BLOCKCHAIN: A PROPOSAL TO REFORM HIGH FREQUENCY TRADING REGULATION⁺

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INTRODUCTION

The traditional method of buying, selling, and yelling orders from the trading floor of the New York Stock Exchange is an archaic concept.¹ The technological transformation of the NYSE has been the expected next step in the technology-driven twenty-first century.² With only about forty people running the trading floor at a given time,

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¹ D.M. Levine, *A Day in the Quiet Life of a NYSE Floor Trader*, FORTUNE (May 29, 2013, 2:15 PM), http://fortune.com/2013/05/29/a-day-in-the-quiet-life-of-a-nyse-floor-trader/ ("[T]here were phones, no screens . . . and I had a buy pad, a sell pad, a cancellation pad' where he wrote down stock orders. 'That's all—there was no technology.'").

² Maureen Farrell, *The Computers That Run the Stock Market*, CNN MONEY (July 8, 2013, 7:16 AM), http://money.cnn.com/2013/07/08/investing/stock-market-citadel/ ("More and more, high speed computer programs are replacing thousands of floor brokers once seen running and yelling across the floor of the NYSE.").

computers outnumber humans and perform most of the work by using algorithms.³ The use of computers and digital screens has increased the efficiency, speed, and accessibility of trades.⁴ Brokers are no longer running through the trading floor with paper slips from orders just placed over the telephone.⁵ With just a few clicks, traders today can complete a large number of transactions and move millions of dollars on the stock market within seconds.⁶

The power of computing makes trades faster and faster,⁷ enabling the phenomena of High Frequency Trading ("HFT"), which uses trading platforms and complex computer algorithms to execute orders at increasingly fast speeds.⁸ High frequency traders can make millions in milliseconds by programming a computer algorithm to buy and sell securities at the right moment on the right exchange.

Despite its benefits, HFT also presents a number of downsides. Wall Street traders' widespread adoption of HFT led to a "Flash Crash" in 2010, when stock prices plunged in only a matter of minutes and nearly one trillion dollars of stockholder value was wiped out before the market rebounded and closed three percent lower than the day before.⁹ In response to the crash, the exchanges implemented circuit breakers that initiate when an individual stock fluctuates between rapid, unusual price swings.¹⁰ Following the U.S. Securities and Exchange Commission ("SEC") regulations imposing circuit breakers on exchanges, HFT continued to develop and prosper without much public and media attention.¹¹

Nevertheless, HFT has once again come into the spotlight.¹² Strong

³ *Id.* ("About 40 people 'run' the trading floor, but they are simply overseeing computers that use algorithms to fill and route stock orders.").

⁴ Nick Baumann, *Too Fast to Fail: How High-Speed Trading Fuels Wall Street Disasters*, MOTHER JONES (Jan. 2013), http://www.motherjones.com/politics/2013/02/high-frequencytrading-danger-risk-wall-street (quoting then-SEC chair Mary Schapiro) ("Thanks to technology, our securities markets are more efficient and accessible than ever before.").

⁵ See Farrell, supra note 2.

⁶ Julia La Roche, A Floor Broker Explains What They Actually Do All Day At The New York Stock Exchange, BUS. INSIDER (Oct. 22, 2012, 10:49 AM), http://www.businessinsider.com/ heres-what-a-nyse-floor-broker-does-2012-10 ("These days there's more IM chatting than talking on the phone and more computers down here trading that [sic] human yelling and screaming.").
⁷ Farrell, supra note 2 ("Trading is definitely faster, but whether it's better and cheaper for the

average retail investor remains to be seen.").

⁸ *High Frequency Trading—HFT*, INVESTOPEDIA, http://www.investopedia.com/terms/h/high-frequency-trading.asp (last visited Sept. 1, 2015) ("A program trading platform that uses powerful computers to transact a large number of

orders at very fast speeds. High-frequency trading uses complex algorithms to analyze multiple markets and execute orders based on market conditions.").

⁹ See Baumann, supra note 4.

¹⁰ Ia.

