that have failed to capture media attention, this list would be much longer.

What can we learn from these incidents? Can we learn anything? Representatives of these firms will assure the public and the industry that they have learned the lessons, that they have improved their technology, and that such incidents will never happen again. In doing so, they are falling victim to the "fallacy of the broken part." This is best illustrated by reference to Dr. Richard I. Cook of the Cognitive Technologies Laboratory at the University of Chicago. In his essay, "How Complex Systems Fail," Dr. Cook states[2]:

[2] Cook (2000). How Complex Systems Fail, page 2.
http://www.ctlab.org/documents/How%20Complex%20Systems%20Fail.pdf

7) Post-accident attribution to a 'root cause' is fundamentally wrong. Because overt failure requires multiple faults, there is no isolated 'cause' of an accident. There are multiple contributors to accidents. Each of these is necessarily insufficient in itself to create an accident. Only jointly are these causes sufficient to create an accident. Indeed, it is the linking of these causes together that creates the circumstances required for the accident. Thus, no isolation of the 'root cause' of an accident is possible. The evaluations based on such reasoning as 'root cause' do not reflect a technical understanding of the nature of failure but rather the social, cultural need to blame specific, localized forces or events for outcomes.

8) Hindsight biases post-accident assessments of human performance. Knowledge of the outcome makes it seem that events leading to the outcome should have appeared more salient to practitioners at the time than was actually the case. This means that ex post facto accident analysis of human performance is inaccurate. The outcome knowledge poisons the ability of after-accident observers to recreate the view of practitioners before the accident of those same factors. It seems that practitioners 'should have known' that the factors would 'inevitably' lead to an accident. Hindsight bias remains the primary obstacle to accident investigation, especially when expert human performance is involved.

15) Views of 'cause' limit the effectiveness of defenses against future events. Post-accident remedies for 'human error' are usually predicated on obstructing activities that can 'cause' accidents. These end-of-the-chain measures do little to reduce the likelihood of further accidents. In fact that likelihood of an identical accident is already extraordinarily low because the pattern of latent failures changes constantly. Instead of increasing safety, post-accident remedies usually increase the coupling and complexity of the system. This increases the potential number of latent failures and so makes the detection and blocking of accident trajectories more difficult.

We can presume to learn the lessons of our repeated technology failures, and we can take pains to "fix" parts of the systems that were so obviously broken. Doing so does not help us prevent future

failures. In the past, I have called this strategy "Technological Whack-A-Mole."[3] New problems will continue to spring up no matter how many we hammer into the ground.

The lesson that regulators should be learning is that advances in technology and massive market fragmentation have created a market unlike anything that we've seen in the past. Instead, regulators focus on repairing the "broken part." Consequently, we convene committees and roundtables, undertake investigations to determine what went wrong, meticulously reconstruct the events under investigation, draft a plan that will take months or years to implement at an extremely high cost to taxpayers or industry, and proclaim victory.

Alternatively, investigators may arrive at an overly simplistic cause-and-effect explanation that neglects to consider the environment in which faults occur and the non-linear phenomena that underlie these faults. One example is the Flash Crash – the perfect demonstration of a failure in which nothing actually broke. The Flash Crash resulted from a complex and non-linear interplay between participants, regulations and technology. The study of the Flash Crash was substantially flawed, plagued by poor data and poor understanding of high-frequency market dynamics. The regulatory response is similarly flawed; a Level-Up/Level-Down regime that presumes remedying the most obvious symptoms will address the cause.

"Mini flash crashes" offer us another example. The SEC has contended that these events are actually the result of human error or "fat fingers" and not related to high-frequency trading. This is another illustration of assigning linear cause-and-effect relationships to non-linear events. While there may be a "precipitating event" such as a "fat finger" that causes these incidents, it defies logic to ignore the complexity of the market, the fragmentation of liquidity, the rapid speed at which resting orders can be withdrawn and the non-linear feedback loops / illiquidity contagions that market making strategies fall into as large orders plow through an order book. There was a time when markets were simpler and easier to understand. That time has long passed but regulators are still struggling to accept and embrace this.

Today's markets are characterized by interconnectedness and speed, and contending with this combination has proven very difficult for regulators. This environment generates a massive amount of data, though this amount of data still pales in comparison to other examples of "big data" in different

[3] Lauer (2013). 'Fixing' Technology Complexity on Wall Street: No More Whack-a-Mole. http://www.huffingtonpost.com/dave-lauer/high-frequency-trading-technology_b_3830734.html

industries. Regulators have fallen significantly behind in their ability to collect and analyze data, and this should be a huge concern to practitioners, legislators and the public. This is an issue that I will address later, as I examine the recommendations I made in my 2012 testimony before the Subcommittee on Securities, Insurance and Investment.

As we confront the issue of market complexity and fragmentation, you often hear proponents of the current market structure ask "What is the right number of market centers?" They claim that if you are going to allow more than one, you must let the market figure out the appropriate number. Having adopted this mentality, having passed the trade-through rule as part of Regulation NMS, and lacking a trade-at rule in conjunction with Regulation ATS, we are left with the current highly fragmented market. There are fewer incentives to display liquidity, and as such dark volume is increasing every year. Trading volume on non-lit venues has just recently passed the 40% mark.

Regulation NMS gave us protected endpoints regardless of market share, and forced an incredible amount of complexity on to the markets in an attempt to end the NYSE monopoly and push them into the electronic trading era. While that goal has been met, and the value has been tremendous, it is completely reasonable to now question whether the cost of meeting that goal through Regulation NMS is a reasonable one to bear. We've managed to create a network of dark pools that rarely route to one another, and instead of providing a safe haven for large institutional orders, there has been a proliferation of shallow pools with average trade sizes at or below the displayed market. This has not only driven complexity in technology, connectivity and order routing but has also created intractable conflicts-of-interest when you combine this landscape with the maker-taker pricing model, the absence

of a trade-at rule and government-imposed price controls of 30 mils per share. Regulation has created this monstrosity of a market, and it is only by peeling back some regulations and refining others that we can hope to simplify market structure and increase market efficiency.

While KOR and Healthy Markets advocate for the removal of some regulations, modifications of others and the passage of new rules, we are driven by a belief that we cannot regulate without unintended consequences. To minimize these unintended consequences, we must attempt to regulate in a bottom-up manner, rather than top-down. This is an approach that focuses on creating the right environment and incentives, removing conflicts-of-interest and disclosing these conflicts when they cannot be removed. This approach allows competition to proceed in a productive manner, hopefully finding the equilibrium that we all seek. Removing conflicts where possible and shining light on them when not allows participants to make more informed decisions and forces firms to compete. There can be no doubt that the days of the floor broker, 1/8ths, and the NYSE monopoly are long gone. But the pendulum has swung too far in the other direction. **Complexity is not necessarily bad, but unnecessary complexity certainly is.**

If we embrace the language of complexity we "realize that control is little more than an illusion, at least in some areas and some parts of how the system works. … In complex systems order arises because of (or emerges from) the interaction of lower order components and their interaction with the environment."[4] The design of the environment and the incentives for those lower order components is everything.

Conflicts and Incentives: Self-Regulation

So how can we understand where our structure has gone wrong and how can we begin to reform it? Let's start with the Self-Regulatory Organization. As KOR covered in our October 1st 2012 comment letter to the SEC: "Today, SROs file rules under Section 19(b) of Exchange Act of 1934 and more specifically under rule 19(b)(7)(c) which has changed little since adopted over 78 years ago[5]. When those rules were adopted, Exchanges were mutually owned by 'not-for-profit' organizations whose goal was to serve the public and their associated members."[6] Regardless of how "altruistic" the Exchanges

[4] Dekker, Sidney (2011). Drift Into Failure. Page 172.
[5] Because Section 19(b)(7)(C) of the Act states that filings abrogated pursuant to this Section should be re-filed pursuant to paragraph (b)(1) of Section 19 of the Act, SROs are required to file electronically such proposed rule changes in accordance with form 19b-4. See about form 19b-4: http://www.sec.gov/about/forms/form19b-4.pdf
[6] KOR Trading Comment Letter by Chris Nagy. October 2, 2012: http://www.sec.gov/comments/4-652/4652-27.pdf

were, there can be little doubt that the rules under which Exchanges are governed today are antiquated, the product of a time when electricity had just reached 70% of households, not an era in which a gigabyte of data can be transmitted around the world in seconds. It is incumbent upon Congress and the SEC to revisit the self-regulatory structure and design a system of incentives and regulation with the requisite variety and industry skills along with the independence to enforce a reasonably designed set of rules.

Before getting started, I'd like to preface this section with a disclaimer. I am not advocating that the self-regulatory structure disappear. I agree with the CFA Institute that "[w]ith its inherent conflicts and governance challenges, the self-regulatory system is far from perfect. Such a system is needed, however, in today's highly complex and technologically changing and evolving markets."[7] I believe that the framework is dated, and must undergo a transformation so that it does not continue to undermine the integrity of markets.

Is there evidence that the self-regulatory structure is failing us? Certainly it should be apparent that the incentives of a for-profit, publicly traded or broker/dealer-owned, self-regulatory organization are to increase shareholder value, not to build transparent, fair and efficient markets. "In no other industry can a for-profit publically traded organization create and enforce industry regulations and market standards which, in many instances are immediately effective[8]."[9]

Do we really need evidence that this conflict is intractable? That's easy enough to produce. Let's simply consider the mountain of reforms that SROs could have undertaken on their own, yet have refused to. In some cases, it has taken catastrophic failure and, in others, regulatory fiat. There are yet

[7] CFA Institute (2013). Self Regulation in the Securities Markets: http://www.academia.edu/5797953/SELF-REGULATION_IN_THE_SECURITIES_MARKETS_Transitions_and_New_Possibilities

[8] Securities Act of 1934 Section 19(F)(ii) The rules promulgated by the commission under clause (i) are not required to include republication of proposed rule changes or solicitation of public comment. (3)(A) Notwithstanding the provisions of paragraph (2) of this subsection, a proposed rule change shall take effect upon filing with the Commission if designated by the self-regulatory organization as (i) constituting a stated policy, practice, or interpretation with respect to the meaning, administration, or enforcement of an existing rule of the self-regulatory organization, (ii) establishing or changing a due, fee, or other charge imposed by the self-regulatory organization on any person, whether or not the person is a member of the self-regulatory organization, or (iii) concerned solely with the administration of the self-regulatory organization or other matters which the Commission, by rule, consistent with the public interest and the purposes of this subsection, may specify as without the provisions of such paragraph (2). (B) Notwithstanding any other provision of this subsection, a proposed rule change may be put into effect summarily if it appears to the Commission that such action is necessary for the protection of investors, the maintenance of fair and orderly markets, or the safeguarding of securities or funds. Any proposed rule change so put into effect shall be filed promptly thereafter in accordance with the provisions of paragraph.

[9] KOR Trading Comment Letter by Chris Nagy. October 2, 2012: http://www.sec.gov/comments/4-652/4652-27.pdf

other reforms that the SROs still have not undertaken. One is left befuddled as to why catastrophe or regulatory dictate are required in these cases:

1. Server clock synchronization
2. SIP infrastructure resilience
3. SIP infrastructure performance
4. Order type consolidation / preening
5. Market data availability for research and surveillance
6. Industry-wide testing for disaster recovery
7. Enhanced transparency around ATS reports

Let's examine each of these with consideration to the conflicts-of-interest they create and the want they leave for appropriate incentives. Hopefully, this will help us to understand the issue more clearly.

Server Clock Synchronization

To some, the synchronization of server clocks to a common time source would appear a small and simple issue, hardly worth even being mentioned. But to regulators attempting to reconstruct events, study the market and perform proper surveillance in a world of high-frequency trading, there is no substitute for high-resolution server clocks and microsecond-level clock synchronization. Exchanges timestamp all of the messages that they send to participants, yet these timestamps are universally ignored because they are not synchronizing to a common clock source and cannot, therefore, be sequenced with each other across market centers. This technology has been readily available for years, and there is simply no reasonable excuse as to why the SROs have yet to implement it. Why is regulatory intervention needed here? It defies common sense.

