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Senate Subcommittee on Securities, Insurance, and

Investment

and the

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"Examining the Efficiency, Stability, and Integrity of the U.S. Capital Markets"

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I wish to thank the Subcommittee for investigating these important questions in market structure. My name is James J. Angel and I study the nuts and bolts details of financial markets at Georgetown University. I have visited over 50 financial exchanges around the world. I am also the former Chair of the Nasdaq Economic Advisory Board and I am currently a public member of the board of directors of the Direct Edge Stock Exchanges.[1] I am a co-inventor of two patents relating to trading technology. I am also the guy who warned the SEC in writing five times before the "Flash Crash" that our markets are vulnerable to such big glitches.[2]

Another Flash Crash can happen again, and we need to take steps to fix our fragmented regulatory system to prevent another one from further damaging our capital markets. Here's why:

The market is a complex network.

Our financial market is not a single exchange with a wooden trading floor, but a complex network linking numerous participants trading many different types of linked products including exchange-traded equities, options, and futures as well as over-the-counter instruments. This network includes not only numerous trading platforms but a vast infrastructure of supporting services. Participants include:

- Equity exchanges
- Option exchanges
- Futures exchanges
- Automated trading systems operated by broker-dealers

[1] These remarks are my own and do not necessarily represent those of Georgetown University or the Direct Edge stock exchanges.

[2] See the appendix for details.

- Proprietary trading systems operated by broker-dealers
- Proprietary trading systems operated by other investors
- Algorithm providers
- Data vendors
- Telecommunications providers
- Data centers
- Analytics providers
- Settlement organizations such as DTCC
- Stock transfer agencies
- Banks
- Proxy service firms
- Professional traders
- Money managers
- Hedge funds
- Retail investors
- Media

Problems anywhere in the network can disrupt the entire market.

A problem anywhere in the network can lead to a disruption. For example, on Monday, September 8 2008, the South Florida Sun Sentinel erroneously published an old story that United Airlines had filed for bankruptcy – an event that had occurred in 2002.[3] Some investors thought that United Airlines was filing for bankruptcy again, and the stock of the new United Airlines temporarily plummeted more than 75% before recovering. Power outages and telecom problems can also disrupt the market.

Most of the time our market network has enough redundancy to prevent a failure in one location from disrupting the whole network. Minor problems at one exchange or other part of the system are routine occurrences. Equity exchanges routinely declare "self help" when there are problems with other exchanges. Under normal conditions, market participants just trade around the problem and it never makes the news. On May 6, 2010, the market buckled under the flow of data and seemingly minor problems in data feeds cascaded into a chaotic partial failure of the entire network.

[3] See http://www.upi.com/Business_News/2008/09/08/United-Airlines-hit-by-5-year-old-news/UPI-66501220903137/.

Our market network performs really well – most of the time.

By most measurable standards, our market network is working better than ever before. Our automated markets provide fast, low cost executions. Total trading volume and displayed liquidity have jumped dramatically in recent years. This can be seen in the attached study I performed with Larry Harris of USC and Chester Spatt of Carnegie-Mellon, both former chief economists at the SEC. However, in that study, which was submitted to the SEC, we also warned of the danger of misfiring algorithms that could cause a meltdown – or a melt up of the market.[4]

Our market network has finite capacity.

Just like any human system, our market network can only handle so much activity before it has problems with traffic jams. When the flow of data through a computer network overflows its capacity, strange things begin to happen. As the market is quite complex, bottlenecks can occur in unexpected places. Dealing with the capacity limitations of the network is not as simple as making sure that the equity exchanges have lots of spare computer capacity – the SEC does a pretty good job of that. As the network involves many unregulated entities, such as data vendors and IT providers as well as investors themselves, it is virtually impossible for the SEC or any regulator to force every network participant to maintain ludicrously high levels of excess capacity. This is especially true since network participants will rationally resist sizing their systems for once-a-decade data tsunamis. Instead, we need to have well thought out safeguards for dealing with these extreme events, which occur regularly in our financial markets.

The Flash Crash was exacerbated by bad market data

[4] Indeed, some stocks on May 6 did melt up. A trade in Sotheby's was printed at $100,000 per share. The study can be seen at http://www.sec.gov/comments/s7-02-10/s70210-54.pdf.