¹¹ See Ari Rubenstein, Thank You, Michael Lewis, CNBC (Apr. 30, 2014, 11:07 AM), http://www.cnbc.com/2014/04/30/thank-you-michael-lewis-hft-traderflash-

boyscommentary.html.

¹² Id.

accusations have recently emerged blaming HFT for extreme stock price fluctuations and unstable markets,¹³ as popularized in the 2014 release of Michael Lewis' best-selling novel, *Flash Boys: A Wall Street Revolt*, which has led to a growing consensus that this form of trading negatively impacts investors and the general public.¹⁴ The SEC is once again faced with increasing pressure to take additional remedial action.¹⁵ Past regulations have been no match for the continuing technologically innovative behavior of high frequency traders.

This Note argues that when the SEC contemplates new rules for HFT, it should use a pseudonymous blockchain public ledger to record all trades placed on the exchanges in order to eliminate the possibility for gain.¹⁶ Instead of trades only being revealed on the exchanges once they are posted, a blockchain public ledger will operate as a triple-entry accounting system, showing each order to the sender, the receiver, and the network as it is executed while still maintaining the secrecy of the transacting parties.¹⁷ In addition to encouraging the SEC to implement new blockchain technology,¹⁸ this Note also maintains that the SEC would benefit from applying unique high frequency trading regulatory ideas used in different countries.¹⁹ The SEC can most effectively regulate HFT practices by using foreign regulatory ideas and by employing a blockchain public ledger.²⁰

This Note unfolds in five parts. Part I addresses the history of high frequency trading including its early usage, its downsides, and its evolution to today. Part II explores the current SEC regulations and methods that cover the practice of HFT. Part III addresses the problems traditional regulation faces in governing HFT. Part IV proposes that the SEC use a blockchain public ledger to regulate HFT in the future while considering the technological aspects, costs, downsides, and possible effects of blockchain implementation. Additionally, Part V proposes that the SEC also adopt HFT regulatory ideas from abroad, with a focus

¹³ Eric Garcia, *Controversial High-Frequency Trading Study Says Practice Boosts Liquidity*, MARKETWATCH (Dec. 1, 2014, 2:43 PM), http://www.marketwatch.com/story/controversialhigh-frequency-trading-study-says-practice-boosts-liquidity-2014-12-01.

¹⁴ See Steven Pearlstein, 'Flash Boys': Michael Lewis Does It Again, WASH. POST (Apr. 12, 2014), http://www.washingtonpost.com/business/flash-boys-michael-lewis-does-it-again/2014/04/12/4a53daf8-bf5d-11e3-b195-dd0c1174052c_story.html.

¹⁵ Id.

 ¹⁶ Kieren James-Lubin, *Essentials for a Blockchain Based Security Issuance*, CONSENSUS (Aug. 14, 2014), http://kjameslubin.blogspot.com/2014/08/essentials-for-blockchain-based.html.
 ¹⁷ Id.

¹⁸ Carlo Caraluzzo, *Overstock.com Plans New Bitcoin-Blockchain Based Stock Market*, COINTELEGRAPH (Oct. 8, 2014, 10:52 AM), http://cointelegraph.com/news/112699/ overstockcom-plans-new-bitcoin-blockchain-based-stock-market.

 ¹⁹ Holly A. Bell & Harrison Searles, An Analysis of Global HFT Regulation: Motivations, Market Failures, and Alternative Outcomes (Mercatus Ctr. at George Mason Univ., Working Paper No. 14-11, 2014), http://mercatus.org/sites/default/files/Bell_GlobalHFTRegulation_v2.pdf.
 ²⁰ See id.

on practices in the United Kingdom and Germany.

I. BACKGROUND

State and federal securities laws regulate securities exchanges and trading firms.²¹ With an influx of new technology entering the securities markets, regulators are facing difficult challenges to monitor new practices.²² In particular, HFT firms formulate algorithms to accurately place a large number of trades in speeds unattainable by humans.²³ The algorithmic trading comprising HFT is proprietary and lucrative.²⁴ Average investors with fewer resources lag behind high frequency traders in physical access to the markets and general speed of trading.²⁵ In an effort to control HFT under the current securities laws, regulators adapt old rules to changing trading environments.²⁶ Without curbing the technological advances encompassed in modern day securities trading, regulators must develop new rules and methods to monitor and regulate new speeds of trading.

