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1. Introduction

The phenomenon of a 'flash crash' first surfaced on May 6th 2010, when security prices in the Dow Jones index experienced a sudden fall, losing up to 9% of its value in a matter of minutes (Treanor, 2015). Unlike other sharp intraday market breaks,multiple securities traded at clearly unreasonable prices, including some (e.g., Accenture, 3M) that traded for pennies (Madhavan, 2012).

This coined the term 'flash crash': when a sudden and deep fall in stock prices occurs within an extremely short period of time. While market crashes typically occur over a few days, 'flash crashes' occur in a matter of minutes, resulting with losses in the billions, and devastation of investor and market confidence. While flash crashes have continued to occur since, the underlying causes have remained somewhat ambiguous, with numerous hypotheses offering a variety of explanations. In this paper, we analyse how technical, economic and social mechanisms interact to contribute to the occurrence of flash crashes, and evaluate current mechanisms to mitigate the damages involved.

2. Technical Mechanisms

The cause behind the flash crash has left many traders baffled and there have been a range of explanations behind the technicalities of a flash crash.

2.1 "Fat Finger" error

In the aftermath of the 6 May 2010 Dow Jones flash crash, earlier theories have provided an explanation for the cause of it using the "fat finger" error. The "fat finger" error is an error such that a trader enters an incorrect order, whereby the order placed is far greater than the intended size. For instance, placing a sell order in billions rather than a sell order in millions. This can then trigger a cascading of trading that lead to a drop in stock prices. However, it is unlikely for the "fat finger" error to occur in reality to occur as financial institutions have taken several procedures and protection meausres against it (Jonathan, 2010).

2.2 Spoofing

Spoofing involves placing a high number of orders with the intent of cancelling them before they are fully filled (Montgomery, 2016). It creates a false sense of investor demand in the market, thereby changing the behaviour of other traders and profiting from these changes in the process. For instance, a trader who uses spoofing may submit a large sell order. A submission of a large scale sell order give a false impression of the market desire to sell, prompting traders to drive the price down. However, spoofing can be difficult to prove because the trader might have legitimate reasons to cancel an order. It is difficult to determine the intentions behind a trade (Bates, 2015).

2.3 High frequency trading (HFT)

More recently, there have been more insights on the relationship between high frequency trading (HFT) and flash crash. High frequency traders' responses to the unusually large selling pressure exacerbated market volatility and induces the flash crash.

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To understand the relationship between HFT and flash crash, we first need to understand what is high frequency trading. In the early days, trading of stocks can happen in a simple process; the investor conveyed his decisions to buy or sell to a broker. With this information, the broker then routed the order to an exchange, where trade is executed after successful matching of bids and offers. However, today's trading is a lot more complex and is done in microseconds (PWC, 2015). High frequency trading activity can generate an astounding volume of trades in a day, sometimes exceeding over one million per day. What is characteristic of HFT is their full automation, relatively short holding period and rapid execution; It goes above algorithmic trading by having minimal execution and holding times. HFT is defined as "real-time computer-generated decision making in financial trading, without human interference and based on automatized order generation and order management" (Monson 2013). HFT looks to identify profitable arbitrage opportunities that result from market structure inefficiencies. More than often, such arbitrage opportunities exist for only a short period of time. Since computers are able to scan the market for them, arbitrage is the main and appropriate trading strategy applied by HFT. and execute appropriate trading strategies to the disadvantage of other investors. HFT can bring about positive benefits. High frequency trading can substantially improve market liquidity, remove bid-ask spread that would have been previously too small, lowers market volatility and also makes investing less expensive for other market participants. While HFT has its advantages, its growing use also has given rise to certain risks that cannot be ignored, as discussed below.

