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Dear SEC:

Here are my comments on market technology issues and market stability.

Respectfully submitted,

Jim

¹ I am also on the boards of directors of the EDGA and EDGX stock exchanges. My comments are strictly my own and don't necessarily represent those of Georgetown University, the University of Pennsylvania, EDGX, EDGA, or anyone else for that matter.

Principles of Market Stability: A call for three dimensional protection.

James J. Angel, Ph.D., CFA

The U.S. equity market of today is an amazing technology network that connects thousands of participants. It is a technology network that connects investors, brokers, communication vendors, data centers, utilities, analytics providers, media, settlement organizations, banks, regulators, and exchanges around the world. On a daily basis this network usually handles millions of transactions flawlessly at very low cost. Yet in recent years our market network has suffered a series of public technology failures that have shaken investor confidence in our market infrastructure. Here are some useful principles for understanding our technical challenges that point the way to improvements.

1. The market is more than the national securities exchanges.

It is human nature to focus on the most visible aspects of the network, the exchanges. However, it is extremely important to understand that our financial market is an economic ecosystem containing many parts that work together. Truly understanding the nature of the modern market means understanding the entire ecosystem. Focusing only on one element will lead to continuing surprises stemming from the interaction of the different pieces of the eco-system. The tone of the preliminary Flash Crash report sounded as if the investigators were surprised that there were interactions between futures and cash markets.

Implication: No one regulator has the entire market in its jurisdiction. Regulators need to continually fight the human temptation to think only in their regulatory box, and develop a more outer focused world-view. This can be done through explicit programs of employee training designed to foster awareness of activities outside the agency, more exchanges of personnel and joint ventures with other regulators in the United States as well as other countries. Closely related regulatory agencies should be housed in common facilities physically close to the markets they are regulating.

2. The basic job of the market is good price discovery.

Our financial markets provide many essential services to society, ranging from a payment system to risk management tools. One of the most important features of the market is its ability to produce the price. Prices send strong signals to investors about corporate values, investment risks, and expected performance of corporations. Getting the price right is important for basic fairness to buyers and sellers, as well as for allocating capital to useful purposes and the proper functioning of risk management. Under normal conditions, the markets do a great job through trading of consolidating all available information to discover a price that balances supply and demand.

Implication: Market stability measures should have the fundamental goal of getting the price right.

3. Technology breaks. We need to be prepared.

Our modern world provides many technological wonders, ranging from bridges to airplanes. Despite our best efforts, sometimes bridges collapse and airplanes crash. From time to time our market infrastructure is challenged by unusual events. Many of these are unpredictably predictable. Terrorist attacks. Wars. Technology outages. Financial Panics.

As a former engineer, I can attest that good engineering means planning for backup systems and redundancy. It is an inevitable nature of the complex nature of modern systems and the fallibility of humans that sooner or later something goes wrong. This will be the case no matter how many “policies and procedures” are mandated by regulators.

Implication: While we should not reduce our efforts to prevent system problems, we must design our market network to contain the damage when systems fail. We need markets that are both fail-safe and fail-graceful.

4. We need to approach market technology with a technical and business, not a legal, frame of mind.

It is tempting for the SEC follow its usual custom and to pass a rule which says that market participants must have policies and procedures in place to have good technology and to document those procedures, and then send enforcement people in to inspect the paperwork. However, approaching the problem legalistically sets up an adversarial and thus unproductive atmosphere from the start.

Implication: **The SEC should approach system technology the way the FAA and NTSB approach transportation safety by relying primarily on experienced technical experts, not attorneys.**

5. We need to be able to deal more gracefully with message overloads.

We know that from time to time our markets are overwhelmed by tsunamis of market activity. This has been the case since long before computers. Common sense would dictate that we have good market-wide procedures in place to deal gracefully with data overloads, but we don't. Electric utilities have plans in place for load shedding when electrical demands exceed capacity. Our financial markets should have similar market-wide plans to deal rationally with overloads.

The practice up until now has been to expect the exchanges to keep adding capacity, which is good as far as it goes. Each individual system usually deals with overloads through queuing. However, we saw during the Flash Crash how variable queuing at different systems contributed to the market instability: the scrambled data led to concerns about data integrity that pushed stabilizing liquidity providers to the sidelines, leading further instability.

However, it is not cost-effective for society to build and run our market network for those few rare seconds of extreme demand. Even small market participants now have the capacity to flood the market with message traffic. We have recently seen many instances of “quote pollution” – huge spikes in quote volume that do nothing to enhance price discovery. These excessive cancellations raise bandwidth costs for everyone, and can cause market-wide network degradation.

Implication: We should have reasonable market-wide programs to reduce quote pollution, and mechanisms for load shedding in times of peak demand. The old Rule 80A “side car” is one precedent.