Stock exchanges encourage investment from those willing to participate in the markets and follow general guidelines. The markets inherently carry some degree of inequality and unfairness because the party issuing the stock may have more information about its value than the party purchasing the stock. In order to address this information asymmetry, Congress has imbued the SEC with the power to regulate stock exchanges. The SEC implements and enforces rules to protect investors, maintain fair and efficient markets, and facilitate capital formation.²⁷ To facilitate fairness, the rules provide that investors should have access to basic facts about an investment before buying it and while holding it.²⁸ The information flow helps ensure a more efficient and transparent capital market.²⁹ The SEC continually develops new rules to regulate and adapts old rules to the changing environments and practices.

28 Id.

²¹ Securities, LEGAL INFO. INST., https://www.law.cornell.edu/wex/securities (last visited Mar. 7, 2015).

²² Sam Mamudi & Nick Baker, *Mary Jo White Gets High-Frequency Embrace With SEC Plan*, BLOOMBERG BUS. (June 6, 2014, 12:00 AM), http://www.bloomberg.com/news/articles/2014-06-06/mary-jo-white-gets-high-frequency-embrace-with-sec-plan.

²³ Charles M. Jones, *What Do We Know About High-Frequency Trading?* (Mar. 20, 2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2236201.

²⁴ United States v. Agrawal, 726 F.3d 235, 237–38 (2d Cir. 2013).

²⁵ See Baumann, supra note 4.

²⁶ Julie VerHage & Charlie Gasparino, *SEC Likely Won't Enact Stand-Alone High-Frequency Trading Rules*, FOX BUS. (Oct. 23, 2014), http://www.foxbusiness.com/economy-policy/2014/10/23/sec-likely-wont-enact-stand-alone-h8igh-frequency-trading-rules/.

²⁷ The Investor's Advocate: How the SEC Protects Investors, Maintains Market Integrity, and Facilitates Capital Formation, U.S. SECURITIES AND EXCH. COMM'N, http://www.sec.gov/about/whatwedo.shtml (last updated June 10, 2013).

²⁹ Id.

HFT is just one of the many evolutions of traditional trading and poses a new regulatory challenge to the SEC. The speed of trading presents new risks and challenges because it has the ability to continue evolving at a rapid pace, potentially surpassing regulatory guidelines faster than new rules can be implemented.³⁰

A. Overview of HFT

Roughly fifty percent of stock trading volume in the United States is conducted by computerized HFT algorithms.³¹ HFT employs complex trading mechanisms to execute trades in speeds unattainable by human capacity.³² Wall Street traders develop and continuously update algorithms to analyze multiple markets and execute trades in response to market conditions.³³ Generally, the faster a trade is executed, the more profitable it is for the trader.³⁴ The computer algorithms react to previously selected market conditions to conduct high volume transactions and create short-term profits.³⁵

Two popular methods of HFT are "execution trading" and "small trading."³⁶ Execution trading is when an order is executed through a computerized, proprietary algorithm.³⁷ During the process of small trading, computers look for small trading opportunities in the market instead of executing a set order.³⁸ By discovering asymmetric information within the market and minor price differentials across exchanges, high frequency traders can profit from recognizing opportunities or inconsistencies within stock listings.³⁹

The trading strategies are effectuated through complex algorithms comprised of mathematical models that determine the optimal time for an order to be placed.⁴⁰ The algorithms are increasingly complex, can cost several millions of dollars to develop over the course of a few

³⁰ See Mamudi & Baker, supra note 22.

³¹ See High Frequency Trading (HFT), NASDAQ, http://www.nasdaq.com/investing/glossary /h/high-frequency-trading (last visited Sept. 7, 2015).

³² Eliot Lauer et al., *Stay Afloat in the New Wave of High-Frequency Trading Actions*, N.Y. L.J., Feb. 25, 2013, at S4. ("High-frequency trading (also called high-speed trading) employs computerized systems capable of rapid calculation and data transmission time to run algorithms that identify and execute trading opportunities in milliseconds—and increasingly in microseconds.").