HFT may not be a direct cause of the flash crash but it can reduce liquidity and magnify the downward price pressures, which can in turn boost volatility even more and contribute to market turmoil. For instance during the May 6, 2010 Dow Jones flash crash, there was a market order book imbalance in S&P 500 E-mini futures. Analysts found that this was largely due to Waddell and Reed's large sell orders, as well as Nav Sarao's large spoofing sell orders (Viswanatha, 2015). The net volume on the sell-side was so high, it was found to be 15 times higher than the normal average of that similar time period. Price started to drop as a result of the sell side pressure. Under calm market conditions (where prices are not moving directionally due to an exceptionally large order book imbalance), the last few contracts at the best bid or ask levels will be aggressively removed by HFTs. HFTs will then establish new best bids and asks at adjacent price levels. Though such high frequency trading activity does not result in the directional movement of prices, it increases the rate of price change and also increases trading volume (Kirilenko, 2015). However, when prices are moving directionally due to an imbalance in order book flow, high frequency trading activity exacerbates this movement and contribute to high volatility in the market. Higher volatility will further accelerate the speed of removal of the best bid and ask levels, in turn making high frequency traders act even faster than any other traders. This generate a "hot potato" effect and lead to a quick spike in volume, setting the stage for flash crash. This is what happened during the May 6, 2010 Dow Jones flash crash where "HFTs exacerbated the Flash Crash by aggressively removing the last few contracts at best bids and demanding additional depth while liquidating inventories during key moments of dwindling market liquidity" (Kirilenko, 2015).

The liquidity crisis spread as some high frequency traders begin to withdraw from the market, leading to a further decline in market liquidity. When there is a balance in the order book flow, high frequency market makers have the potential to earn margins on massive number of trades. However, in distressed market conditions (imbalance in order book) where market volatility is high, HFT might increase adverse selection problem, defined as the "potential loss due to informational differences between market maker and market taker" (Aldridge, 2010). Increased liquidity introduces new risks and market makers now face the prospect of losses due to adverse selection. Therefore, as high frequency traders detected the drop in E-mini, many of them remove themselves from trading in equities market due to high volatility and high risk of adverse selection, further evaporating liquidity in the market (Kirilenko, 2015).

Overall, it can be said that high frequency trading activity takes away market liquidity. Firstly, it cascaded negative price movements due to rapid trading on the sell side. Secondly, it caused high frequency traders to pull out from the market (Turbeville, 2013). Therefore, HFT sets the market into a general liquidity crisis and played a key role in inducing the flash crash.

2.4 Structural flaws in market:

Current trading structure can leave markets more vulnerable to rapid and unchecked swings, leading to the flash crash. For instance, decentralization of trading center today reduces market stability as opposed to having concentrated exchanges. Furthermore, the the time nature of the market is continuous. This time nature leads to execution of trade orders at random timing as uncoordinated traders execute trade orders at random timing. Many sell orders can thus appear simultaneously (at the same time) in the market, resulting in a flash crash.

3. Economic and Social Factors

Markets are platforms whereby buyers and sellers interact such that each party seeks to maximise its utility. These players are subject to various circumstance specific constraints and conditions, such as transaction costs, regulations, level of technology, etc. Furthermore, each player has a unique vested interest in trading, and a unique perspective with respect towards trading, leading to employments of different trading systems, automated or manual, as well as unique forms of cognitive bias. These unique attributes are influenced via positive or negative perceptions of macro level conditions of the economy. Thus, we often observe that social, political and economic factors can often affect investors perceptions and confidence, leading to desirable or undesirable effects on the market.

One such example, occurred in April 23 of 2013, when a hoax tweet about an explosion in the White House was published. The tweet falsely claimed that President Obama was severely injured in the blast, and resulted in a 0.9% decline in the S&P 500 Index -- a US$130 Billion loss in stock value in a manner of seconds (Matthews, 2013).

In this section, we analyze the manner in which economic, political and social events influence the market. This entails examining: the mediums through which external infomation entering the market is propagated, the effects of social, economic and

political events on trading behaviour, and ultimately how these combine to bring about flash crashes.

3.1 Algorithms and HFTs

A popular hypothesis of what caused the flash crash following the hoax tweet, is that the downward spiral of security prices was initiated by high frequency traders selling in mass volumes due to information processing algorithms picking up specific keywords that triggered a 'sell' response. It is likely that the words "White House," "explosion," or "Barack Obama" were in databases as keywords that could trigger selling given the right circumstances. These systems consider the credibility and frequency of the information's appearance over the media, to determine if the information is actionable. Given that many people retweeted the message — many of whom were trusted journalists themselves —made the news appear even more trustworthy to the bots (Matthews, 2013).