If traders don't have good price data, they can't trade. Many of the most important participants in our markets are known as "liquidity providers" who buy on the dips and sell on the rebound. They perform an important stabilizing role in markets. In the old days, they were known as specialists and hung out on those old wooden trading floors. Now they do their job with computers that hang out in stock exchange data centers in what is known as "co-location." This kind of "high frequency" trading is a thin margin business with a lot of competition. These traders typically earn a small fraction of a penny per share, but they make money by trading in high volumes. These liquidity providers depend upon accurate data. If they detect that there is a malfunction in their data feeds, they do the rational thing and stop trading until they can figure out what is going wrong. As the SEC and CFTC noted in their report on the Flash Crash:

> *As such, data integrity was cited by the firms we interviewed as their number one concern. To protect against trading on erroneous data, firms implement automated stops that are triggered when the data received appears questionable.*[5]

This is what happened on May 6:

- Heavy trading activity led to traffic jams in market data. In the words of the *Wall Street Journal*'s Scott Patterson, "The market infrastructure was fried."[6]
- Important market participants detected problems in the accuracy of their market data, and stopped trading. This led to a decrease in liquidity.
- Other market participants that did not detect the data problems kept trading. There were few buyers in the market when their sell orders arrived, causing prices to plummet temporarily.

[5] Findings Regarding The Market Events Of May 6, 2010: Report Of The Staffs Of The CFTC And SEC To The Joint Advisory Committee On Emerging Regulatory Issues, http://www.sec.gov/news/studies/2010/marketevents-report.pdf, page 35.

[6] Oral remarks at the Dow Jones Expert Series, Nasdaq Market Site, October 27, 2010.

Flash Crashes are not new.

Financial market history contains many events in which the market was overwhelmed by the flow of data and the market mechanism broke down. Many of these events happened long before computers. On May 3, 1906, the New York Times headline blared "Stocks Break and Recover. On August 9, 1919, the New York Times reported a "sharp break" in prices. As in the Flash Crash, there were problems in getting prices out to the public: "In the break, prices quoted on the ticker tape were once again far behind the market..." Soon there was an upturn and prices recovered.

System problems in times of stress are not new.

Market history contains numerous examples of system problems that occurred during times of market stress. These problems were both a result of the level of market activity and a cause of additional confusion in the market. In the crash of 1929, the ticker tape ran several hours late, adding to the confusion and panic. Investors did not know whether their orders had been executed or at what price. In the crash of 1987, there were, in the SEC's words, "large scale breakdowns in automated trading systems."[7] Among other problems, the printers on the NYSE jammed, so that order tickets could not be printed.

Market tsunamis are regular events, so we need to be prepared for the next one.

On May 6, the market network was so overwhelmed with the flood of data that it broke down and started spewing out bad prices. This is not the first time, nor will it be the last time. Market history teaches us that these extreme but infrequent events happen regularly. We need to be prepared for the next market tsunami. It is impractical to mandate an extreme amount of overcapacity throughout the

[7] http://www.sec.gov/news/studies/tradrep.htm

extended market network. Instead, we should put safeguards in place so that when the next one hits, our market deals with the overflow of activity in a fail-safe manner.

We need safeguards for individual stocks as well as for the whole market network.

Crude "circuit breakers" were put in place after the crash of 1987.[8] If the Flash Crash of 2010 had occurred just a few minutes earlier and been a little steeper, a one hour trading halt would have occurred. Thank God that didn't happen! Imagine the public panic that would have occurred when the news got out that the market crashed and then shut down. The public may well have thought that the fall in prices was a fundamental result of bad news stemming from the situation in Greece, and there may have been even more panic selling when the market reopened. Our close brush with doom on May 6, 2010 shows us how poorly the post-1987 circuit-breakers were designed. We need to seriously rethink the market-wide as well as stock specific safeguards.

We also have mini-disruptions in individuals stocks with distressing regularity. The crude stock-by-stock circuit breakers that were imposed after the Flash Crash are an important first step, but there is much more refinement that needs to take place. The safeguards need to cover all stocks, and they need to be in effect during the open and the close. We need to fix the erroneous trade problem that has led to many false alarms after the circuit breakers were implemented.

The current circuit breaker designs are based on price, which is good, but we should also have circuit breakers that are based on data integrity. When the data feeds can't keep up with the market, we need to slow down the market so we can catch up. This will nip the problems in the bud before prices go crazy.

[8] See http://www.nyse.com/press/circuit_breakers.html for the current circuit breaker levels.