There is one simple answer. While synchronizing their clocks would help to facilitate a fairer, more efficient market, and one that is more readily understood by participants and policed by regulators, current SROs are not incentivized to do so over the possible objections of their shareholders (because of cost) or their best customers (for fear of better surveillance). Regardless of their motives, every day that goes by without synchronization of their system clocks brings further damage to the credibility of SROs and the SRO framework.

SIP infrastructure resilience

After the dismal SIP failure in August 2013, Exchanges were called into the Chair's office at the SEC and instructed to develop a plan to prevent it from happening again. Why was that necessary? Why weren't SROs properly incentivized to maintain this infrastructure in a high-performance and resilient manner consistent with their incentives to do just that with their private, proprietary feeds? One need only review the "Report of the Advisory Committee On Market Information: A Blueprint For Responsible Change"[10] to see that as early as 2001 there were substantive concerns about "a 'single point of failure' with capacity at the consolidator level."[11] While the Seligman study made many excellent suggestions, including the idea of allowing for multiple consolidators to ensure competitive forces are allowed to find better solutions, its suggestions were disregarded. This includes the suggestion that if there was going to be only one SIP, to at least open the bidding process up and allow competitive bidding. Because of explicit and implicit conflicts-of-interest it took 13 years and a massive infrastructure failure to heed this advice.

Once again we fall victim to conflicts-of-interest. Here we have an explicit conflict in that there is no incentive to improve the SIP infrastructure, particularly not when under-investing in technology means keeping a greater share of funds for the SROs charged with running the SIP.

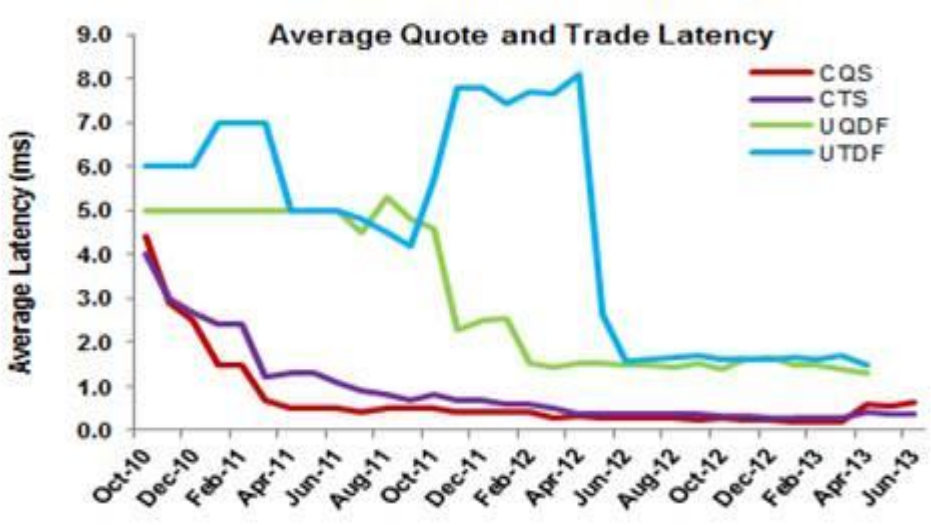
SIP infrastructure performance

There can be no doubt that market data received from the SIP is far slower than the same data received over proprietary, direct feeds. This does not have to be the case, but once again, SROs refuse to change how they produce and distribute data because of conflicts-of-interest. The Seligman study identified this issue in 2001[12], and recommended a new system of distributed consolidators through whom all market data would be distributed. Healthy Markets is advocating for a modified version of this in which the existing consolidator is used, but would support the Seligman recommendations as well.

The chart below shows latency differences between the SIP and the direct feeds starting from 2010. Before 2010, the problem was much worse, and the average was an order-of-

[10] Seligman (2001): http://www.sec.gov/divisions/marketreg/marketinfo/finalreport.htm
[11] Ibid.
[12] Ibid.

magnitude higher (it was approximately 40 milliseconds in 2006). In addition, this chart only shows average numbers, and says nothing about the jitter and outliers, which are such a critical part of high-speed trading.



Here we have an implicit conflict. The fact that the SIP is slower means that faster, direct, proprietary feeds are more valuable. The SROs profit by selling these proprietary feeds and are thus incentivized to avoid equalizing performance between the two systems. **There should be no latency differential between direct feeds and the SIP as measured by receipt time in co-location facilities.**

Order Type Consolidation / Preening

The proliferation of order types has produced a complicated system of indicating buy/sell interest that few can navigate with total comprehension. This complexity may or may not be necessary, though it is certainly a result of Regulation NMS. There should be no doubt that many order types are under-utilized and could be retired, while still others are of questionable utility. In addition, the order type controversy has been covered in the media and has contributed to the general public frustration with unnecessary complexity and markets that the average person simply does not understand. While this controversy has raged for years since Haim Bodek first burnished his sword in the Wall St Journal[13], there has been no action by the SEC or the SROs until Jeff Sprecher's ICE bought the New York Stock Exchange:

[13] Patterson (2012). For Superfast Stock Traders, a Way to Jump Ahead in Line: http://online.wsj.com/news/articles/SB10000872396390443989204577599243693561670?mg=reno64-wsj

"To start, we are self-imposing a six-month moratorium on any new, or novel, order types that further segment the market. We believe that this will give the industry and the SEC time to focus on the complexity that exists. In addition, we have already announced the elimination of more than a dozen unique order types."[14]

Why did it take a futures and commodities exchange to purchase a US Equities SRO before the first substantive action was taken on order types, over 2 years after the issue had been identified? The answer, once again, is couched in a conflict-of-interest for SROs who have no incentive to simplify and consolidate market structure.

Market data availability for research

In my 2012 testimony before the Subcommittee on Securities, Insurance and Investment[15], in subsequent[16] comment[17] letters[18] and most recently in my testimony before the CFTC Technology Advisory Committee[19], I have repeatedly urged regulators to provide a centralized platform for market data so that practitioners and academics can effectively research our markets. **This issue is so important that it is reaching crisis levels.** Data accessibility to academics is nearly non-existent in a complete, unbiased and objective manner. Often, industry firms sponsor research. It should surprise no one that these studies usually arrive at the results that the firms want. If they don't get results they like, the researchers in question won't have access to data for subsequent studies. There is an ongoing debate about market structure and market quality, and there are no clear, objective answers. Research is not reproducible and code is not available. **This is not science. This is a farce. And the future of our economy and markets are at stake.**

If the SROs so desired, they could easily come together and provide the platform that I have called for on repeated occasions. My calls have been directed at the SEC, but they have refused to act:

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[14] Testimony of NYSE President Thomas Farley before Senate PSI on June 17, 2014
[15] http://www.banking.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=56ef1df0-6c9a-4c53-99e8-2ad7a614afe2
[16] 10/2/2012: http://www.sec.gov/comments/4-652/4652-32.pdf
[17] 4/4/2014: http://www.sec.gov/comments/s7-02-10/s70210-413.pdf
[18] 4/16/2014: http://www.sec.gov/comments/sr-finra-2014-018/finra2014018-1.pdf
[19] Attachment 1, original available at http://kortrading.com/wp-content/uploads/2014/02/CFTC-Testimony-David-Lauer-June-3-TAC-Meeting.pdf

October 2012, before the SEC's Technology Roundtable: **"**[T]he SEC should provide an open API-based interface to this system and incentivize independent developers to build novel and advanced pattern recognition algorithms by offering them a percentage of fines collected or using a prize-based mechanism."[20]

September 2012 before the Subcommittee on Securities, Insurance, and Investment: "The Internet and Open Source efforts have taught us that open systems are nearly always preferable to closed. In that spirit, and under the premise that markets are a public good, market data feeds and tick data history should be opened up. It is critical to understand that many academic papers are skewed because they are either funded directly by the industry, or provided access to expensive and proprietary data by the industry. Opening up access to this data would have a dramatic effect. Access to the historical data of direct market data feeds should be made available freely to the public, and a prize-based incentive created for those who can find innovative ways of designing surveillance systems and algorithms. While the exchanges will surely argue vigorously against this idea as market data is a major profit engine for them, it is in the public's interest for the regulation and enforcement to move out of the 20th century."[21]

2013 Article: "Open up access to MIDAS, the SEC's quantitative analysis platform, to academics and independent researchers! Embrace the principles of the open source movement, and make it cheap and easy to perform studies on market data with the goal of advancing the public discussion and regulatory decisions. The SEC team at the head of the MIDAS project is talented, but small and resource-constrained. … Open up the data! There's really no good argument against it."[22]

2014 response to approval of FINRA fees for ATS volume reports: "Regulators need to fundamentally change how they approach access to data. We have a data crisis in US financial markets; academic and public research is crippled, and yet we are just getting *Business as Usual* from the regulators. We don't need more talk from the SEC and FINRA, more speeches and more hearings; we need action."[23]

[20] Lauer (2012), Written Statement, SEC Technology Roundtable
[21] Lauer (2012), Written Testimony before Subcommittee on Securities, Insurance and Investment on "Computerized Trading: What Should the Rules of the Road Be?"
[22] Lauer (2013), HFT – In Search of the Truth. http://dlauer.com/post/55103434587/hft-in-search-of-the-truth
[23] Lauer (2014), Regulators & Data: Business as Usual. http://kortrading.com/business-as-usual/

If the SROs so desired, they could solve this problem practically overnight. **It's time to open up historical data to the public and the academic community free of charge. To do anything less is the height of absurdity.**

Industry-wide testing and backup / recovery

Once again, those observing from outside the industry, like those of us within, are left scratching their heads. We collectively watched as a natural disaster such as Hurricane Sandy closed markets for two days. When a localized event can disrupt a global economy, why does the industry refuse to perform coordinated industry-wide testing? The SROs could mandate this tomorrow, schedule the tests and get it done. Yet they need to be forced by Regulation SCI? Why?

If the SROs were incentivized to maintain fair, transparent, efficient markets, such testing would be routine. There is, unfortunately, nothing in the publicly traded shareholder value commitment that says an organization must or even should do this. It is, therefore, not done. It is a relief that Regulation SCI will change that, but it is nonsensical that it has come to that. It is as if SROs are children that can't be left unattended lest they destroy something valuable.

Need for transparency and ATS regulation

The Healthy Markets platform[24] starts with a simple, well known quote by Supreme Court Justice Louis Brandeis: "Sunlight is ... the best of disinfectants."[25] As such, Transparency is the primary and core principle in our platform. The SEC has long held this to be true, and their Rules 605 and 606 were critical steps to ensure that brokers and market centers were held accountable for their behavior. Yet these rules are completely outdated in the world of fragmented market centers and high-frequency trading. The SROs are perfectly capable of producing updated rule 605 statistics (as outlined in the Healthy Markets platform), yet they continue to produce statistics that are of questionable value and easily gamed. Are they focused on fair and efficient markets? Or are they meeting the lowest possible standards of compliance to avoid fines while passively obstructing the industry's forward progress?

This question applies equally to the state of ATS disclosure. There is nothing preventing ATSs from publishing intimate details of their order matching logic, tiered access, fee structure,

[24] Attachment 2, original available at http://healthymarkets.org
[25] Brandeis, Louis D. (1933). *Other People's Money – And How Bankers Use It.*

order types, etc. Instead we've gotten a trickle of Form ATSs being published, most after being sanitized / scrubbed (as evidenced by the recent revision dates). FINRA was supposed to be investigating Alternative Trading Systems and it has certainly been within their purview for years to mandate enhanced disclosure requirements. So why has it taken a sensationalistic novel published by Michael Lewis to get any action from them? FINRA revealed after an investigation in 2013 that it was concerned by what it found, yet no action was taken other than to mandate volume reports. Consequently, FINRA will be charging an outrageous amount of money for computer-based access to these volume reports. Why must the regulator charge for access to data that should be publicly accessible? Why did the NY Attorney General need to intervene with Barclays? Why didn't the SEC or FINRA discover this activity?

Unfortunately after a close examination of the SRO conflicts and their failures to act in the public interest, we are left with so many more questions than answers.