From the initial volume of sell orders, prices likely fell enough to trigger stop orders to generate even more downward pressure. Thus through the use of automated systems, HFTs can react to extraordinary extents in a short amount of time when events perceived as detrimental, do come to pass. While the announcement of "bad news" has always adversely affected markets, and even causing market meltdowns, it is evident that the arrival of newer systems that enable HFT, and real-time algorithms to trigger trading actions have resulted with an evolution of the trading market that makes it susceptible to flash crashes.

3.2 Momentum of Public Perception

Algorithms and technical mechanisms function as systems that react and respond. This presupposes that they interact within a larger context and environment. In conjection, every instance of a flash crash has been underpinned by macroeconomic factors elements affecting market volatility, almost as if to act as a prerequisite for the phenomenon. We thus examine events leading up to flash crashes, identifying how various elements interact to influence trading behaviour.

Macro Conditions surrounding each flash crash:

<u>6th May 2010</u>

The United Kingdom was having its general election day. In the US, Wall Street was gripped by mounting anxiety about the Greek debt crisis and the euro was falling against the dollar and the yen (Treanor, 2015).

It is plausible that these anxieties were played out when the large sell order for "e-mini" futures was executed, leading to the perpetual net trading and feedback loop that caused prices to spiral.

<u>23rd April 2013</u>

The Boston marathon bombings had just occured on the 15th of April, leaving many at a heightened state of alert. President Obama labelled the incident as an act of terrorism (CNN , 2016).

This heightened state of fear possibly helped to fuel perception that an attack on the White House was entirely plausible, leading to a sense of credibility towards the hoax.

24th August 2015
Fears about China's economic slowdown and uncertainty around the Federal Reserve's policy on raising interest rates led to traders dumping stocks early when there weren't a lot of buyers, which likely triggered high-speed trading models to shut down when they noticed unusual pricing (Wells, 2016).

6th October 2016
The British Pound suffered a fall of 6% in the span of two minutes with expectations of a hard bexit. This follows a speech from Francois Hollande, the French president, in which he stated that the UK would not be able to retain membership of the EU's single market without having to accept the free movement of labour (King, 2016)

The instances listed above, demonstrate how social, political and economic events act as a backdrop for market meltdowns. They influence investors perception and confidence levels, sending traders into panic zones, leading to financial stoppages. When detrimental events unfold, the information is either processed through algorithms or manually by traders, and then employed to be traded upon. We thus examine how such information and expectations influence various types of traders, and how their actions contribute or mitigate the effects of a flash crash.

3.3 Traders

Traders often endeavour to maximise profits, and can do so by processing information to form expectations regarding the movement of prices, and acting in accordance towards these expectations. In the case of a flash crash, we see an interaction between value traders and momentum traders. Value traders employ all information available to postulate upon an instrument's fundamental value, and seek to exploit mispricing. Through the use of algorithms and the possible occurrence, “fat-finger” transactions, we can see how value traders can quickly react to external occurrences like economic shifts, that affect a commodities fundamental value. In the 23rd April 2013 flash crash of the US stock market, we observed that the market quickly regained composure and its losses when the hoax was exposed. The ability of value traders to thus process information accurately and with speed, can thus be said to trigger large spikes in the market when social, political or economic events of proportional scale occur.

However, flash crashes can also occur when value traders inaccurately overestimate the impact of an event on the devaluation of a commodity. It is also arguable that such misinformed behaviour could arise from uninformed traders, making speculations. Here, the “fat-finger” theory is most probable in accounting as the trigger of a flashes crash; where traders err in specifying the size, price limit and time frame of their orders. Following the trigger, momentum traders, seeing prices falling as a signal to sell, would act to exaggerate the extent of the flash crash.

3.4 Relativity of External Impacts

However, not all adverse social, political, and economic events may necessarily lead to a decline in prices, not all decline in prices constitute a market meltdown. Furthermore, a flash crash is an extremely unique form of market meltdown in that it happens in an extremely short period of time. This is observed in the flash crash of 15th January 2015, where, prior to the flash crash, market action remained healthy in 2015, despite many unknowns including if the European Central Bank's (ECB) quantitative easing (QE) program will be tabled in a matter of days, and if Greece will remain in the eurozone (Popplewell, 2015).