The safeguards need to be integrated across the entire market network.

Currently, our fragmented regulatory system treats each exchange as an independent Self Regulatory Organization. There is no real time supervision of the entire market network. There is no entity that can call a timeout when there is some network problem that may not have been anticipated in the circuit breaker design. Somebody needs to be monitoring the system in real time and that somebody needs to have the authority to call a timeout when things go crazy. I think that Finra is the obvious candidate to be that somebody.

We need to worry less about a fragmented market than about fragmented regulation.

Some market participants grumble about the complexity and "fragmentation" of today's markets. Yes, today's market is far more complex than the days of old, but it works much better. Most of our technology today, from the automobile to the word processor, contains far more complicated technology than before, and most of the time works far better.

One can think of the stock market of a few years ago as being similar to a manual typewriter. We upgraded it to an electric typewriter, and then to a word processor. On May 6, 2010, that word processor went into short spasm that highlighted many of the flaws I previously warned the SEC about. However, that does not mean that we should throw out the word processor and go back to a manual typewriter. It means we need to put safeguards in place to make sure that it doesn't happen again.

Even though the technology of our markets has improved dramatically in recent years, our regulatory system is still stuck in the manual typewriter days of the early twentieth century. There are literally hundreds of financial regulatory agencies at the state and federal levels. None of them have the big picture in their in-baskets. Each of them has a fairly narrow mandate.

In the 1975 "National Market System" amendments to the Securities Exchange Act, Congress mandated a competitive market structure. The SEC has dutifully implemented this. However, Congress has not thought through how to regulate our interconnected financial markets. The Dodd-Frank bill did not meaningfully address the dysfunctional fragmentation in our regulatory system.

We need regulators who understand the entire market.

Although the SEC has many dedicated and intelligent public servants, as an organization it does not really understand the entire market network. The Commission is a specialist agency with a narrow mandate that focuses on "securities." Other related financial products (futures, insurance, and loan products) are left to other state and federal agencies, which leads to gaps as well as overlaps in the regulation. If we think of our market network as a body, the SEC is perhaps, a cardiologist who might very well ignore the patient's lung cancer as it assumes that other doctors treat it.[9] And since the cardiologist and the oncologist and in different granite towers, the cancer is ignored.

The regulators need better market intelligence.

One of the frightening aspects of the Flash Crash was how long it took the regulators to piece together what happened, and how their reports still displayed a lack of a deep understanding of the significance of the facts they uncovered. We need regulators who really understand the market network and have access to the data and resources they need to properly nurture and supervise our markets.

The regulators need good funding.

We have been penny wise and pound foolish with respect to funding the SEC. The SEC's total cumulative budget since its founding has been, in today's dollars, about $18 billion. That is less than

[9] In a discussion once with an SEC staffer a few years ago, I raised a concern about systemic risk. I was immediately and emphatically told that systemic risk was not in the SEC's mandate and that it was the Fed's job to worry about it.

half of investor losses in the Madoff scandal. We need good cops on the beat to keep the crooks out. We need to hire enough good people to do the job right, and make sure they have the right tools to do the job. We also need to be able to pay them enough to attract and keep good people. The pay level of SEC officials is very far below their private sector counterparts. SEC salaries should be benchmarked close enough to the private sector so that they can get the right people.

One solution: De facto integration in our financial capitals.

The SEC is sequestered in a granite tower on F Street in Washington, hundreds of miles away from the heart of the markets that it attempts to regulate. The CFTC is in a different granite tower two miles away from the SEC in Lafayette Centre. The banking regulators are spread all over. Congress seemed unwilling to address the dysfunctional structure of our fragmented regulatory morass in the recent Dodd-Frank bill.

However, there is an administrative solution to the fragmentation of our regulatory system that would not require massive legislation: If you want the regulators to work together, house them in close physical proximity. House all of the federal financial regulators in one building with common shared facilities for security, food service, information technology, and so forth. In this way, it will become easy for regulators in the different agencies to literally work closely with each other. It will also make it easier for agencies to make use of the already existing Intergovernmental Personnel Act (IPA) mobility program to rotate employees through the different agencies. Increasing the rotation of employees through the different regulatory agencies will improve the thinking of regulatory agencies by making the agencies more cognizant of the entire market network rather than the narrow piece that their agency regulates.