Conflicts: Speed over Stability and Fragmentation over Simplicity

While this conflict may be part and parcel of the SRO conflict, it is worth highlighting as per the request to testify. The Committee has asked about "the consequences of the focus on speed in today's automated and interconnected markets and whether regulation has adequately addressed this growth." In fact, one is hard pressed to find any example of regulation addressing this growth, let alone adequately. There has been little in the way of regulatory attempts to even understand the speed at which markets trade[26], let alone to examine whether it needs regulatory attention. While I am not trying to advocate for slower markets, I do not pretend to know the answers. Further study is warranted, and part of that is making the appropriate data available to academics to attempt to answer the question as to whether market quality has improved since the implementation of Regulation NMS and the acceleration of trading and matching systems. There has most certainly been a cost associated with this acceleration as measured by the technology required to maintain pace with extreme data rates or the resulting fragility of the markets as corners are cut in development and testing.

Further, as a result of Regulation NMS and ATS, and the lack of a trade-at rule, we've seen massive fragmentation in the markets. We are left picking up the pieces of a massively conflicted system in which brokers are not only allowed to own and operate their own dark pools, but in which they are

[26] One lone example is the SEC's Quote Lifetime study on their Market Structure website: http://www.sec.gov/marketstructure/research/highlight-2014-02.html#.U7YETfldUeo

also able to route 90% of their customers' orders through such venues without drawing any regulatory scrutiny around best execution requirements. **This is the perfect example of an environment in which poor regulation and poor foresight combined to ensure that incentives and conflicts-of-interest would drive the industry in the wrong direction.** It is also an example of something that can be easily remedied by making best execution requirements stronger (an issue addressed later in this testimony) and incentivizing displayed liquidity through a trade-at rule. The effects of this would be profound.

Conflicts: Maker/Taker and Payment-For-Order-Flow

While the topics of Maker/Taker and Payment For Order Flow (PFOF) are not specifically part of the Committee's request, they must be mentioned in the context of system stability and resiliency. The Maker/Taker business model and the SEC-imposed fee cap of 30 mils per share have created a prisoner's dilemma. First, the race to the bottom brought access fees up to, or close to, the price controlled cap. This allowed exchanges to increase their rebates to levels near that cap. This led to increased costs for taking liquidity in the lit market, which drove volume to internalizers and dark pools. The subsequent increase in dark trading has been tremendous and unprecedented. Driving this liquidity off of exchanges has had a significant impact on both market making and execution quality in the lit markets. This has increased adverse selection on lit markets and reduced market maker profitability to such an extent that diversity has been lost. Over half of trading is now done by high-frequency firms, largely because this is now the only profitable timescale on which to trade. The dominance of Maker/Taker and high-frequency trading in exchange volumes, and the associated reduction in diversity of the marketplace has increased market fragility. This worrisome development may help to explain the increase in "mini flash crashes" or illiquidity contagions.

There is a lesson to be learned here, as was covered in the previous section on fragmentation. A trade-at rule, as has been adopted by Australia[27] and Canada[28] (appropriately named Market Integrity Rules in both countries), would serve to push liquidity and activity back to the lit exchanges, rendering market-making a more profitable activity and encouraging a greater diversity of market making participant. This could help to improve system stability and reduce order book fragility. This is a theory that emphasizes the beneficial effects of reducing adverse selection on lit exchanges. At Healthy Markets we are advocating strongly for this theory to be tested. We were thrilled to see the SEC include

[27] http://www.asic.gov.au/asic/asic.nsf/byheadline/Market+integrity+rules?openDocument
[28] http://www.iiroc.ca/Documents/2012/77c0af22-004e-417d-9217-a160b3fcb5c5_en.pdf

a trade-at group in the decimalization pilot, and we continue to push for another pilot that will reduce or eliminate rebates and include a trade-at rule.

Regulatory Organization and Resources

"Regulators that are serious about improving compliance and protecting investors must embrace technology and adapt their organizations to the realities of 21st century trading. This will require courageous leadership, a tectonic shift in thinking, and a radical reallocation of budget and staff resources. "

Director, Market Surveillance Technology for an international regulator

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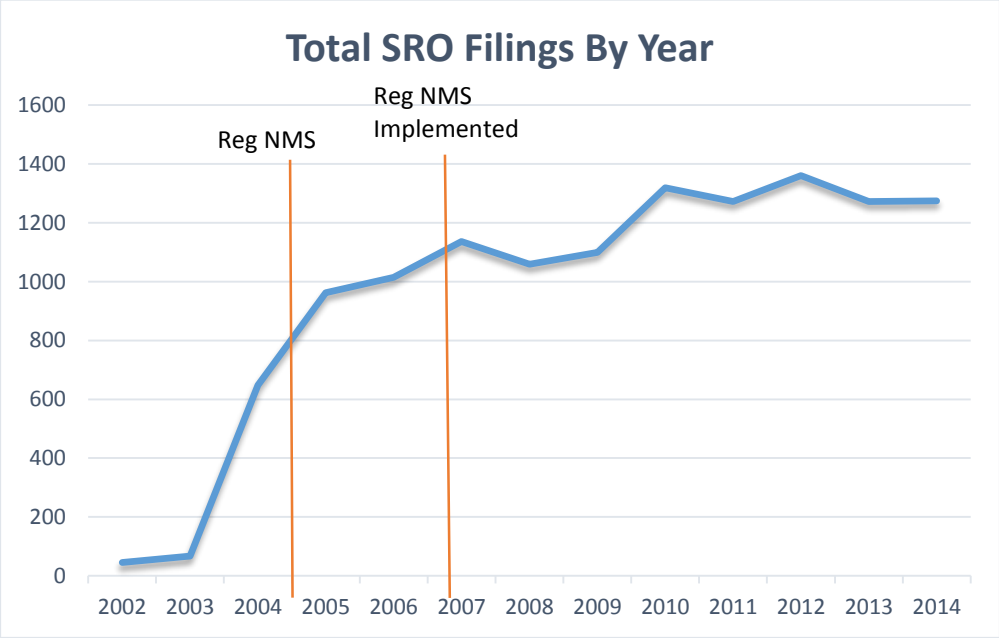
Regulators face a nearly Sisyphean task in trying to make sense of modern electronic markets, let alone regulate them. This task is made all the more difficult by the deluge of data with which they must contend, the complexity and consequences of rule filings, and the lack of appropriate resources and budget. The SEC increasingly finds itself delaying approval of rule filings and reaching out to the industry with detailed questions on the consequences of these filings. The increase in rule filings over time, especially in the wake of the approval of Regulation NMS in 2005, is startling:



Since 2010 the average SRO filings per year have been 1,300, yet the SROs pay no cost for these filings. This is a not only a huge amount of work to perform, but the implications of approvals are significant. Substantial technological and market structure expertise is needed to evaluate many of these filings and the unintended consequences may not be clear. As the number of filings increases and staffing levels do not, we are asking more of our regulators than we should.

This provides the perfect introduction to some of the more significant and foundational issues that our regulators are facing: inappropriate resourcing for confronting the challenges of modern electronic markets and a dated, bureaucratic mindset that fosters top-down regulation, rather than bottom-up co-evolution. In my testimony before the CFTC Technology Advisory Committee, I identified five key challenges that regulators face[29]:

1. Lack of sophisticated technology skills to collect, normalize, process and analyze huge amounts of data.
2. Cultural challenge of re-orienting perspective to foundational integration of technology rather than simply as a tool or supplement to operations.
3. Political frictions that ensure silos remain within and across agencies.
4. Bureaucratic mindset that focuses on job security and individual "fiefdoms" to the detriment of open, transparent analysis and data sharing.
5. Conflicted, for-profit SRO structure that leads to questionable incentives.

"Never has the need for expertise been greater, or the resource gap wider. Regulatory organizations are predominantly staffed by attorneys, yet they wonder why they have trouble keeping pace with private companies staffed by experts in every domain – traders, programmers, quantitative modelers and operational / back-office engineers. **The markets have changed.** Can this be stated more strongly? The markets look **nothing** like they did 100 years ago, or 50 years ago, or even 15 years ago. Yet regulators continue with nearly the same type of staffing, similar allocations of resources and similar approaches to surveillance."[30]

In that testimony to the CFTC, I focused heavily on what technology-centric regulation means, and there is no need to repeat that here. I would urge anybody interested in ideas on how to regulate in the 21st century to read that document as well as to explore the wealth of research and writing that has been produced in recent years on complex industry regulation and systems thinking. If regulators have any hope of catching up with, and staying ahead of the industry, this mindset is a required shift. It will

[29] Lauer (2014). "Written Statement: Market Surveillance in the 21st Century." Included as Attachment 1, original at: http://kortrading.com/wp-content/uploads/2014/02/CFTC-Testimony-David-Lauer-June-3-TAC-Meeting.pdf
[30] Ibid.

not be easy, but there's little hope otherwise. This represents one of the greatest risks to market integrity that we face – regulators who are unable to understand or keep up with the rapid pace of technological change in markets.

Nowhere is this failure more readily apparent than in the inability of regulators to provide effective oversight, whether in ensuring Best Execution, controlling retail and institutional broker order routing practices or demanding any level of accountability in broker-operated dark pools. If the SEC and FINRA were capable of policing the industry, why did the New York Attorney General find the alleged fraud and deception occurring at Barclays? Does anybody reasonably think that there will not be additional revelations at other broker-operated dark pools? Is this an issue of technological sophistication? Or is FINRA simply too hesitant to police the brokers sufficiently? Once again we are left with more questions than answers, and conflicts-of-interest lurking around every corner.

All of this contributes to a broad public perception of an industry that is operating with reckless abandon and one that is not being policed sufficiently by regulators. The evolution of the SRO structure has saddled FINRA with many of the duties that were once under the domain of the front-line SRO. Upon recognizing the presence of intractable conflicts, some front-line functions were divested to FINRA. This legacy structure may not make sense anymore. It has become unclear why FINRA is not part of the SEC, or at the very least why the agency operates without Congressional oversight. As we re-examine the regulatory structure in the light of market integrity, investor confidence and addressing conflicts-of-interest, I would not recommend abandoning SRO. Front-line regulatory functions are critical in this complex environment and an increase in the variety of regulatory competence is important. Some functions should not be under this structure though, and I would argue that surveillance and enforcement are among these.

2012 Testimony Recommendations

The Committee has requested that I comment on whether any recommendations discussed in my 2012 testimony have been addressed and, if not, whether they are still relevant. I truly appreciate the opportunity to discuss some of these ideas and follow-up on them. There are several recommendations I would like to highlight and address.

Marketwide Surveillance

Shortly before I advocated for a marketwide surveillance system, the SEC announced the MIDAS project. While I was optimistic at first, it has become clear that MIDAS is incapable of surveillance and incapable of accurately studying market structure above what any participant can do. Furthermore, MIDAS is only looking at equity data, and does not take futures market data. I spent 12 pages of testimony before the CFTC TAC explaining how to build a proper cross-asset class marketwide surveillance system and I do not believe there is a need to rehash that material (it has been included at Attachment 1). However, I will once again urge Congress and the SEC to act right away to build this system. Neither I, nor anyone else I have spoken with in the industry, is optimistic with regards to the timeline for delivery of the Consolidated Audit Trail (CAT). In light of this, the SEC and CFTC could work together to build a much simpler surveillance system that can function and provide insight and surveillance while CAT is being built. It should be concerning to anyone reading this that there is no algorithmic, cross asset-class surveillance being performed right now. **This leaves little doubt that there is market manipulation taking place. Bad actors know that nobody is watching.**

I will also take this opportunity to re-iterate the need to get market data with participant IDs into the hands of regulators and academics studying market structure. While I believe the industry would be best off with everyone having secure, API-based access to this data, it is sufficient to begin with a central repository and computational platform where academics and regulators are able to run studies on detailed data-sets. Privacy concerns are valid and reasonable, but they can be addressed. Privacy can be protected and confidentiality maintained, all while creating a platform that would revolutionize the study of markets.