Rather, the flash crash was triggered by a sudden shift in policy by the Swiss National Bank (SNB), to abandon its cap on the Swiss-Frac to Euro rates, and allowing CHF rates to strengthen against the euro. Although, there is the argument that economic conditions surrounding the dynamics of the exchange rate were such that the SNB were often the main or only player intervening in stabilizing the CHF at €1.20, we find that the macro-economic conditions can be hard to predict with respect to their impact on the market.
We reference the recent US elections and examine the effect of the news on the Dow Jones Index, to demonstrate the relative nature with regards to investor confidence in perceiving events of significance.



Figure 1: Intra-Day Prices for Dow Jones on 8th November 2016[1]

Figure 1 displays the intraday prices of the Dow Jones Index on the day of the US Election results. Contrary to general sentiments of anxiety and negativity towards a Trump presidency, we observe that the index instead rises, peaking around midday and closing higher than it opened. This is of interest as there were substantial reports capturing the general sentime that a Trump presidency would bode ill for the US economy. From racially intolerant remarks, to an unusually aggressive stance towards foreign trade, the Trump campaign raised many warning flags that the US might

[1] Google Finance. Dow Jones Industrial Average 2 Minute [Digital image]. Retrieved

undertake a more protectionist policy. Furthermore, his victory comes as an upset, with many expecting Hillary Clinton to lead the polls (Matthews, 2016).

Analysts have pointed to speculation that a Trump presidency would in fact be more moderate than the one portrayed in the campaign, and pursue more business-friendly policies. Contrary to earlier reports that a Trump victory would unhinge markets, investors have perceived Trumps first speech to hold a more conciliatory tone, leading to wagers that he would increase fiscal spending to boost economic growth. The sum of these events led to a significant drop in volatility, with the CBOE Volatility Index falling 23 percent in the wake of the results, and the S&P500, Nasdaq and the Dow all climbing to season highs (Jackson, 2016).

Concluding the analysis regarding social, political and economic factors, we observe that events of significance have always impacted investor expectations and are propagated into the market via various mechanisms. In the specific scenario of a flash crash, the advancement of data collection and processing methods, have enabled for high volumes of securities to be exchanged in reaction to respective events. We have also observed that while these events can intuitively be interpreted as to their expected impacts on the market, the actual impact that does materialise often remains unpredictable. Thus we find that such factors are unreliable to be employed as indicators, but are better served as elements that comprise the economic context in which a market is framed. What this does mean to the policy maker and to the everyday trader, specifically regarding the topic of flash crashes, is that such occurrences continue to remain highly difficult to anticipate and prevent without considering the structural and inherent risks modern markets now possess with the advancement technology. The rate at which information is gathered and processed, the speed and volumes that trades can be executed at, and the connectivity of a global economy, have unlocked financial prospects like never before. These advancements thus bring about the risk of flash crashes, and are as irreversible as they are innovative. What is prudent therefore, is to continue developing market structures and policies, to mitigate fundamental errors that can cause market failures, and we address this in the next section.

4. Preventing Flash Crashes

With everyone flooding the sell side desperate to sell off their stocks during a flash crash, this only make matters worse as prices continue to plunge. Stockholders' value diminishes drastically and the market capitalization of numerous companies shrink phenomenally. This would lead to possible detrimental effects to future business progression. The devastating effects of a flash crash, coupled with the many possible causes of a flash crash (such as those mentioned above), has led to many regulators to focus more resources and efforts into mitigating this issue. These regulators are namely, the Securities and Exchange Commision (SEC) - a federal agency responsible for enforcing the federal securities law and proposing rules- and the joint Commodity Futures Trading Commission- Securities and Exchange Commision (CFTC-SEC) advisory committee.

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4.1 Structural safety nets

After the 2010 flash crash, the SEC and the joint CFTC-SEC advisory committee implemented a few structural safety nets which mainly aims at pausing trading platforms during a flash crash and restricting certain trades which might trigger or further aggravate a flash crash. From 2010 onwards, the committees have been actively looking for ways to improve its preventive measures. This section will touch on three of the fourteen recommendations made by the CFTC-SEC advisory committee. They are namely 1) A Circuit Breaker Program 2) Limit systems 3) Standards for breaking erroneous trades. Other than the three, other recommendations included; limiting unfiltered market access, implementing effective audit trails, etc. These would be covered in other sections of this essay.