Second, locate this facility in the heart of our financial markets in New York City. Even though we live in an electronically linked world, physical proximity still matters. Being in the heart of the

financial system makes it easier for the regulators to actually interact with the people in the markets. I know from my own experience that it is hard to understand markets from my ivory tower office. I learn about markets by taking every opportunity I can to make on site visits to market practitioners. It is very important for the regulators to get out of their granite towers and interact with the financial markets, and it will be much easier if they are located closer to the markets they are regulating. It will also be easier for them to invite market practitioners in to visit them as well.

Closeness to the markets is one of the reasons why trading firms still congregate in the New York City area. Notice that NASDAQ, which operates an all electronic market, moved its headquarters to New York when it realized that its key employees were spending so much time shuttling between Washington and New York. Pipeline Trading, which was founded by scientists from Los Alamos, New Mexico, set up shop in New York because that is the heart of the financial markets.

Locating the bulk of our regulators in New York means that the regulatory agencies will draw from a labor pool that understands financial markets and has good market experience. I understand that it is hard right now for the regulators to attract good people to move to DC. The agencies thus draw from a labor pool of government regulators who are well meaning but don't have the background or experience needed for the job.

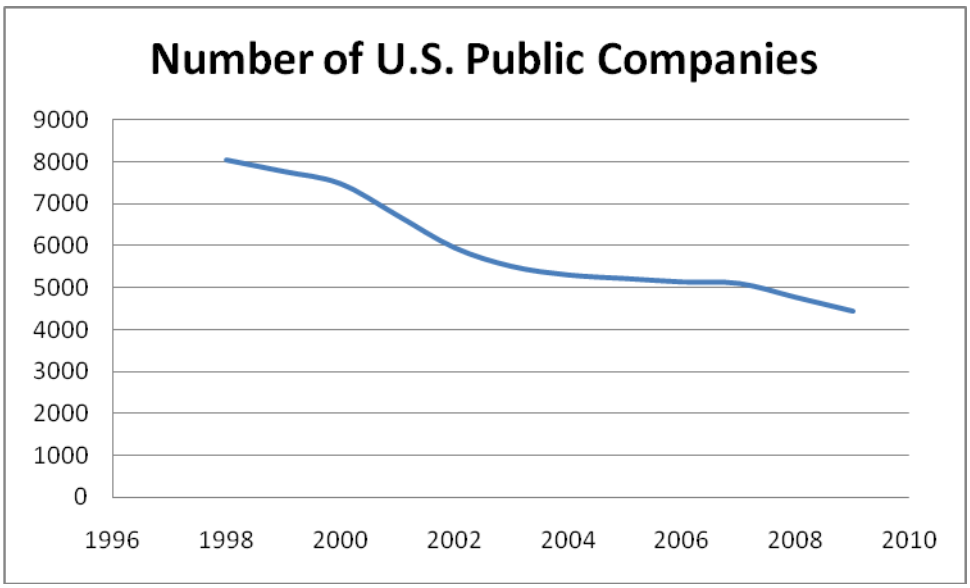
The falling number of public companies is a major problem!

Although not a focus of this hearing, there is another market-structure related problem that cries out for serious attention: The number of listed US companies has fallen sharply over the last decade. At the end of 1997, before the dot-com bubble went crazy, there were 8,201 operating domestic companies listed on the NYSE, NASDAQ, and AMEX exchanges. At the end of 2009, only 4,439.[10]

[10] This data comes from the Center for Research in Securities Prices (CRSP) database for common stocks of U.S. companies listed on U.S. exchanges.

By the end of October, 2010, there were only 3,964 companies in the Wilshire 5000 index, an index which include all domestic companies listed on our exchanges.[11]

While private equity firms have picked up some of the slack, they are not a substitute for vibrant capital markets. Indeed, private equity investors need the public markets in order to be able to exit their investments. Without an exit strategy, investors won't invest in the first place.



[11] http://www.wilshire.com/Indexes/Broad/Wilshire5000/Characteristics.html, accessed December 5, 2010.

Fewer public companies = fewer jobs.

In rough numbers, if we assume that half of the roughly 4,000 missing companies are now private or part of larger public companies, that still leaves about 2,000 missing US companies. If each of those missing companies employed 1,000 workers, that is two million fewer jobs. Two million more jobs would slash over one percent off of our unemployment rate.

We have made it too expensive to be a public company.