Without such a platform it is impossible to study markets, impossible to get the appropriate data for critical studies and impossible to understand what is taking place in markets today. The MIDAS platform is ideal for such an undertaking, but it is severely lacking. It is missing the following data:

1. Identifiers for each order (either at the firm or supervisory individual level)
2. Hidden orders on lit exchanges
3. All orders on dark pools, including resting limit orders and IOIs
4. Immediate-or-cancel orders on lit exchanges
5. Some exotic order types on lit exchanges

These shortcomings are catastrophic. I can't overstate this. **These gaps render MIDAS incapable of providing the requisite insight that regulators need to achieve the data-driven approach to**

regulation called for by SEC Chair White[31]. There is no issue that is more critical to ensuring market integrity than proper access to data for study and surveillance, and no issue that is more readily and easily solved. It is time to stop making excuses. There is no reason why this can't be done and done quickly. Had action been taken on my original recommendation in 2012, the system could quite possibly have been operational for over a year by now. Our level of insight and understanding of markets would be light-years ahead of where it stands today.

Reducing off-exchange trading and ending PFOF

In my testimony, I advocated for the elimination of PFOF and for rules that will help push more trading to lit markets. I no longer believe that PFOF should be directly addressed, as that is a clear example of top-down regulation. Instead, the Healthy Markets platform advocates for a trade-at rule to ensure that any volume taking place off of lit markets at least provides substantial price improvement to compensate for the damage to the price discovery process. We were very encouraged to see the SEC include a trade-at group in their tick size pilot proposal, and we will continue to push for this enhancement to be included in the final pilot design. We also continue to advocate for a pilot that will reduce or eliminate rebates, and which will also include a trade-at rule. It appears that there is interest at the SEC in such a pilot, and we will continue to take a vocal stance in support of its implementation.

The issue of PFOF is directly related to Best Execution. The current system of relying on brokers for "regular and rigorous" review is not only dated, but lacks the proper level of disclosure, transparency and oversight. Recent concerns have been raised around order routing practices at retail brokers (starting with the study[32] by Robert Battalio, Shane Corwin and Robert Jennings and continuing with the admission of fee-based routing practices by TD Ameritrade at the Senate PSI hearing on June 17th) and institutional brokers (Barclays suit by the NY Attorney General).

An important consideration for Best Execution would be the primacy of conflicts, subjecting any conflicted routing decisions to a much higher standard of execution quality. This can help to address the issues that have been found on both the retail and institutional side. However, for any change to Best Execution, enforcement must be a focus. Enforcement has been non-existent. In fact, six years have

[31] White (2014). Enhancing Our Equity Market Structure: http://www.sec.gov/News/Speech/Detail/Speech/1370542004312#.U7qrZ_ldVuM

[32] Battalio, Robert H. and Corwin, Shane A. and Jennings, Robert H., Can Brokers Have It All? On the Relation between Make Take Fees & Limit Order Execution Quality (March 5, 2014). Available at SSRN:http://ssrn.com/abstract=2367462

passed since the last enforcement actions were taken. Regulators should mandate enhanced disclosure, more relevant factors and conflict considerations.

Revocation of order type approval

One of the ideas put forth in 2012 was to demand that SROs demonstrate the utility of their order types and that they are being used, or to retire them. There has been no progress on this issue, excepting the recent decision by NYSE to retire over a dozen order types. The SEC has requested that SROs begin an inventory of all order types to ensure that the functionality is correct and properly described in filings. I would prefer that they go a step further and institute a retrospective review of all order type rule filings, and ask the SROs to produce data on how the order types are being used, whether they are being used at all, and where opportunities exist to reduce the number of order types and the resulting complexity. If the SROs have already done this internally, then it should be simple for them to produce the data and convince the SEC as to the utility of the order type.

Establish strong, clear market technology standards

It is clear that this recommendation, along with those made during my subsequent participation on the Technology Roundtable in October 2012, has been acted upon by way of Regulation SCI. I support many of the ideas in Regulation SCI, although, once again, it is an unfortunate example of top-down rather than bottom-up regulation. I look forward to the final rule proposal.

Conclusion

I would like to thank the Committee for inviting me to testify and considering my suggestions. These questions of market complexity, market disruptions and of how best to learn from past events are indeed complicated. I do not believe the answer lies in root-cause analysis of technology failures or in attempting to address the reliability and resiliency problems that are thereby identified. We will be far better off as an industry if regulators can start to re-orient themselves towards regulating with a complex systems mentality. We can't possibly account for every failure scenario and every edge case. As Dr. Nancy Leveson discussed on the SEC Technology Roundtable in October 2012[33]:

> *"The third and final practice I want to talk about is the application of systems thinking and system engineering. These industries realize the problem is not just a*

[33] http://www.sec.gov/news/otherwebcasts/2012/ttr100212-transcript.pdf

technology problem; that they need to design the larger system so that software errors don't cause mayhem because they know that the software errors are going to occur despite what they do."

"The financial industry needs to learn, too, that computers aren't magic; that our engineering techniques for creating software aren't perfect; and that failsafe and fault tolerant designs, whether these features are automated or they use humans in a monitoring function, are a goal but not yet a reality."

This same thinking is echoed by Sidney Dekker in his book Drift Into Failiure:

"System thinking is about relationships, not parts. System thinking is about the complexity of the whole, not the simplicity of carved-out bits. Systems thinking is about non-linearity and dynamics, not about linear cause-effect-cause sequences. Systems thinking is about accidents that are more than the sum of the broken parts. It is about understanding how accidents can happen when no parts are broken, or no parts are seen as broken."

If we are to follow their lead, we must examine the environment and interconnectedness of systems, we must embrace technological failure and design around it. Most importantly, we must identify conflicts-of-interest and skewed incentives and address or mitigate them at every opportunity. Where they cannot be mitigated, we must have disclosure and transparency to ensure that there is sufficient visibility and an understanding of risk.

The answer to market integrity is not to upgrade technology or build a more resilient backup system (though these are obviously important!). The answer is to embrace complexity and equip our regulatory framework to evolve as the industry advances. I applaud the SEC for initiating a comprehensive review of market structure and for the scope and ambition of Chair White's speeches in June 2014. I urge regulators to undertake a review that addresses not just the rules that govern trading, but also the staffing requirements and mindset necessary to do so properly, and I urge Congress to fund regulators appropriately to ensure they can succeed.

Attachment 1: CFTC Technology Advisory Committee Testimony

Dave Lauer

Written Statement: Market Surveillance in the 21st Century

CFTC Technology Advisory Committee, June 2, 2014

"Regulators that are serious about improving compliance and protecting investors must embrace technology and adapt their organizations to the realities of 21st century trading. This will require courageous leadership, a tectonic shift in thinking, and a radical reallocation of budget and staff resources. "

Director, Market Surveillance Technology for an international regulator

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Introduction

The technology revolution that has swept Wall Street and the Financial Services industry has missed one critical segment – market surveillance. Regulators continue to play catch-up to an industry that is moving forward at light-speed, literally. Are regulators doomed to forever remain behind the industry as they attempt to make sense of mountains of data? Must they resign themselves to a flawed approach under the reasoning that only industry practitioners are capable of making sense in a timely manner of terabytes and petabytes of market data?

Or is there a way for regulators to leapfrog the industry, and institute a technology-centric approach that will ensure they remain ahead of the most sophisticated firms in the industry regardless of how quickly technology evolves? It may sound absurd but it is possible. It may not be politically feasible, but with fundamental shifts in their approach to, and treatment of data, regulators can ensure that they remain at the forefront of data analytics and forensics.

As the SEC touts MIDAS as a revolutionary breakthrough in market analysis, many in the industry are shocked at the pride of just reaching the point that most firms were at in the late 90's and early 2000's. To say that they are 10 years behind would be generous.

As FINRA attempts to use OATS to enforce rules and detect malfeasance, those in the industry who want to see proper surveillance are left speechless at the timestamp resolution and age of the systems and technology storing and analyzing this data.

As so many electronic trading firms operate across asset classes, they do so knowing that there is not a single cross-asset electronic analysis being performed on their order flow. Most of them still operate within the law and rules, but as in anything there are inevitably bad actors.

Regulators face several challenges as they attempt to police today's high-speed, electronic markets:

6. Lack of sophisticated technology skills to collect, normalize, process and analyze huge amounts of data.
   "Big Data Is the Commission's Biggest Problem." – Commissioner O'Malia
7. Cultural challenge of re-orienting perspective to foundational integration of technology rather than simply as a tool or supplement to operations.
8. Political frictions that ensure silos remain within and across agencies.
9. Bureaucratic mindset that focuses on job security and individual "fiefdoms" to the detriment of open, transparent analysis and data sharing.
10. Conflicted, for-profit SRO structure that leads to questionable incentives for policing and surveillance.

The first challenge is the easiest to solve. As for the rest, I will make several proposals in this testimony for what regulators should be trying to accomplish, and the roadmap for achieving these goals. Politics is not my forte (as should be obvious from the blunt language so far), and I have little insight to offer on how to navigate jurisdictional issues and bureaucratic "fiefdoms".

My experience in designing low-latency trading systems and then in high-frequency trading was informative in one very important way. Since 2005 I have witnessed an incredible technology revolution on Wall Street from the inside, and have had a very small role in it.

I worked in a world in which data is data – and asset classes are secondary. Each market center has a set of rules, some instruments have different rules, fees or margins than others. In this new trading world, there is no reason not to bring in as much data as you can to make the best, most profitable, most effective trading decisions. The firms I spent time with or worked at were almost without fail all looking at futures, equities and options data to get the best valuation on an instrument that they could, to find the most edge and therefore to trade in any asset class, at any time. That's not to say there aren't challenges with this approach – options market data alone represents an order-of-magnitude difficulty above equities, which is an order-of-magnitude difficulty above futures. This isn't meant to characterize all firms – most have individual desks devoted to each asset class and some just focus on a single asset class. But while market centers focus on a sliver of data and regulators focus on a piece of the pie, these firms are able to see the entire picture and profit from that information.

If I were to adopt the perspective of a market manipulator looking for weaknesses in the current system, the lack of cross asset-class surveillance would be a big flashing neon sign welcoming me. I would also have a clear understanding of the inadequacy of current systems, notably the SEC MIDAS and FINRA OATS platforms.

Surveillance is important for detecting nefarious behavior and market manipulation. It is far more important when it acts as a deterrent, ensuring that behavior doesn't happen at all. In order to do that, it must be effective, advanced and intimidating. It must also be visible, frequent, regular and transparent.

"To catch a geek, you have to be a geek. To deter a geek, you have to demonstrate that your technological proficiency matches theirs."
Director, Market Surveillance Technology for an international regulator

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Technology-Centric Regulation

In the quotes above, an international regulator who asked not to be named spoke about a "radical reallocation of budget and resources" in order to reach a "technological proficiency that matches" the industry. This is a point that cannot be overstated. In his seminal book Drift Into Failure, Sidney Dekker stresses that regulators cannot keep pace with practitioners in a complex industry without becoming co-/counter-evolvers. This means building a nimble, dynamic organization – a concept anathema to traditional regulatory agencies. Many will question whether that is even possible. Unfortunately, I would contend that without it, we simply shouldn't bother wasting resources, and should cut regulatory budgets dramatically.

Never has the need for expertise been greater, or the resource gap wider.

Regulatory organizations are predominantly staffed by attorneys, yet they wonder why they have trouble keeping pace with private companies staffed by experts in every domain – traders, programmers, quantitative modelers and operational / back-office engineers. **The markets have changed.** Can this be stated more strongly? The markets look **nothing** like they did 100 years ago, or 50 years ago, or even 15 years ago. Yet regulators continue with nearly the same type of staffing, similar allocations of resources and similar approaches to surveillance.

Technology-centric organizations are flat meritocracies that embrace failure and experimentation. They thrive on expertise at every level. They are younger and handsomely reward initiative and competence with both money and career advancement. To these firms, the word “bureaucracy” is a kiss worse than death. They are able to sprint while regulators are struggling to crawl.