³³ *High Frequency Trading—HFT, supra* note 8 ("High-frequency trading uses complex algorithms to analyze multiple markets and execute orders based on market conditions.").

 $^{^{34}}$ *Id.* ("Typically, the traders with the fastest execution speeds will be more profitable than traders with slower execution speeds.").

³⁵ See High Frequency Trading, BUSINESSDICTIONARY.COM, http://www.businessdictionary.com /definition/high-frequency-trading.html (last visited Sept. 7, 2015).

³⁶ See High Frequency Trading (HFT), supra note 31.

³⁷ Id.

³⁸ Id.

³⁹ See Jones, supra note 23.

⁴⁰ Algorithmic Trading, INVESTOPEDIA, algorithmictrading.asp (last visited Sept. 7, 2015).

http://www.investopedia.com/terms/a/

years, and can span thousands of pages in length if printed out.⁴¹

Algorithmic trading allows computers to directly interface with trading platforms, placing orders without any human intervention.⁴² In its most basic form, algorithmic trading uses a set of rules to insert portions of an order into the market at pre-determined intervals.⁴³ However, there are more complex variations that involve proprietary algorithms that use information gathered from different markets and different assets to transact numerous related trades in tiny fractions of a second.⁴⁴ Traders are even developing Alternative Trading Systems ("ATS"), which create computerized neural networks allowing the algorithms to evolve and adapt to market at that specific point in time.⁴⁶

High frequency trading firms also use directional strategies,⁴⁷ which enable computers to analyze past events and generate statistically robust patterns.⁴⁸ With the compilation of past occurrences, high frequency trading firms then estimate expected price responses to future anticipated events.⁴⁹ To collect and interpret the historical market data, codes are written to translate, organize, and review the data in a usable format.⁵⁰ A signal or "alpha"⁵¹ is then tested over the market data. Different firms develop their own alphas or combination of alphas to use in a trading strategy.⁵² The combination of codes and algorithms a firm uses is proprietary and particularly guarded because the unique set of data is how the firm conducts its trades and makes money.⁵³

Liquidity detection strategies allow high frequency traders to employ their computers to detect hidden demand for liquidity in the market.⁵⁴ Some firms benefit from providing liquidity⁵⁵ in the market by

⁴⁶ Id.

⁴⁸ Id.

49 Id.

⁴¹ United States v. Agrawal, 726 F.3d 235, 237–38 (2d Cir. 2013).

⁴² Charles R. Korsmo, *High-Frequency Trading: A Regulatory Strategy*, 48 U. RICH. L. REV. 523 (2014).

 ⁴³ TECH. COMM. OF INT'L ORG. OF SECURITIES COMM'NS, CONSULTATION REPORT: REGULATORY ISSUES RAISED BY THE IMPACT OF TECHNOLOGICAL CHANGES ON MARKET INTEGRITY AND EFFICIENCY (July 2011) [hereinafter *Consultation Report*].
 ⁴⁴ Id

⁴⁵ Michael J. McGowan, *The Rise of Computerized High Frequency Trading: Use and Controversy*, 2010 DUKE L. & TECH. REV. 16 (2010).

⁴⁷ *Consultation Report*, supra note 43 ("[U]n-hedged positions being carried for some . . . period of time, in anticipation of small but lasting intra-day price changes.").

⁵⁰ Citadel Inv. Grp., LLC v. Teza Techs. LLC, 398 Ill. App. 3d 724, 725 (2010).

⁵¹ *Id.* at 726 n.1 ("Signals or 'alphas' are mathematical price prediction algorithms or models developed and tested by Citadel.").

⁵² Id. at 726.

⁵³ Rob Iati, *The Real Story of Trading Software Espionage*, WALLSTREET & TECHNOLOGY, (Jul. 10, 2009, 12:32 PM), http://www.wallstreetandtech.com/trading-technology/the-real-story-of-trading-software-espionage/a/d-id/1262125?.

⁵⁴ See Consultation Report, supra note 43.