4.1.1 Market wide Circuit breakers

One measure the SEC adopted was to set up a market wide circuit breaker (Protess, 2012). This is a direct deterrence to an event of a flash crash. In short, this circuit breaker pauses market-wide trading for five minutes when the security prices move more than 10% during a five minute period (Bates, 2011). The benefit of this is that it is a relatively simple and effective measure to counter a possible flash crash. Stopping any more trades that would result in dampening or eliminating further effects of a full-on flash crash. In addition, as demonstrated by the CME's Stop logic Functionality that triggered a halt in E-mini trading, pausing a market could be an effective way to provide time for traders to reassess their strategies, for algorithms to reset their parameters, and for an orderly market to re-establish itself (SEC, 2011). However the limitations is that it does not mitigate the effects of the flash crash fully. The stock prices would already have been brought down by a huge 10% before the solution kicks in. Hence, more preventive measures would need to be implemented.

4.1.2 Limit up/ Limit down system

To further improve the circuit breaker approach, the Joint CFTC-SEC advisory committee, incorporated a limit up/ limit down mechanism that would directly prevent trades outside certain parameters, while allowing trades to go in within those parameters. This could prevent anomalous trades from ever occurring and hence limit their disruptive effects.

4.1.3 Clearer processes for breaking erroneous trades

A lesson learnt from the may 6 2010 flash crash is that trader's uncertainty about when trades will be broken can affect trading strategies and market liquidity. To reduce this uncertainty, allowing traders to better manage their risk, the SEC worked with the exchanges and the Financial Industry Regulatory Authority (FINRA) to set up more transparent objective standards for breaking erroneous trades which was made effective on December 12, 2010. For example, where circuit breakers are not applicable, the exchanges and FINRA will break trades at specified levels for events involving multiple stocks depending on how many stocks are involved: for events involving more than 20 stocks, trades will be broken when it is at least 30% away from the reference price (Appendix A) .

4.1.4 Evaluation of structural safety nets

The three aforementioned preventive measures are a good start for fighting an event of a flash crash. However, many researchers believe that it is far from addressing the underlying problem. These methods are effective methods to fight the 'fire', the painful event of a flash crash. However, this fire fighting methods are not sufficient. As much as these measures could help dampen the effects of a flash crash, the fact is, there would still be damaging effects from the flash crash before the flash crash is stopped by the circuit breakers, limit systems, etc. Hence, many are working towards other methods that can sniff out smoke, to snuff the fire before it can even start. Agencies are looking for solutions that could predict or detect a possible flash crash before its damaging effects appear.

Currently, there are algorithms made that can respond immediately to market abnormalities and anticipate interruptions to liquidity (Bate, 2011). These algorithms could help alert managers of possible issues or could help by changing trading strategies in accordance with the market glitches. Future improvements on these algorithms and proper education on utilising them could help reduce the probability of a flash crash.

4.2 Regulating HFT

As mentioned above, a big causational factor links back to high frequency trading (HFT) and Algorithmic trading. The CFTC technical advisory committee has defined HFT to be a form of automatic trading that employs algorithms for decision making, technologies designed to minimize response times, high speed connections to markets and high message rates (Appendix B). With their ability to trade at high volumes in a matter of a matter of microseconds, this form of trading adds a huge amount of volatility in the markets, making flash crashes susceptible. As such, regulators have been trying to come up with policies and rules to control the behavioural patterns of HFT. Below are the few major policies regulators have come up with regarding HFT that are essentially preventive measures against possible flash crashes.

4.2.1 Banning naked access

Naked access lets high speed traders and others buy and sell stocks on exchange using a broker's computer code without requiring them to filter through the broker's systems or undergo any pre-trade checks (Holzer and Peterson, 2010). The implication of this set up allows HFTs to save time as they go pass broker's controls. However, it also means that the lack of risk controls could lead to order-entry errors which could leave other market participants financially vulnerable. Hence, the SEC in Nov 2010 voted unanimously to require brokers and dealers to have risk controls in place before providing their customers with access to the market, effectively banning naked access. The benefit of this rule mitigates the possibility of flash crashes as probability or order-entry errors going through will be reduced due to risk control. However a negative impact of this policy would be that it would cause financial strain on smaller trading firms. The enhanced controls will cost the broker-dealer industry $100 million annually and will be spread unevenly, affecting smaller shops more as they will see trading slowed down, on top of the additional expenses of implementing risk controls (Holzer, 2010).