6. Complexity is risky.

Our markets are already highly complex technology networks. This is an inevitable artifact of the modern age. None of us want to go back to the days when human beings yelled at each other face-to-face on a wooden trading floor. However, our market stability measures should not add additional complexity, and thus risk, to the markets. The very fact that they kick in only rarely means that they are fundamentally untested. When the next freak event occurs – which it will, we just don’t know when – we don’t know how the combination of limit-up limit-down, market wide circuit breakers, public reaction, data overloads, derivative markets, and partial technology outages will interact. I am concerned that the complexity of the limit-up limit-down system will lead to unanticipated behavior at exactly the worst moment when the system is under the most stress. The LULD system depends on the market doing massive amounts of calculations correctly at exactly the moment when systems are most stressed. We learned during the Flash Crash that we can’t depend on market systems to keep up with the tsunami of message traffic in those situations.

The nightmare scenario is for a multi-stock flash crash to occur in such a way that it triggers a market-wide shut down. The news of the market wide shutdown causes further unnecessary panic. We were indeed lucky that the flash crash did not trigger a market-wide trading halt. Imagine the public panic that would have ensued as the media broadcast “Market crashes. Wall Street shuts down.” Imagine the mess that would have ensued if the market had been shut down and all the mutual fund trades (as well as margin accounts) had been priced at clearly erroneous prices.

Implication: Market stability measures such as circuit breakers need to be simple enough that they will work properly during times of market system degradation.

7. We must change our ethic from “The show must go on” to “Get it right.”

Our markets have an admirable ethic to keep the systems running no matter what. This is usually a good thing. Our markets are a vital part of our economy. Keeping the markets open means that all information, positive or negative, can find its way into the price as quickly as possible. But if the machine is broken and is in imminent danger of producing bad prices, it is better to pause gracefully to make sure that it functions in its primary role of price discovery.

8. There are many technological indicators of incipient market failures.

The electronics in modern airplanes monitor numerous systems, looking for signs of trouble before they threaten the safety of the flight. They don't wait for the plane to crash before signaling trouble. Our current equity circuit breakers look only at price. In other words, we wait for the crash before doing anything.

However, recall that our markets are technology systems. There are plenty of non-price warnings that trouble is about to occur. For example, during the recent Knight incident, there were widely noticed unexpected spikes in volume in many of the affected stocks. Similarly, before the Flash Crash, there were noticeable reductions in market liquidity despite the very high trading volumes. And there were noticeable delays in market data that led to the destabilizing data integrity concerns.

Implication: Our market stability measures (circuit breakers) should be based on more than just price. In particular, we need three dimensional stability measures based on 1) price, 2) volume and liquidity, 3) data integrity. Disruptions in any dimension should trigger protective measures such as trading pauses or load shedding.

9. Industry-wide testing isn't.

Our exchanges regularly conduct market-wide testing of new systems, which I have personally observed. Unfortunately, many brokerage firms do not always participate, and even when they do their customers do not. The market-wide testing involves the running of a number of testing scenarios. This is as good as it goes, but it is not good enough. The Facebook IPO is a sad example of the limits of such testing. The industry did major testing that was widely reported in the media, but all that testing did not highlight the fatal flaw in the system.

Implication: We need to be aware of the limitations of industry-wide testing and have procedures in place to deal with bugs that make it through testing.

10. System changes should be rolled out gradually.

Our markets already have procedures in place to roll out new systems in a carefully controlled manner. Trading starts first with test symbols, then with a few low volume symbols, then gradually for the entire market. The Knight incident apparently involved software changes to accommodate the NYSE's RLP pilot program. My understanding is that the system changes at the NYSE were judged to be so minor that a gradual rollout was not done. While the system changes at the NYSE may have been minor, apparently this was not so for firms participating in the program such as Knight.

Another reason for gradual rollouts is that they create natural experiments for assessing the economic impact of various changes. Given the controversial nature of the RLP program, the pilot should have been rolled out gradually in a carefully designed manner.

Implication: New exchange systems should be gradually rolled out in a carefully designed manner so that 1) technology issues can be identified early before causing damage, and 2) good data can be collected to determine the economic impact of the changes.

11. IPOs should be opened the ways stocks open every day.

Several of the major technology failures have involved IPOs. IPOs are unfortunately a rather rare event, and we currently use different systems to open IPOs than we use daily to open stocks. This makes no sense. Every day we successfully open thousands of stocks in a carefully staged sequence: The exchanges turn on their computers as early as 4am for “pre-market” trading, and orders gradually roll in from presumably sophisticated traders. This “pre-market” trading between consenting adults produces good price information. Meanwhile, retail and other orders are queuing up for the 9:30 am opening auction. The fair and orderly opening auction produces a good price, in part thanks to the information that was produced in the “pre-market” trading. In contrast, in the case of IPOs and stocks re-opening from a trading halt, the “gun jumping” rules prevent any trading before the auction, thus depriving the market of important information needed to find the right price. IPO openings are thus especially risky for the market, both from a technology perspective (rarely used special systems), and from a market perspective (lack of “pre-market” price information).

Recommendation: **IPOs and post-pause re-openings should use regular daily opening procedures:** Let traders trade “pre-open”, while regular retail orders queue up for the opening auction.

12. Backup data centers should be tested with real trading.

Given the limitations of industry-wide testing, the only way to truly test our backup systems is to actually operate our markets on them. This will highlight any weaknesses in our backup systems.

Recommendation: **Each year we should mark the anniversary of the September 11 attacks by operating all of our exchanges completely from their backup data centers.**