⁵⁵ *Liquidity*, INVESTOPEDIA, http://www.investopedia.com/terms/l/liquidity.asp (last visited Sept.

the Electronic Communications Networks ("ECNs") and exchanges, making the role of market maker⁵⁶ especially advantageous.⁵⁷ Firms also profit from the bid-ask spread⁵⁸ in addition to simply placing orders and using limit orders.⁵⁹

Not only are technological advances helping high frequency traders profit in their everyday trading, but physical privileges are also aiding firms in placing faster orders.⁶⁰ High frequency traders place their servers right next to the exchanges and reap a 200-millisecond advantage over other traders.⁶¹ Co-location strategies make this possible by taking advantage of the physical proximity between trading systems and trading venue servers.⁶² By reducing the physical distance the information must travel across wires, high frequency trading firms can reduce the speed of their trades even more.⁶³ Firms compete to get closer and closer to the exchanges.⁶⁴ Co-locating provides firms with the advantage of receiving information milliseconds before other traders.⁶⁵ HFT firms pay millions of dollars for this advantage because every fraction of a second counts in high frequency trading.⁶⁶ The high cost provides firms with access to direct data feeds⁶⁷ that ordinary investors may not be able to access.⁶⁸ The location strategy, combined with increasingly easy access to high bandwidth at a low cost, increases not only the speed of trades but also the number of trades.⁶⁹ With more

^{7, 2015) (}Liquidity is "the degree to which an asset or security can be quickly bought or sold in the market without affecting the asset's price.").

⁵⁶ *Market Maker*, INVESTOPEDIA, http://www.investopedia.com/terms/m/marketmaker.asp (last visited Sept. 7, 2015) (A market maker is "[a] broker-dealer firm that accepts the risk of holding a certain number of shares of a particular security in order to facilitate trading in that security. Each market maker competes for customer order flow by displaying buy and sell quotations for a guaranteed number of shares. Once an order is received, the market maker immediately sells from its own inventory or seeks an offsetting order. This process takes place in mere seconds.").

⁵⁷ Prableen Bajpai, *Strategies and Secrets of High Frequency Trading (HFT) Firms*, INVESTOPEDIA, http://www.investopedia.com/articles/active-trading/092114/strategies-and-secrets-high-frequency-trading-hft-firms.asp (last visited Sept 7, 2015).

⁵⁸ Bid-Ask Spread, INVESTOPEDIA, http://www.investopedia.com/terms/b/bid-askspread.asp (last visited Sept. 14, 2015) (Bid-ask spread is "the amount by which the ask price exceeds the bid. This is essentially the difference in price between the highest price that a buyer is willing to pay for an asset and the lowest price for which a seller is willing to sell it.").
⁵⁹ Id

⁶⁰ Decentralized Autonomous Society, Interview by Sam Frank with Vitalik Buterin, Inventor of Ethereum, in N.Y.C., N.Y. (Feb. 24, 2015).

 $^{^{61}}$ Id.

⁶² See Consultation Report, supra note 43.

⁶³ See Baumann, supra note 4.

⁶⁴ 155 CONG. REC. S9308-02, 9315-16 (daily ed. Sept. 14, 2009).

⁶⁵ Id. at 9316.

⁶⁶ Id.

 ⁶⁷ Complaint at 6, People v. Barclays Capital, Inc., No. 451391/2014, (N.Y. Sup. Ct. June 25, 2014) (noting that direct data feeds are "high-speed data feeds that travel faster and contain more information than market data available to ordinary investors by other, less expensive means").
 ⁶⁸ Id.