There are several causes for the declining number of public companies: For one thing, it has become very expensive to be a public company compared with a private company. The compliance burdens on public companies, such as Sarbanes Oxley §404 compliance is one problem. The Dodd-Frank law exempted tiny companies from this §404 burden, but the burden remains for the majority of exchange listed companies. The cost and risk of litigation exposure is another – the cost of directors and officers insurance for a public company is several times higher than the premium for a similar sized private company.

Our market structure is not welcoming to small companies.

Market structure issues are also involved. Our markets provide great service to large companies, but it is not clear that the best market structure for big companies is also best for smaller companies. However, SEC policy over the last two decades has been to make the trading of smaller stocks the same as for larger stocks. There is no such thing as a "one size fits all" market, but the SEC does not seem to understand this. Small companies are lost and ignored by the market as an unintended consequence of many of the market structure changes of the last 20 years. We should encourage experimentation with different market models for smaller stocks. [12]

[12] For the record, I strongly disagree with the allegations in the Litan and Bradley study that blame the proliferation of index products such as ETFs for the decline in public companies. *Choking the Recovery: Why New Growth Companies Aren't Going Public and Unrecognized Risks of Future Market Disruptions.*

Considerable attention needs to be applied to this problem. Smaller companies are the engine of innovation and economic growth. Without good capital markets nurture these companies of tomorrow, we will condemn our nation to economic stagnation.

Respectfully submitted,

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http://www.kauffman.org/uploadedFiles/etf_study_11-8-10.pdf. Although I do not agree with all of its recommendations, the Grant Thornton report is also worth noting: *A Wake Up Call for America* by David Weild and Edward Kim
http://www.grantthornton.com/staticfiles/GTCom/Public%20companies%20and%20capital%20markets/gt_wakeup_call_.pdf

Appendix: Written submissions to the SEC regarding market glitches prior to May 6, 2010

Warning Number 1

In my May 5, 2009 comments presented at the SEC Roundtable on short selling (http://www.sec.gov/comments/4-581/4581-2.pdf), I warned on page 3 that we would have more high speed meltdowns like the one that affected Dendreon in April 2009:

> **We need a shock absorber to prevent another Dendreon.**
>
> Those calling for a return of some type of uptick rule are expressing a legitimate concern. They intuitively grasp that there is something wrong with short-term price formation in our markets today. The recent incident with Dendreon (DNDN) on April 28, 2009 demonstrates the need for a shock absorber. The company was about to make an announcement regarding the effectiveness of its prostate drug Provenge. The stock plunged 69% in less than two minutes. [13] After the news was revealed, the stock quickly returned to its previous levels. Investors who had placed stop loss orders to protect themselves found that their orders were executed at very unfavorable prices. Why did the stock plunge? It is too early to tell. Was it a "fat fingers" mistake in which an investor hit the wrong button? Did an algorithm misfire? Was it a chaotic interaction between dueling algorithms? Did a long seller panic and dump too many shares too fast? Was there a deliberate "bear raid" manipulation going on from informed traders hoping to push the price down so they could trigger stop loss orders and scoop up shares cheaply? Or was it just the case that the market was very thin just before the news announcement and a few large sell orders exhausted the available liquidity, triggering the selloff? Regardless of the reason, the incident demonstrates the need for a shock absorber to deal with extreme situations.

[13] Ortega, Edward, Nasdaq Will Let Stand Dendreon Trades Under Review
http://www.bloomberg.com/apps/news?pid=newsarchive&sid=a314cxKBoGHI

The era in which humans traded with humans is long gone. Now computers trade with other computers in the blink of an electron. Most other developed equity markets around the world have some kind of procedure for dealing with extreme situations. Whether it is a price limit, a trading halt, or a special quote mechanism, the United States needs to install a shock absorber to deal with excessive volatility. One of the main purposes of the stock market is to provide good price discovery. If the price discovery mechanism appears to be broken, it will reduce investor confidence in the market.

Unfortunately, merely reimposing the old useless uptick rule or forcing a pre-borrow for shorted shares will not solve the problem of excessive intraday volatility. What is needed is to think outside the box of "lets get the short sellers" to the more useful question of "what kind of shock absorber works best in our modern markets?"