4.2.2 Consolidated audit trails

As of 27th April 2012, the SEC approved of Rule 613. The purpose of Rule 613 is to create a comprehensive consolidated audit trail that would allow regulators to efficiently and accurately track all trading activities throughout the U..S. markets in National Market System (NMS) securities. The 351 page proposal included many detailed guidelines including the requirement of self-regulatory organizations (SROs) to jointly submit a NMS plan to consolidate audit trails. The proposal also specifies the type of data to be collected and when the data is to be reported. Data includes customer and order event information from the time of order inception through routing, cancellation, modification, or execution. This is yet another form of efficient risk control, to detect any form of anomalous or erroneous trading patterns and curb it before an event of a flash crash happens. The downside would be the additional financial strains it puts on regulatory organizations.

4.2.3 Guidelines with regards to Disruptive Trading Practices

As of 16th May 2013, the CFTC approved a final rule that sets out interpretive guidance on disruptive trading practices. This provides guidance on section 747 of the "Dodd-Frank Act", which prohibits certain disruptive trading practices. The interpretive statement will assist market participants and the public with guidance on how the Commission intends to apply the statutory prohibitions set forth in that act. In short, the guidelines set in 2013 would provides rules on what traders should not be doing. Many of these rules touch on the area of HFT. For example, a HFT strategy that rapidly sends and cancels the same order many times is interpreted to be creating the false appearance of liquidity (O'Malia, 2013). This guidelines aims to remove loopholes that allow disruptive trading practices to occur without punishment. As such, the guidelines would provide traders utilising HFT a better picture on how they should be behaving (CFTC, 2013).

4.2.4 Regulations in the EU and UK

Outside the scope the the U.S. regulators, the European Securities and Markets Authorities (ESMA) and the Financial Conduct Authority (FCA) have also been actively refining policies to control the increasing activity of HFTs in European and UK markets. With the passing of Markets in Financial Instruments Directive II (MiFID II) around July 2014, new rules for HFT in EU and UK markets will take hold. In short, MiFID II requires that all HFT firms have to be authorized when they engage in algorithmic trading. They would also have to notify competent authorities of the trading venues in which they engage in algorithmic trading. The purpose of this required authorization is to ensure these firms have the proper controls and systems suitable to the business it operates, for example; adequate staff expertise, IT requirements that meet certain standards, etc (FCA, 2014). In addition, those engaging in market making strategies will have to enter into market making agreements in their respective venues, in order to improve the liquidity in the markets, particularly in times of high volatility.

Other than MiFID II, there are other guidelines and policies such as Guidelines 2012/122 (ESMA, 2012) and Market Abuse Regulations (MAR) to regulate these kinds of trading strategies. For instance, under MAR, Algorithmic trading firms and HFTs should have in place automated surveillance systems to keep themselves accountable to authorities (ACA compliance Europe, 2016).

4.2.5 Evaluation of regulating HFTs

All in all, relevant authorities around the world are taking good active steps to control HFTs trading behaviours. As such, the market would be safer off with less firms undergoing systemic failures and submitting erroneous orders which might then trigger a flash crash. Also, such regulations will prevent market abuse using these new trading strategies. However, aside from all the good it brings, there come a cost to such regulations. Things like establishing a consolidated audit trail and implementing real time surveillance proves to be costly and will put financial strain on authorities and market participants. The question would then be; which cost is bigger? The consequence of reducing regulations and increase probability of a flash crash? or reducing the probability of a flash crash but instead increasing the use of financial resources to deter it from happening? It is not definitive which one is bigger, but at least, cost for regulations can be predicted and planned out whereas consequences for a flash crash are unpredictable and drastically large. As such, these regulations are beneficial, however how effective they are at detecting and preventing flash crashes would be hard to measure (ACA, 2016).

4.3 Options

In addition to current measures taken by authorities to prevent flash crash, market participants could also take it upon themselves to defend their positions in a possible event of a flash crash. One way which many experts advise would be to invest in options, particularly, put options (Finberg, n.a). This works as an insurance policy in the event of a flash crash. Traders investing in such options would have a better ability of defending themselves against the drastic drop in stock prices (Lee, 2016).