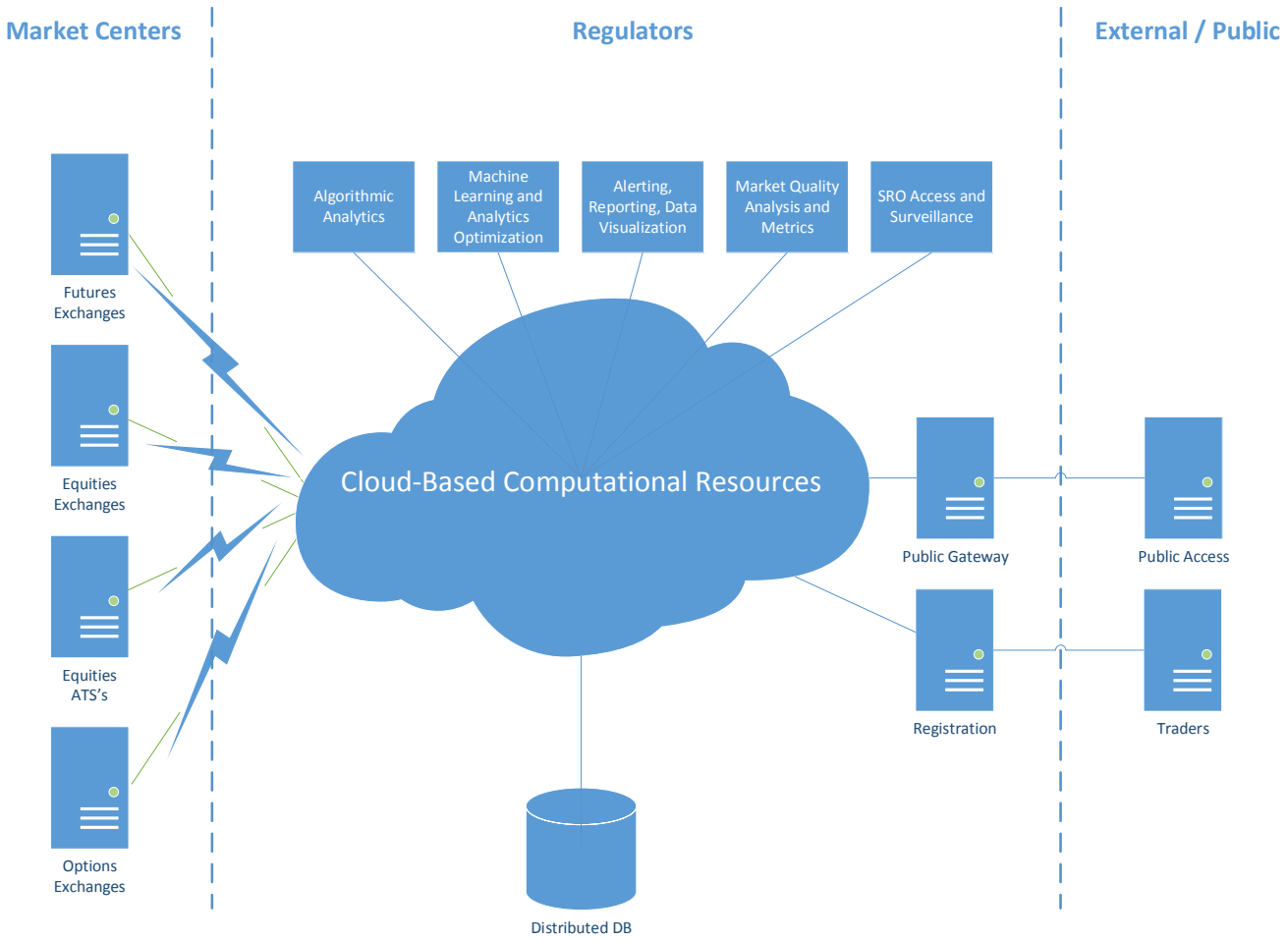
This is not to denigrate the adoption of technology that has happened at government agencies, but it is to point out that regulators see technology as another tool to be wielded within the same infrastructure as the past. Private firms who operate like that have long ago fallen to the wayside, as smaller, nimbler, technology-centric firms have destroyed them in the markets and run away with all of the edge.

Technology-centric organizations do not see technology as a tool built by an IT group in the basement or windowless offices. Instead it permeates nearly every activity, operation and function of the organization. Technology should not only be used to make existing processes faster or more efficient – it should transform those processes and enable new ones that were never thought possible. If regulators truly want to catch up, or even leapfrog the industry, this is the re-orientation that must take place.

Vision

I’d like to present my vision for the ultimate market surveillance system which is presented without regard to current systems, political feasibility or other considerations. It is simply a technologist’s and practitioner’s view of how markets should be watched by regulators in the modern electronic trading era. It is also not an attempt to reinvent the Consolidated Audit Trail (CAT); CAT will serve certain purposes once it is built but it is years away. The system depicted here can be built quickly with the proper resourcing and priorities. If this plan were proposed to a private firm that started work right away, it could be operational by the end of 2014.

This is a very high-level architecture, and will require a drill-down into every component.



"Our markets are fragmented. Our surveillance is not."

VP Surveillance for an international regulator

Market Centers

In this diagram, the market centers are all on the left and are included regardless of asset class. While this testimony is being prepared for the CFTC, there is no reasonable way to guard against malfeasance then to do so across asset classes. While market manipulation is a concern, cross asset-class front-running should also be front-and-center.

The first step to build this cross asset-class marketwide surveillance system is to develop a FIX specification for all market centers to generate a privileged regulatory feed. In conversations with a

regulator who did just this; they believe this is a 2-3 month development task after the specification is published.

Equally important is for all market centers to start using high-resolution, synchronized clocks for time-stamping messages. The CFTC TAC HFT Subcommittee in its October 2012 report made this same point, calling it "critical to reconstructing and sequencing market events,"[34] but lamented that then-current methods of clock synchronization were insufficient for these purposes. Without attempting to argue whether or not that was true at the time, it is certainly no longer the case. Technology is readily accessible for synchronizing to the microsecond, and there is no excuse for not having this in place today. Without it, this surveillance system will suffer the same shortcomings as current systems such as OATS, where aggregation and sequencing is rendered impossible by timestamp resolution and the lack of any clock synchronization. A simple call to a firm such as FSM Labs will quickly and cost effectively solve this issue.

While market centers would be able to continue to operate their surveillance groups in the same manner as they presently do, part of the appeal of this marketwide surveillance system would be that they could leverage centralized resources instead to reduce or eliminate duplication of effort. Market centers will still remain on the front lines for policing their markets and ensuring their rules are followed. They will simply have the option of leveraging a centralized infrastructure, and the possibility of looking at activity on other markets in the context of what's happening on their own. This represents potentially substantial cost savings for the SRO's and could be used to help finance system development.

Regulators

Certainly the most critical departure / disruption in this new surveillance system is the regulator. There are many components pictured here, and it is critical to understand how they all operate.

Cloud-Based Computational Resources

This is the heart of the entire system. High-speed networks and server resources keep data flowing in real-time, leveraging a cloud architecture to dynamically scale up and down as computational demands increase or decrease. While the "Distributed DB" is pictured separately in the architecture above, that is simply to call out the importance of this data store. In actuality, the database is another cloud component, able to scale up as data storage needs increase. As regulators determine the timeframes

[34] CFTC TAC Subcommittee on Automated and High Frequency Trading Working Group #2, "Quality Measures and Gap Analysis" http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/tac103012_wg2.pdf

over which data needs to be readily and speedily accessible, lower-cost data warehouse storage solutions can be used for long-term data storage.

The cloud-based computing resources are split between a virtual private cloud and public cloud. The virtual private cloud is a secure, isolated set of resources that are performing confidential regulatory tasks. The virtual public cloud provides web resources for the public and executes tasks from academics and the public on obfuscated data, as will be described later.

- Private cloud services
    - Data receipt and processing from market centers
    - Module execution (to be expanded upon below)
    - Storage and warehousing of order and trade data
- Public cloud services
    - Web-based systems for viewing derived data and reports
    - Web-based registration system for traders
    - Computational services for the public and academics for market data studies and algorithmic development contests

Surveillance Modules

Along the top of the surveillance architecture are a set of modules. This is a logical illustration of the categories of various surveillance and analytical tasks that can be run within this system. It is not meant to represent an exhaustive list, merely an illustration at a high-level of what can be done with a high-performance computing system dedicated to cross asset-class marketwide surveillance.

Algorithmic Analytics / Pattern Matching

If the cloud computing system is the heart, this module is the brains. The critical consideration with analytics and pattern matching is that it must be built with a "pluggable" pattern in which it is a simple and easy exercise to program and deploy new analytics and pattern recognition algorithms. This will allow for maximum flexibility as the system matures and is developed over time.

This module will initially look very familiar to those currently working on surveillance systems. It will have a familiar set of patterns – layering, spoofing, manipulation of opening/closing, quote stuffing, front-running, etc.

Sourcing these modules will be a difficult task for a regulator without the requisite resources and knowledge. Building this in a "pluggable" pattern ensures that regulators can leverage existing surveillance technology at SRO's, or third-party vendor offerings such as SMARTS, Surveyor or Delta Surveillance. Regulators can push these vendors to make their platforms and analytics more modular, and could use that architecture to plug in the most effective parts of each.

The pluggable architecture will also allow for more innovative, generic heuristics. Trending of activity, normality modeling, anomaly detection, clustering and dimensionality reduction could all have a role to play in this area. This module goes hand-in-hand with the next one – Analytics Optimization

Machine Learning and Analytics Optimization

While the human brain is smart, it is its neural plasticity that allows us to constantly reshape our thoughts to adapt to new knowledge and skills. While sufficiently sophisticated analytics and patterns are the core of a good surveillance system, a concept well understood by the current set of surveillance vendor offerings, an oft-overlooked technique is the use of machine learning to continually optimize analytics parameters. For example, generally at some point there will need to be manual review of an alert or exception to determine if it is worthy of enforcement. Over time, this creates a "labeled dataset," which is perfect for supervised machine learning. Machine learning techniques are excellent in discovering the optimal parameters for the analytics and patterns that are searching for manipulation and crimes. This is an example where regulators don't need **more** technology, just **smarter** technology. There is in fact a high likelihood that this could be done today, with the data that SRO's and regulators are currently in possession of.

Optimization serves two critical purposes:

- Better parameters provide more true positives, missing fewer items; and
- They also provide fewer false positives, reducing "operator fatigue."

Optimizing detection algorithms could have a substantial impact on the efficacy of surveillance algorithms. For example, one examination of closing price manipulation estimates that "only about 0.4% of all manipulation is prosecuted. For every prosecuted closing price manipulation approximately 308 to 326 manipulations remain either undetected or not prosecuted."[35]

One of the commonly cited reasons to **not** use technology in a more central and automated fashion in surveillance is the high incidence of false positives. Leveraging basic machine learning techniques can help regulators avoid these pitfalls, and advance to the point where systems become more streamlined, accurate and automated.

[35] Comerton-Forde, Carole and Putniņš, Tālis J., Stock Price Manipulation: Prevalence and Determinants (October 4, 2012). Review of Finance. http://ssrn.com/abstract=1243042 or http://dx.doi.org/10.2139/ssrn.1243042

Alerting, Reporting and Data Visualization

While detection is a critical function for any surveillance system, it must be followed by an alert that allows analysts to examine what the system has found. Even this alerting data should be trended and analyzed, and reporting done on these alerts to ensure that analytics and pattern matching is efficient and effective. In addition, there have been incredible advances in data visualization over the past few years, yet few of these advances have been taken advantage of by US regulators. Taken to its extreme, regulators would be well served to work with a top-tier design agency, and start to "re-design" surveillance for the 21st century. This means taking current systems, workflows and interfaces and asking how appropriate or effective they are in a more technology-centric world.

Market Quality Analysis and Metrics

The dataset collected by the cross asset-class marketwide surveillance system is perfect for running studies and analysis to determine market health, how that is changing over time, and how it is changing in response to new rules or pilot programs. There is no definitive source for market quality metrics, nothing like Professor Michael Aitken demonstrated in his analysis of the price improvement rule on Australian markets[36]. US regulators should strive to have a similar system, which is publicly accessible, to act as the definitive source for market quality information. Even the SEC in its most recent research analysis on HFT admits that it must rely on academic studies for market quality information, the results of which are often contradictory[37]. With an agreed-upon set of metrics and a high-quality, objective source of data, many of these outstanding questions about market quality would disappear.