It is certainly not obvious what form such a shock absorber should take. One thing that is clear is that the 1939 uptick rule will not achieve the objective of reducing excess volatility. Installing a broken shock absorber from a 1939 Chevrolet Coupe into our 2009 Corvette market will not do the job. What would make sense is a dampener similar to the exchanges' proposal. The beauty of the exchange's circuit-breaker with restriction idea is that it does not interfere with normal market operations under normal conditions. It only kicks in when needed, at times when the market is under stress. Perhaps a more gradual shock absorber would make more sense. For example, one approach would be:

- At prices at or above 5% below the previous close: No restrictions
- At prices below 5% below the previous close: Hard preborrow for short sales
- At prices 10% below the previous close: price test for short sales

- If the price hits 20% below the previous close: Automatic 10 minute trading halt. The stock would reopen with the usual opening auction after market surveillance has determined that there are no pending news announcements.

I urge the Commission to begin consultation with the industry to develop one that fits the unique and competitive nature of our markets. If nothing is done, there will be more Dendreons.

Warning Number 2

In my comment letter of June 19, 2009 (http://www.sec.gov/comments/s7-08-09/s70809-3758.pdf), I stated on page2:

Our electronic markets lack a shock absorber.

Most electronic exchanges around the world have automated systems in place to deal with extreme events. We don't. High speed algorithmic trading has brought amazing liquidity and low transactions costs to the markets, but it also brings the risk of market disruption at warp speed.

Our markets are vulnerable to short-term fluctuations that can result in prices that do not reflect the market's consensus of the value of the stock. The disruption in the trading of Dendreon (DND) on April 28, 2009 that I referred to in my remarks at the Roundtable is a smoking gun. (My remarks are repeated at the end of this comment letter for you convenience as well.)

The stock plunged for no apparent reason, and by the time the humans halted trading the damage was done. Many investors who had placed stop-loss orders discovered that their orders had been filled at very low prices. Furthermore, incidents like these bring up suspicions of foul play, and these suspicions hurt our capital markets. When investors think that market manipulation is unpunished, they will withdraw from our capital markets, reducing their usefulness to our society.

Short selling is not the only cause of short term market disruptions.

A burst of short selling can cause a "Dendreon moment", but so can long selling. Markets can also be disrupted on the up side as well. In considering what to do about situations like this, the Commission should consider the broader needs of the market for a shock absorber to deal with excessive short-term volatility.

The Commission should actively consider shock absorbers that deal with ALL price disruptions, not just ones triggered by short sales. One time-tested model to consider is the "volatility interruption" used by Deutsche Börse.[14] When the stock moves outside of a reference range, trading is halted for a period of time and trading then restarts with a call auction.

We need not follow the Deutsche Börse model exactly. Short orders at prices below the previous opening or closing price could be excluded from the restarting auction (with appropriate exemptions for market makers and arbitrageurs). After trading restarts, restrictions should be placed on short sales at prices 5% or more below the previous opening or closing price to maintain fair and orderly trading. These could include 1) preborrowing requirements or a bid test.

Any changes should be carefully studied with a transparent pilot experiment.

Before the Commission institutes any such changes, it should experiment carefully as it did with the original Regulation SHO pilot. In this way, the Commission could adopt the best of the different proposals after carefully examining their impact.

[14] http://deutsche-boerse.com/dbag/dispatch/en/binary/gdb_content_pool/imported_files/public_files/10_downloads/31_trading_member/10_Products_and_Functionalities/20_Stocks/50_Xetra_Market_Model/marktmodell_aktien.pdf

Warning Number 3

In my September 21, 2009 comment letter to the SEC on short selling (http://www.sec.gov/comments/s7-08-09/s70809-4658.pdf), I stated on page 1:

> The big picture is that today's warp speed computerized markets contain the potential for another financial catastrophe at warp speed. If an algorithm at a large financial institution misfires, whether because of an honest malfunction or sabotage, it could create an enormous critical chain reaction that would cause a tsunami of economic destruction within milliseconds. Yet we currently rely on slow humans at our exchanges to make decisions. We need automated circuit breakers that function on a stock by stock basis that will kick in instantly when something goes haywire. To date, the SEC has taken the same approach to such warnings as FEMA took to warnings that New Orleans was vulnerable to a Category 5 hurricane. Do we need a Category 5 meltdown in the equity market before the SEC moves to take action to prevent such a preventable calamity? The individual exchanges cannot act on their own because of the competitive fragmented nature of our modern markets. If a single exchange halts trading, it stands at a competitive disadvantage to its competitors. Dealing with this threat requires intelligent coordinated action by the SEC.