5. Conclusion

In this paper, we examined how technical mechanisms have now enabled a sudden and pronounced drop in prices, in which HFT magnifies the effect of a liquidity shortage, and how spoofing and fat finger trading can contribute and trigger downward spirals by applying pressures to the buy-sell mechanisms. We realised that these actions are reflections of investor expectations, an instance of anxiety overloads even, where a quick and devastating loss of investor confidence can lead intense decreases of prices in a short time frame. We observe that the use of algorithms and HFT have allowed traders to react to the economic environment they are in with greater sensitivity than before, in speed and volume. The macro climate has always affected pricing and the health of the economic market, through political, social and/or economical factors, yet in the case of a flash crash, various scenarios over the course of the last half-decade have shown that the actual impact of external events can be hard to predict. While general indicators for volatility like civil unrest, economic health, etc., can give an estimation as to the probability of the occurrence of a flash crash, it is hard to separate the effect of these macro conditions in contributing to a flash crash because much of the analysis is done in retrospect, and ignores the effect of the implementation of new measures and policy targeted at preventing flash crashes. Thus, it is apparent that while the intents and incentives behind transactions have remained similar, the system by which such wills are executed have evolved and brought about new benefits and challenges.

We isolate the root contribution to this rising phenomenon, to be the bane of technological advancements and the evolution of trading markets, and thus discuss the impact of policies in correcting and mitigating the risk of these new methods. The main focus of preventing flash crashes, centres on regulation, such that traders are brought to check, and that erroneous trading behavior that could lead to flash crashes are curbed as much as possible. This would include regulating HFT, and implementing audit trails to increase transparency, effectively discouraging spoofing and increasing detection of fat finger transactions. Coupled with this, we see that the main focus of mitigating the effects of flash crashes are centred on safety nets, so as to lessen the extent of price drop and volume traded.

The big question that therefore remains is if flash crashes are a result of faulty usage of new systems in the trading realm, or if flash crashes are a result of faulty systems. The former is by far the easier to correct, and current measures would see to effective mitigation. However, the latter seems to be the more probable option, when one considers the flash crash of the hoax tweet on the white house, and the fact that the root causes of flash crashes have remained elusive. It is therefore necessary for more focus to be given to systemic and intrinsic risk and flaws of these new trading mechanisms, as to their source of origins, and how to effectively mitigate them; inadvertently addressing the issue of flash crashes.

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Appendix A: comprehensive list of standards for breaking trades, approved by the SEC[2]

For stocks that are subject to the circuit breaker program, trades will be broken at specified levels depending on the stock price:

- For stocks priced $25 or less, trades will be broken if the trades are at least 10% away from the circuit breaker trigger price.
- For stocks priced more than $25 to $50, trades will be broken if they are 5% away from the circuit breaker trigger price.
- For stocks priced more than $50, the trades will be broken if they are 3% away from the circuit breaker trigger price.

Where circuit breakers are not applicable, the exchanges and FINRA will break trades at specified levels for events involving multiple stocks depending on how many stocks are involved:

- For events involving between five and 20 stocks, trades will be broken that are at least 10% away from the "reference price," typically the last sale before pricing was disrupted.
- For events involving more than 20 stocks, trades will be broken that are at least 30% away from the reference price.

[2] Findings regarding the market events of May 6, 2010 [Digital image]. (n.d.). Retrieved December 7, 2016, from https://www.sec.gov/news/studies/2010/marketevents-report.pdf

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Appendix B: Definition of HFT set by CFTC technical Advisory Committee, 2012[3]

Draft Definition, May 2012:

High frequency trading is a form of automated trading that employs:

(a) algorithms for decision making, order initiation, generation, routing, or execution, for each individual transaction without human direction;

(b) low-latency technology that is designed to minimize response times, including proximity and co-location services;

(c) high speed connections to markets for order entry; and

(d) high message rates (orders, quotes or cancellations).

[3] CFTC Technical Advisory Committee Sub-Committee on Automated and High Frequency Trading [Digital image]. (n.d.). Retrieved December 7, 2016, from http://www.cftc.gov/idc/groups/public/@newsroom/documents/file/wg1presentation062012.pdf