SRO Access and Surveillance

The final component is SRO access to the same resources. This is simply an idea that SRO's should be able to use the same tools as regulators and the same resources to avoid duplication and wasted time / money. While some SRO's may decide that they would prefer to keep their surveillance systems in-house, the industry could realize significant cost savings and greater knowledge sharing / expertise transfer if these tasks are centralized. As previously stated, this cost savings should allow for partial funding of the effort by the SRO's and a much more efficient system overall.

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[36] "Review of recent rule changes affecting dark liquidity", May 2014, Australian Securities and Investment Commission, http://www.asic.gov.au/asic/pdflib.nsf/LookupByFileName/rep394-published-19-May-2014.pdf/$file/rep394-published-19-May-2014.pdf

[37] "Equity Market Structure Literature Review", March 18, 2014, Division of Trading and Markets, SEC, http://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf

External / Public

There are two main components to the externally-facing interface to the cross asset-class marketwide surveillance system. The first is the Registration System. The second, and perhaps one of the more innovative aspects of this proposal is the idea that this system can be used as a point of engagement with the public and academic community.

Strategy Registration System

As I proposed in my October 2012 Written Comment for the SEC's Technology Roundtable, the first step in building out a proper surveillance system is to have appropriate identifiers associated with orders. As the CFTC also considers whether to have high-speed trading firms register, the potential exists to address both issues at once.

This can be accomplished via a Strategy Registration System. While some will argue that monitoring individual strategies is unnecessary, and this system would work sufficiently well at the trader, rather than strategy level, I am going to continue to push for this level of granularity. Strategy-level surveillance will certainly make for more efficient and effective detection of market manipulation.

It will also enable a new breed of kill switch that is able to dynamically adapt to changing market and trading conditions, and monitor individual algorithms in an automated fashion. The kill switch discussion is out-of-context in this testimony, so I have separated the registration system into two phases – what's necessary for surveillance and what's necessary for the kill switch. The kill switch discussion is for another time, and its own paper entirely.

All of that being said, identifiers at the trader level are sufficient, and should be the minimum level of granularity that regulators are willing to accept. Firms should have to first register as automated trading firms, and upon approval they can then register their trading strategies or traders. The Strategy (or Trader) Registration System is a relatively simple web application that would allow firms to register any trading that will be done electronically. This application would treat sell-side algorithm registration differently from market making / proprietary trading algorithms, which will be its primary focus. For market making / proprietary trading firms, algorithms would need to be registered with the following information, separated into two distinct phases:

- Phase 1 registration - Surveillance
    - Strategy name
    - Supervisory individual responsible for strategy's actions
    - Contact information for supervisory individual and emergency contacts

    - Asset classes being traded
    - Market centers
- Phase 2 registration – Kill Switch
    - Strategy Profile
        - Average/Min/Max cancellation rate
        - Average/Min/Max orders per second
        - Will strategy send ISO orders?
        - Etc.
    - Group sign-off
        - Strategy developer
        - Strategy trader
        - Trading desk manager
        - Operations group manager
        - Head of trading or other executive at the firm

Sell-side execution algorithms will also require this type of registration, although the expectation would be that some of their activity characteristics are not as straightforward to backtest / measure, and minor updates to those algorithms would not require updated registration.

This should be a modern web app, with the ability to save and edit these forms, and use a distributed system for sharing the forms in order to review or sign-off. The form will assign a globally unique ID to the strategy/trader. Exchanges will have to extend their FIX and proprietary electronic order entry protocols to support the receipt of this ID, and participants will have to attach the ID to every quote they submit. Most importantly, the values in the extended Strategy Profile must be empirically measured – not estimated. This will require a minimum level of quality assurance and backtesting so the firm can be assured that these values are reasonable and realistic.

The ability of academics to use publicly available trade and quote data to inform current market structure policy debates is limited at best. To better inform policy, the relevant bodies should periodically make well-documented, market-wide data sets available to the public for analysis.

Prof. Robert Battalio, Professor of Finance at the University of Notre Dame

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Public Access

As previously stated, one of the more innovative and disruptive proposals in this testimony is the various ways to give the public access to market data that is being collected. There are two primary reasons that this is a critical function for this system:

1. Research on US markets has reached a crisis point – proper data simply cannot be obtained by academics. Even the SEC acknowledges the "formidable data challenges facing researchers"[38] in their March 2014 HFT literature review. The CFTC's TAC ATS/HFT Working Group 4 realized the same issue in their report, stating "[a]cademic analysis is difficult because … data remains confidential."[39] The data that is available to researchers either comes from conflicted sponsors (firms in the industry) or exchanges with older or limited datasets. When academics produce research that contradicts their sponsors' goals, their access to data is cut off. **This is no way to study the engine of the US economy.** Regulators must step in and correct this problem by providing the definitive dataset for academic research. A secondary goal would also be to allow academics to run their studies using resources sponsored by, or at least maintained by regulators. Data access is one part of the problem – the computational resources to properly process that data is another. Regulators can solve both.
2. Regulators are limited. They are limited in their resources, experience in markets and depth of knowledge of manipulation tactics. These limitations are inevitable – they are the nature of being a regulator. The public is limited in other ways. However, there is a vigorous community that has developed around analyzing markets and market structure. Financial services regulators have not yet tapped the potential of this community. Websites such as kaggle.com and other prize-based incentives have demonstrated the incredible scientific brain power that is out there, hungry to apply advanced modeling and machine learning techniques to a new industry or problem. Another approach would be to model this after a whistleblower program and award people a percentage of the fines collected as a result of their algorithms. This would of course present problems of algorithmic overlap (multiple algorithms detecting the same behavior), so other success factors may need to be accounted for: computational efficiency, accuracy / false positives, and heuristic flexibility. It could also open the floodgates for detecting much more complex types of market and price manipulation than previously thought possible. For example, it may be possible for a trader to manipulate the US Treasury yield curve with a more creative and mathematically-based mechanism than just layering or spoofing a single futures contract, but it's hard to imagine regulators having the capability to detect such activity without help from practitioners.

There is no doubt that there are many valid concerns over providing access to data in this way. Most of those concerns focus on data confidentiality and whether trading strategies can be reverse-engineered. Some others are around data security. These are critically important issues that must be addressed before anything can be opened up in such a revolutionary way. There are answers to these questions though, and some initial ideas to address them include:

- Data security: all data possessed by financial services regulators is critically important to keep safe and confidential. This data would be no different. Modern security practices should be

[38] "Equity Market Structure Literature Review", March 18, 2014, Division of Trading and Markets, SEC, http://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf

[39] CFTC TAC Subcommittee on Automated and High Frequency Trading Working Group #4, "Risk Management and Market Structure" http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/tac103012_wg4.pdf

adopted, as the SEC has recognized in convening a panel on Cybersecurity. This is no matter to be taken lightly, nor is it a problem that cannot be solved.

- Data confidentiality: all identifying information must be obfuscated when the public interfaces with that information in any way, even if they don't have direct access to that data. This includes strategy, trader, firm, broker and order ID's. In addition, all data could be delayed by one or two quarters. There is no hard requirement for immediate academic and public access.
- Reverse engineering: this is perhaps the most important and difficult concern. That is why this proposal does not give the public direct access to market data, but rather to an API (Application Programming Interface) through which they can interact with the data. They can have access to derived data, but not to the raw market data. This can be enforced with stiff fines and policed in a simple way. The amount of data received and frequency with which someone runs studies on the data will quickly betray someone who is trying to access raw data. Those issues can be alerted to an analyst who can examine the program being run, the data being returned, and quickly make a determination as to whether it follows the rules or not.

The benefits to regulators in adopting an open approach such as this would be incredible. The expansion of their resources beyond regulatory staff and the insight of resources from outside the regulatory world would make a tremendous and material difference to the analysis and policing of markets. I don't believe that the benefits of this idea can be overstated – indeed it helps address many of the problems commonly associated with regulation: lack of technological nimbleness, lack of practical experience and insight, and limited resources. Implementing this platform within a newly technology-centric organization could catapult regulators ahead of the industry and ensure that they will remain so, even as technology advances at a furious pace.

Roadmap

The Vision laid out above is what I believe to be the most practical, achievable surveillance system in a reasonable timeframe. It is not meant to be the Consolidated Audit Trail, **it is meant to take readily available technology and leverage it in creative ways to facilitate the maximal amount of functionality in an environment of constrained resources**. Building this system will be challenging for the reasons listed on Page 1. While the technology challenge is formidable, it's also been done by many firms in the industry. This is not a multi-billion dollar project, it's a low single-digit million dollar project. If this was a private firm who kicked off the development effort now, they could have it operational by the end of 2014.

There are several tasks that can begin and run in parallel:

- Foundational tasks / research
    - Write FIX spec

    - Deploy clock synchronization technology across all market centers
    - Evaluate vendor surveillance products
    - Evaluate cloud computing solutions
    - Security plan written, integrated into every aspect of development / deployment
    - Policies and procedures developed for academic and public access to data
- Development
    - Exchanges build FIX feeds
    - FIX engine deployed to cloud to receive and process feeds
    - Web registration system built for strategy or trader ID's
    - Module development starts in parallel
    - Proper DevOps approach to infrastructure to make cloud computing and storage supportable and scalable
    - API development and workflow creation for academic and public access to data
- Testing
    - Once platform and modules pass unit tests, integration testing begins
    - Data starts flowing through the system, modules get tested
    - Load and volume testing for high-volume situations

"If a regulator cannot regulate a complex system, then what can it do? Will a regulator always be caught behind the curves of self-organization and emergence, holding a bag of obsolete rules that came from less evolved systems? … Rather than a regulator, complex systems should have a co-evolver/counter-evolver. This must be an organization that has the requisite variety not only to have an idea of the complexity of the operational organization (and thus has to co-evolve with how that organization evolves). It should also have requisite variety to counter-evolve."

Sidney Dekker, Drift Into Failure

Today

While the vision and roadmap outline one possible destination that market surveillance can reach, it is by no means the only thing that can be done. Regulators can kick off parallel efforts to more effectively monitor markets today.

Regulators can work with existing surveillance groups to understand the data that they have access to today and start to make use of that. Hopefully this Technology Advisory Committee meeting helps that process along. This exercise could reveal a substantial amount of untapped potential in the current set

of data that is available. It would also make an excellent test case for evaluating vendor surveillance products and developing a new set of analytics, as well as leveraging machine learning for optimization of current approaches and algorithms.

Regulators can also get participants to give them the full set of ID's that they are trading under in every market, and use those ID's to connect activity across asset classes. While timestamps will prove a problem for high-frequency trading, lower frequency behavior may be found through simple analysis of existing data.

For any of this to work, **the SEC and CFTC will have to start working together**. Surveillance is the perfect example where all regulatory entities (agencies and SRO's) should be working very closely. In addition, one of the principles of the vision laid out above is a renewed engagement of industry practitioners. This is an example of how regulators can "co-evolve" with a complex industry. They must find creative ways to engage and incentivize traders and practitioners – firms and people who live and breathe markets everyday – if they want to have any hope of understanding and detecting manipulation. While offering prize-based or percentage-of-fines incentives and the technology resources to develop and test detection algorithms should be the ultimate goal, regulators can begin with something simpler:

- Immediate formation of a new committee composed of surveillance personnel and experienced traders to dive deeply into the problems in the current market.
- Development and release of a new dataset for academics to use containing data from futures, equities and options, similar to Nasdaq's HFT dataset.

Attachment 2: Healthy Markets Initiative Platform

The Market Structure debate is a contentious one that has enthralled the entire Financial Services industry. This debate rages from Twitter to the Wall St Journal. Everyone in the industry has a strong opinion on the state of the market and how to reform it. KOR Group LLC principals, Chris Nagy and Dave Lauer, have been at the center of this debate for years and have recognized that, despite many differences of opinion, a broad cross-section of industry professionals can agree on some fundamental reforms for increasing transparency and reducing conflicts-of-interest. While these views are not universally shared, KOR believes that enough key firms can agree on a core set of reforms and principles to effectively lobby for these changes. KOR further believes that these changes would have an enormously beneficial impact on US equity markets.

On the other side of this debate are powerful, entrenched interests with effective lobbying operations and a strong presence in DC. KOR's intention is to build a coalition of like-minded firms that can agree both on general guiding principles and specific remedies. It is only by assembling an equally powerful coalition that the entrenched interests can be challenged.