Warning Number 4

In my joint study with former SEC chief economists Lawrence Harris and Chester Spatt (http://www.sec.gov/comments/s7-02-10/s70210-54.pdf), we stated on page 47:

> 8.3 Misfiring algorithms
>
> In a related area, we are also concerned that, even without naked access, the risk control procedures at a brokerage firm may fail to react in a timely manner when a trading system malfunctions. In the worst case scenario, a computerized trading system at a large brokerage firm sends a large number of erroneous sell orders in a large number of stocks, creating a positive feedback loop through the triggering of stop orders, option replication strategies, and margin liquidations. In the minutes it takes humans at the exchanges to react to the situation, billions of dollars of damage may be done.
>
> Currently our exchanges have no automatic systems that would halt trading in a particular stock or for the entire market during extraordinary events.6 It is our understanding that the circuit breakers instituted after the Crash of 1987 would be manually implemented, which could take several minutes.7 These circuit breakers are triggered only by changes in the Dow Jones Industrial average, so severe damage could be done to other groups of stocks, and the circuit breakers would not kick in. Also, a misfiring algorithm could also create a "melt-up" as well. We recommend that the exchanges and clearinghouses examine the risk and take appropriate actions. Perhaps the issue most simply could be addressed by requiring that all computer systems that submit orders pass their orders through an independent box that quickly counts them and their sizes to ensure that they do not collectively violate preset activity parameters.

Warning Number 5

In my comment letter of April 30, 2010 (http://www.sec.gov/comments/s7-02-10/s70210-172.pdf), I stated on page 5 (yellow text and **bolding** are in the original):

> **High frequency technology requires high frequency circuit breakers.**
>
> There is one risk that HFT imposes on the market that must be addressed by the Commission. With so much activity driven by automated computer systems, there is a risk that something will go extremely wrong at high speed. For example, a runaway algo at a large firm could trigger a large series of sell orders across multiple assets, triggering other sell orders and causing major disruptions with losses in the billions. With the global linkage of cash and derivative markets around the world, it would be extremely difficult to go back after the fact and bust the appropriate trades, leading to years of litigation. The uncertainty and confusion would cause serious damage. Even more troubling is the prospect that such a glitch could be caused intentionally, either by a disgruntled employee or a terrorist.
>
> All market participants have the right incentives to prevent this from happening. The brokerage firms and exchanges have filters in place designed to catch "fat fingers" and other mistakes. However, the never ending quest for higher speed also creates incentives for them to cut corners and eliminate time consuming safeguards that might slow their response time. In today's competitive market place, no one market center can take all the needed actions alone. There needs to be coordinated guidance from the Commission on this issue.
>
> No human system is perfect. Despite all of the correct incentives and precautions, airplanes sometimes crash. Eventually there will be some big glitch. We need a market wide circuit breaker that is activated automatically in real time. It is my understanding that the crude market-wide circuit breakers imposed after the crash of 1987 are currently operated manually. In the minute or so it takes for humans to respond to a machine meltdown, billions of dollars of damages could occur.[15] The April 28, 2009 incident involving Dendreon is an example of what can go wrong. The stock lost over half its value for no apparent reason in less than two minutes before the humans could stop trading. When trading resumed, the stock returned to its previous value. Many investors who had placed stop orders experienced severe losses from trades that were not busted. Almost exactly one year later, on April 27, 2010, a botched basket trade resulted in the need to bust clearly erroneous trades in over 80 different stocks. It is extremely messy to attempt to bust erroneous trades after the fact, especially if multiple instruments in multiple asset classes traded on multiple exchanges in multiple countries are involved. For example, an investor may sell stock that was purchased during the malfunction only to find that

[15] See Bernard S. Donefer, Algos Gone Wild: Risk in the World of Automated Trading Strategies, *Journal of Trading* 5 (2), Spring 2010 pages 31-34 http://www.iijournals.com/doi/abs/10.3905/JOT.2010.5.2.031

the purchase was busted but not the later sale, leading to an inadvertent naked short position. We need a real time circuit breaker that can stop the market before extreme damage occurs.

The Commission should consider imposing an automated market wide trading halt in any instrument that falls 10% in a short period of time. The stock would then re-open using the opening auction after humans have examined the situation to make sure that the stock can be re-opened in a fair and orderly manner.

If this Commission fails to act on this risk after asking so many questions about HFT in this Release, this Commission and its staff will be blamed for ignoring this risk when the inevitable big glitch occurs."