It is also critical to understand that change is coming. The SEC will be actively examining market structure issues in 2014 and running pilot projects to evaluate significant changes. It is critical that subject-matter experts who are independent of any particular firm or segment of the industry are at the forefront of guiding the SEC to make effective changes. These independent experts would also be critical in preventing the SEC from overreaching its authority or overreacting based on the issue du jour in the media.

HEALTHY MARKETS's principles are simple:

- **Transparency**: "Sunlight is … the best of disinfectants." – Supreme Court Justice Louis Brandeis
- **Metrics:** In order to evaluate any changes, a new set of metrics must be agreed upon and developed.
- **Data Freedom:** All recommendations and rulemaking must be data-driven; In addition to the Division of Economic & Risk Analysis "DERA", data should be in the provided to academics, researchers and the public.
- **Displayed Liquidity:** Displayed price discovery is one of the critical functions of the market and must be encouraged.
- **Competition** for order flow is healthy for markets.

The HEALTHY MARKETS Group platform naturally follows from these principles:

- Modernization of Rules 605 (Market Quality Metrics) and 606 (Broker Routing Metrics);

- Passing of a trade-at rule for US equities, starting with including trade-at in the tick size pilot;
- Pilot to eliminate rebates, which includes a trade-at provision;
- More active SEC & FINRA monitoring and guidance on best execution rules;
- Full disclosure of all market center and Alternative Trading System filings;
- Mandating that ATS's use direct feeds instead of SIP to calculate NBBO and provide latency reports demonstrating that their ATS receives data before, or at the same time as, any other group in the company.
- A push for the SEC to provide open access to MIDAS and any other market data research tools for general study by academics and the public.
- Data feed reform to ensure that consolidated data is always **received** before any proprietary feed data. This includes proper incentives to maintain the consolidated feed and timestamp synchronization across all markets.

Investors Deserve to know how well their orders are being executed and where they go

On July 28, 2000, the SEC proposed SEC 11Ac 1-5, order execution statistics & SEC 11Ac1-6[40], routing and material relationship aspects disclosures. The rules, now known as SEC Rules 605 and 606 were adopted in response to increasing competition and resulting fragmentation in the market. The SEC sought to assure investors that the U.S. National Market System continues to meet their needs by ensuring the practicability of Best Execution of all investor orders, including limit orders, no matter where they originate. The Commission noted that fragmented markets may isolate customer orders from full interaction with other buying and selling interests. The Commission also noted that Internalization and payment for order-flow practices contribute to an environment in which vigorous quote competition is not always rewarded.

Brokers have a duty of Best Execution in accepting orders and routing them to a market center for execution. Brokers generally act as agents for their customers and, although not specifically defined, owe them a duty of Best Execution, which is derived from common law agency principals and fiduciary obligations[41]. It is incorporated both in self-regulatory organization rules and through judicial and Commission decisions in the antifraud provisions of the federal securities laws. The duty of Best Execution requires a broker to seek the most favorable terms "reasonably available under the circumstances" for a customer order[42].

[40]See: http://www.sec.gov/rules/final/34-43590.htm#secv
[41] See: https://www.finra.org/web/groups/industry/@ip/@reg/@notice/documents/notices/p003889.pdf
[42] SEC Order Handling Release at 48323, *NASD Notice to Members 96-65* at 541

The SEC moved with decisive action, taking just five months to adopt a comprehensive framework of rules 605 & 606 and expediting the phase-in process by May of 2001 for both rules. For a period of time, the rules functioned as intended. Brokers increasingly sought Best Execution and regularly published various statistics regarding execution quality. Over time and in particular with the adoption of Regulation NMS, the rules became increasingly outdated and their usefulness, while still relevant, has diminished. In part, the rules have eroded due to the increasing complexity of order-types as well as speed and routing practices in today's marketplace. Rules 605 and 606 have not kept pace with these changes. The SEC even went so far as to say "improved visibility could shift order-flow to those market centers that consistently generate the better prices for investors and the Commission will assess the impact of the rules to determine whether additional action is necessary to further the Exchange Act's objectives for a National Markets System."

Fourteen years later, modernization of Rules 605 and 606 has not happened. As such, broker evaluation is a difficult and subjective process. Further, there is no clear, independent measure of market quality by which the SEC can judge the efficacy of the rules that have been passed, most notably Regulation NMS. The US equity markets changed dramatically with the adoption of NMS in 2007, but there is no clear, definitive proof that market quality has improved since then.

Recently Congress held a hearing about Regulation NMS[43] and it was no surprise that Best Execution and conflicts were at the center of the debate, but there was no mention of either rule. Transparency can play a major role in creating efficient markets and provides SEC staff with the necessary tools to ensure brokers comply with their duty to benefit investors. In fact, many brokers regularly route their limit orders to different destinations than their market orders. This is done in spite of the fact that, in some instances, those limit orders could be afforded an offsetting execution to the market order or receive faster execution thorough Rule 5320[44] (Manning). While this is technically legal, it is unethical. Should Best Execution principles be revisited (as we are urging), a reexamination of this practice must be part of that process. Further, the lack of qualitative measurements in the Options markets has led to increased conflicts associated with agency order-flow inducements[45].

[43] February 28, 2014 House Financial Services Committee hearing entitled "Equity Market Structure: A Review of Regulation NMS"
[44] See FINRA NTM 11-24
[45] See To Pay or Be Paid: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1954119

Now is the time to modernize Rules 605 and 606 before any other rules and changes are placed into the market. In modernizing the Rules, the following should be considered:

Modernize Rule 605/606 Execution Benchmarks, Measurements and Best Execution policy

Rule 605:

- Amend Rule 605 to capture the full range of order execution.
- Include dark and reserve orders as new order types.
- Require all ATS and Dark Pools to report under Rule 605.
- Shorten the reporting time-frame and require the reports be made available monthly 15 calendar days following the end of the preceding month. Require all historical reports remain freely and easily accessible.
- Require all quote and trade data to be carried out to the millisecond using proprietary feeds over the current SIP requirement.
- Require millisecond-level clock synchronization at every Exchange, ECN and ATS.
- Amend Rule 605 based on the time the broker's router receives the order.
- Replace execution time categories as follows:
    - Less than 500 microseconds
    - 500 microseconds – 1 millisecond
    - 1-10 milliseconds
    - 10-100 milliseconds
    - 100 milliseconds to one second
    - Current time categories
- Expand coverage to Odd-Lot orders especially since they are now tape reportable.
- Expand order buckets size categories:
    - 1-99 shares
    - 100 share increments to 9,999 shares
    - 10,000 – 24,999
    - Greater than 25,000
- Add Covered Trades.
- Expand Realized Spread into separate buckets (e.g. 50ms, 100ms…3minutes) to better identify adverse selection.
- Require "Immediate or Cancel", "Peg", "Flash" order types to be reported separate from Market Orders.
- Include Market Opening/Closing orders.
- Add "Realized Liquidity" by taking the displayed BBO size in relation to the size of the order.
- Include broker-dealer order receipt time as a measurement in addition to market center receipt time.
- Add Quoted Spread.
- Add Spread Leeway (Quoted spread divided by the Minimum Price Variation).

- Require all non-marketable limit orders to be set on a timer so that once they are displayed at the BBO, average time to execution is displayed.
- Require that execution data contains header information.
- Require Broker-Dealers who route orders to execution venues to make 605 data about those orders available.
- Statistics should be calculated for:
    - Orders that execute on the receiving platform
    - Orders routed out
    - Routed and not routed orders
- Expand Rule 605 to Exchange traded option securities.

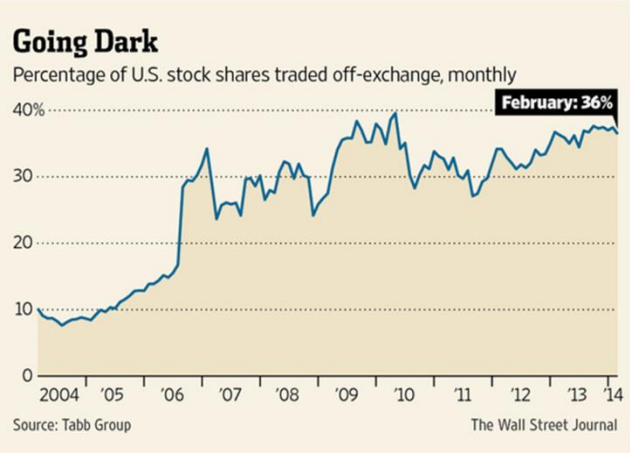
Modernize Rule 605/606 Execution Benchmarks, Measurements and Enforcement

Rule 606

- Remove AMEX, NYSE and Nasdaq and replace with "NMS Securities."
- Add OTC Bulletin Board/OTC Market securities.
- Include category "Odd Lot Orders."
- Include category "Marketable Limit Orders."
- Include information on the percentage of shares executed versus sent.
- Include block transactions.
- Require Rule 606 cover 100% of order flow received.
- Require Directed Orders to be reported as a separate category from Non-Directed Orders, removing the current exemption.
- For executing venues: Require total payments or charges are reported by Broker-Dealer.
- For Broker-Dealers: Require total payments or charges received be reported under information concerning significant venues.
- For Brokers that send orders to internalized executing center, require payments or charges on the aggregate order-flow to be reported.
- Require the execution venue to be reported. In the case of options, report on exchange where the order executed rather than the intermediary.
- Require the reports be made available monthly 15 calendar days following the end of the preceding month.
- Require that all current and historic reports be freely and easily accessible and downloadable in a pipe delimited format.
- Require field of average payments received be reported out to the hundredths of a cent, rather than maximum's (e.g. less than $0.01).
- Require Broker-Dealers to post explicit details regarding payments, costs and execution metrics agreed to by the executing firm.
- Require greater transparency around broker-dealer internal order routing practices and decisions.

Transparent reporting is a necessary first step prior to rolling out the broader structural changes under consideration. Qualitative reporting and disclosure of routing practices allows for analysis of the effects of order routing practices, competition, pricing and other metrics, which in turn allows for better outcomes and fewer unintended consequences of broader change.

Adopt a Trade-at regime for NMS securities.



Broker-Dealer internalization and dark pool trading have grown dramatically since the adoption of Regulation NMS in US equity markets. As of February 2014, 36% of US stock trading volume is transacted off-exchange. In 2010, in response to growing dark volume, the SEC issued a concept release seeking comments on all aspects of a trade-at rule[46]. Trade-at was further expounded upon following the market events of May 6th, 2010 from the CFTC & SEC Joint Advisory Committee on Emerging Regulatory Issues[47]. In their findings, the committee recommends that:

> ***"The SEC studies the costs and benefits of alternative routing requirements. In particular, we recommend that the SEC consider adopting a 'Trade-at' routing regime."***

Trade-at regimes are found in U.S. Markets

Unlike the equity markets, all options trades must be executed on an exchange[48]. There is no Trade Reporting Facility (TRF) as is found in the equity markets and no off-exchange internalization is

[46] See SEC Concept Release https://www.sec.gov/rules/concept/2010/34-61358.pdf
[47] See Joint Advisory Committee on Emerging Regulatory Issues recommendations: http://www.cftc.gov/ucm/groups/public/@aboutcftc/documents/file/jacreport_021811.pdf
[48] *See* Securities Exchange Act Release Nos. 42894 (June 2, 2000), 65 FR 36850 (June 12, 2000) (File No. SR-Amex-99-36); 42835 (May 26, 2000), 65 FR 35683 (June 5, 2000) (File No. SR-CBOE-99-10); 42848 (May 26, 2000), 65 FR 36206 (June 7, 2000) (File No. SR-PCX-99-18). *See also* Securities Exchange Act Release No. 42455 (Feb. 24, 2000), 65 FR 11388 (Mar. 2, 2000) (concerning the ISE's "facilitation mechanism").

permitted. Moreover, the strength of the options model was borne out on May 6th, 2010 when the options markets were able to absorb the spikes in volatility better than the underlying equities[49]. In the Report from the CFTC/SEC to the Joint Advisory Committee on Emerging Regulatory issues, staff noted:

"In general, the options markets and participants reported that trading in options did not experience similar disruptions as in the underlying securities markets".

Furthermore, there were no significant liquidity shortages reported in the options markets on May 6th and very few trades were broken or adjusted. Another unique aspect of the options markets is there are thirteen exchanges aggressively quoting displayed liquidity which is significantly greater than what is found in the equity markets. Furthermore, liquidity in the options markets across the thirteen quoting exchanges shows greater displayed liquidity than what is found in the underlying equity markets in many NMS securities[50].

Recently, Congress passed H.R. 3448 "The Small Cap Liquidity Reform Act of 2014" which seeks to widen spreads to a minimum increment of $0.05. The Act, among other items, requires that the SEC determine the increment at which the securities of such companies are traded[51]. Congress realized that simply widening quoted spreads without making a determination of the trading increment could lead to greater internalization, thus diminishing the intended goal of enhancing displayed liquidity on Small Cap securities. As the Commission considers the increments, Healthy Markets strongly suggests the Commission also consider adopting a Trade-at pilot in conjunction with widening spreads.

The benefits of a Trade-at regime outweigh the burdens.

A trade-at program should begin as a pilot, allowing for the Commission and others to study the effects to help determine whether the pilot should be expanded or eliminated. Recently Canada and Australia adopted Trade-at regimes to dissuade off board trading. In creating a trade-at for NMS securities, Healthy Markets invokes features adopted by both Canadian[52] and Australian markets. Namely, provisions for a trade-at should, at a minimum, have the features described below:

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[49] See Report from the CFTC/ SEC to the Joint Advisory Committee on Emerging Regulatory issues (I.D. 62): http://www.cftc.gov/ucm/groups/public/@otherif/documents/ifdocs/staff-findings050610.pdf

[50] See Illiquidity Premia: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1784868
[51] See H.R. 3448: http://beta.congress.gov/bill/113th-congress/house-bill/3448/text
[52] See IIROC: http://www.iiroc.ca/Documents/2012/77c0af22-004e-417d-9217-a160b3fcb5c5_en.pdf

- Define “better price” to mean a minimum of one trading increment except when the difference between the best ask price and the best bid price is one trading increment. In such cases, the amount shall be a minimum of one-half of one trading increment.
- Permit the SEC to designate a minimum size for orders that are not displayed in a consolidated market display.
- Permit the SEC to designate a minimum size for block orders that must be displayed in a consolidated market display.
- Provide that an order entered on a marketplace must trade with visible orders on that marketplace at the same price before trading with dark orders at the same price on that marketplace.
- Require, subject to certain exceptions, an order entered on a marketplace that trades with an order that has not been displayed in a consolidated market display to either:
    - o receive a better price, or
    - o be for more than 50 standard trading units or have a value of more than $100,000.
- Mandate that Price-Improving Orders may only occur at the mid-point of the NBBO spread at the time of order-execution.
- Begin selection of Trade-At pilot securities with the roll-out of the decimal pilot for Small Cap securities. In doing so the Commission should seek to select ½ of the decimal pilot securities for inclusion in a Trade-at Pilot. This selection must be randomized.

Healthy Markets believes that such an approach would lead to sound data, allowing for a reasonable determination as to whether such a pilot should be expanded or eliminated.

Re-Examination of Maker-Taker

The maker-taker model has become the predominant economic model for exchanges in the US stock market. Under this model, those who post orders are called “makers.” If an aggressive order crosses the spread, that is called the “taker.” In this model, generally, exchanges pay rebates to the “makers” and charge fees to the “takers.” The exchanges make the ”vig,” the difference between the rebate and fee. This “vig” generally ranges from $0.0003 – $0.0015. Generally, longer-term investors are “takers” while Market Makers will be the “makers” (though this statement is not meant to be construed as always true. Certainly long-term investors will enter positions passively at times). The fees paid to “take” liquidity vary, but are capped by regulation at $0.003 through Rule 610 “Access Rule” of Regulation NMS[53], and generally trend towards that cap, as would be expected.

[53] See Reg NMS File No. S7-10-04 ID (27) https://www.sec.gov/rules/final/34-51808.pdf

Healthy Markets believes Maker-Taker suffers from many flaws, including but not limited to:

- A lack of transparency around net-pricing. The publicly quoted price is not the actual price when access fees are accounted for.
- The incentivizing of churn and volume-trading for rebate collection, rather than liquidity provision and price discovery.
- The conflict-of-interest created for brokers (most notably retail brokers, but certainly anyone acting as an agent) to route "cost effectively" by default. This results in brokers attempting to minimize access fees and maximize rebates while charging their clients a fixed price (either per-trade in retail or per-share for institutions) and keeping the cost savings / rebates for themselves.

While many will argue that economic forces and free market competition are enough to address these problems and to determine the equilibrium business models for exchanges, Healthy Markets would argue that this is naïve and overly optimistic. We are already in an environment of price controls and heavy regulations. It should be clear that nearly all lit trading venues (and certainly all venues with substantial volume) have become maker-taker with access fees for taking liquidity at the cap determined by the SEC. This is the result of a race-to-the-bottom in which each exchange is forced to increase rebates, add liquidity tiers and increase fee complexity in order to compete with the other exchanges. Other models cannot be successful in this environment where the predominant supplier of liquidity is driven by rebate collection and has driven out most other suppliers of liquidity.

There is an argument to be made that brokers will still remain sophisticated and will route order flow to ensure Best Execution for their clients. Unfortunately, the definition of Best Execution has become outdated and can still be claimed despite clear evidence that brokers are routing for their own interests rather than the interests of their clients. In one of the only studies to examine this conflict-of-interest, a study from Notre Dame by Battalio, Corwin and Jennings (March 2014)[54] offers "strong evidence that venues with high take fees (liquidity rebates) offer inferior limit order execution quality." The authors present substantial evidence that order routing decisions are governed by the fee schedules rather than execution quality, making the following conclusions:

"Limit orders resting on venues with high take fees require more time to fill than those on venues with lower take fees."

[54] See: Can Brokers Have it all? http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2367462

"For take fee differences exceeding $0.0001 per share, the lower take fee venue has higher measured limit order execution quality."

"The decision to route the bulk of one's limit orders to a single venue offering the highest liquidity rebate is inconsistent with a broker's fiduciary responsibility to obtain best execution."

"Inverted venues have shorter queues and are at least as likely to receive marketable orders as the traditional venues."

"Several large, national brokerage[s] are making order routing decisions that appear to be consistent with the goal of maximizing order flow rebates. … Proprietary data suggests this type of order routing results in lower fill rates and increased adverse selection costs."

Healthy Markets strongly supports a pilot program to eliminate rebates[55]. The pilot program could be run concurrently with the tick size pilot, as it can be run in an entirely different class of securities designated by market capitalization. Such a program would shift the incentives for liquidity providers away from capturing rebates and towards spread capture. It would encourage a greater diversity of timescales for providing liquidity, especially when done in conjunction with a trade-at provision. Current liquidity providers believe that rebates are necessary on lit exchanges to compensate for the high levels of adverse selection that result from a high level of off-exchange trading. Healthy Markets understands this concern and therefore would argue for a similar trade-at provision in this pilot as in the tick size pilot – that half of the pilot securities also have a trade-at provision. Healthy Markets believes that the designation of a group of securities with no rebates and the implementation of a trade-at provision will demonstrate substantially superior metrics for liquidity and spreads. Healthy Markets also believes that, under these reforms, much of the order book instability associated with illiquidity contagions will disappear.

When Rule 610 of Regulation NMS was adopted, no studies were conducted as to the appropriateness of a fee cap. This is true in spite of the fact that Rule 610 was one of the most controversial aspects of the new Regulation. It is only through a pilot program that the effects of these rule changes can be adequately monitored and compared. We believe that the results will be clear and quick and that it will be obvious, in short order, that the pilot should be made permanent.

[55] See : http://Healthy Marketstrading.com/wp-content/uploads/2014/03/ssrn-id1584026.pdf

Improved Technology Across the Industry

There is no doubt that the technology revolution that has swept the Financial Services industry has brought incredible benefits. Those benefits have brought down trading costs over the last 20 years in an unprecedented fashion. As we work to implement reforms, it is critical to ensure that we do not negatively affect any of those improvements in markets. It is our belief that there are several important but simple things that can be done, which will have significant impact on market quality and public trust in markets.

Healthy Markets has identified many problems that have accompanied these technology changes. These problems include:

- Research
    - Markets have become difficult to study. The amount of data to study is immense, and requires resources (computing and storage) and skills (finance and parallelized research design) that many academics (and the public) don't have.
    - Obtaining data is even more difficult. There is no free, public source for complete depth-of-book data on markets, and no data on dark pool IOIs and lit market IOCs. When academics are able to obtain data, it's either very limited (i.e. Nasdaq makes its data available) or it is sponsored by an HFT firm or broker. When the results of the research don't conform to the sponsor's agenda, access is cut off.
- Complexity
    - Technological complexity has resulted in a much higher incidence of technology problems. Infrastructure is highly connected, and in some cases poorly maintained. The SIP is the perfect example, where incentives are not aligned for keeping the technology competitive with high-performance systems.
- Transparency
    - It has become easier to hide behind technology and reduce transparency.
    - The explosion of Alternative Trading Systems has increased a part of the market where there is no visibility, either from a quoted price discovery perspective or from a regulatory filing perspective.

Healthy Markets believes there are actually three simple answers to address these problems:

1. MIDAS reform
    a. Add Dark Pool IOIs and market-wide IOCs to MIDAS. MIDAS should be able to study this huge part of the market that it is unable to see right now. Quotes in Dark Pools are just as important as those in lit pools. Ultimately, obfuscated participant ID's should be associated with each quote and trade to allow MIDAS to do proper research. Both of these efforts should be kicked off immediately.
    b. Provide open access to MIDAS to all qualified researchers, academics, and even the public. Anybody who wants to study markets should be able to. The value of this step cannot be overstated. The open source movement has shown the world that there is a better, more collaborative way to build software and study problems. There is no

downside to this, other than cost of Amazon instances, and the value received for that cost would be tremendous.

2. Data feed reform
    a. All exchanges should synchronize their system clocks to the microsecond. This is no longer difficult or burdensome, and is a critical step towards understanding cross-market dynamics. It would also allow participants to see a more similar NBBO though they may be geographically dispersed.
    b. Mandate that any ATS that matches trades in a manner dependent on the NBBO has to use direct feeds to calculate the NBBO. Furthermore, for those firms that do not strictly run an ATS, they have to produce reports that demonstrate that their latency to process the feeds and receive data **within the application** is the same as, or lower than, any other business unit that receives those feeds. This is critical to ensure that they do not simply route the direct feeds in, but process them so slowly as to replicate SIP performance (or worse). Firms should be made to understand the principles behind this, and should be audited on a regular basis to demonstrate they are adhering to those principles.
    c. A longer-term goal should be to have SIP performance that is the same as, or superior to, direct feeds. While direct feeds carry depth-of-book information that is important for some participants, they should never be **received** before the same update on the consolidated SIP feed. This is an important distinction for regulators to make – the perspective needs to shift from when data is transmitted from a market center, to when that data can first **be received** by a participant. Focus needs to be on data receipt time, not data transmission time.
3. Regulatory Filing Reform
    a. All ATS filings should be made immediately public. All future filings should go through the same public comment process as SRO filings. It is a simple historical circumstance that ATS filings are hidden from the public while the burden is on SROs to file publicly. This does not serve the public interest in any way, and makes it easy for media and others to sensationalize and demonize what is occurring in this part of the market. There should not be any reasoned argument against this.
    b. FINRA should change how they are going to be reporting dark volume statistics. Once again, this data should be made readily available in a programmatic fashion for free. FINRA should ensure that all data can be accessed either in a delimited file format or via API, and this access should be free. There is no excuse for a regulator to try to profit from data that is being made publicly available.

Once again, Healthy Markets' guiding principles are what the entire industry should aspire to: Transparency, Quality Metrics, Data Freedom and Displayed Liquidity. When discussing technology, we should also aspire to simplicity wherever possible, and an understanding of complex systems wherever necessary.