⁶⁹ Nina Mehta, High-Frequency Trading Is a Tough Game, TRADERS (Nov. 24, 2009),

firms testing this method, concerns are raised regarding equal access to the market since such services are limited by the capacity of physical space.⁷⁰

Index arbitrage is another method employed by HFT firms to recognize and profit from the differences in the prices of securities on different markets.⁷¹ An algorithm enables a firm to profit by recognizing price differences and executing a trade faster than someone else.⁷² High frequency traders also benefit from the general flow of the market by gathering embedded data and extracting information that may not yet be known to other investors.⁷³ The information provided from this data that has yet to reach the general marketplace allows high frequency traders to interpret the information quickly and place orders.⁷⁴ This statistics-based method allows a trader to capitalize on temporary inconsistencies and minor fluctuations.⁷⁵ Without the speed and accuracy of algorithms, many of these discrepancies would likely go unnoticed.⁷⁶

The majority of stock trading volume in the United States is executed by the computers and algorithms that drive HFT.⁷⁷ Taking advantage of the growing technological capabilities, HFT firms use anticipation and momentum strategies to direct their computer programs to buy and sell in anticipation of other trades or by starting a momentum of trades.⁷⁸ In an order anticipation strategy, the computers attempt to discover the existence of large buyers or sellers in the marketplace.⁷⁹ Once identified, the algorithms then trade ahead of the large buyers or sellers in "anticipation that their large orders will move market prices."⁸⁰ In a momentum ignition strategy, computer programs and algorithms quickly initiate "a series of orders and trades in an attempt to ignite a rapid price move up or down."⁸¹ Once the price returns back to normal, the instigator profits from the artificially created, rapid price increase.⁸² The high frequency trader takes a position early on, after the price has increased, and then trades out before the price drops back

http://www.tradersmagazine.com/news/high-frequency-trading-tough-game-104672-1.html. ⁷⁰ See Consultation Report, supra note 43.

⁷¹ United States v. Agrawal, 726 F.3d 235, 238 (2d Cir. 2013).

⁷² Mark Koba, *High Frequency Trading: CNBC Explains*, CNBC (Jan. 24, 2013, 2:34 PM), http://www.cnbc.com/id/100405633.

⁷³ Id.

⁷⁴ Id.

⁷⁵ See Bajpai, supra note 57.

⁷⁶ Id.

⁷⁷ See High Frequency Trading—HFT, supra note 8.

⁷⁸ Equity Market Structure Literature Review Part II: High Frequency Trading, U.S. SEC. & EXCH. COMM'N (Mar. 18, 2014), http://www.sec.gov/marketstructure/research/hft_lit_review_march_2014.pdf.

⁷⁹ Id.

⁸⁰ Id.

⁸¹ Id.

⁸² See Bajpai, supra note 57.

down to normal levels.⁸³ By correctly anticipating the large orders or initiating the momentum for a specific price, the high frequency traders profit from making the sale or buying ahead of other traders.⁸⁴

B. Downsides of HFT

Although it is profitable for traders, HFT does have tangible downsides. For example, on May 6, 2010, securities prices on the S&P 500 quickly dropped in a "Flash Crash" ⁸⁵ and then recovered twenty minutes later, causing investors to lose about \$862 billion.⁸⁶ During the Flash Crash, prices for the E-Mini S&P 500 futures contract and the SPY S&P 500 exchange traded fund plunged five percent in five minutes.⁸⁷ Ten minutes later, the prices recovered from the losses.⁸⁸ During the recovery period, prices of individual equities and exchange traded funds plummeted to extremely low levels before they, too, rebounded.⁸⁹ Attributable to a computer glitch, the point drop was the worst recorded in the Dow Jones Industrial Average history.⁹⁰ By the close of the market, prices were back to normal as if nothing had ever happened.⁹¹

After the event, the exchanges implemented circuit breakers to delay trading if such an event were to occur again.⁹² If a price were to fluctuate too quickly, the circuit breakers would pause trading in an individual security.⁹³ The circuit breakers would initiate if the security moved ten percent or more within five minutes or less.⁹⁴ The SEC also implemented a Consolidated Audit Trail ("CAT") to increase confidence of market participants, even in times of extreme conditions.⁹⁵

⁸⁸ Id.

⁸⁹ Id.

94 Id.

⁸³ Id.

⁸⁴ See Equity Market Structure Literature Review Part II: High Frequency Trading, supra note 78.

⁸⁵ Flash Crash, INVESTOPEDIA, http://www.investopedia.com/terms/f/flash-crash.asp (last visited Sept. 7, 2015) ("The quick drop and recovery in securities prices that occurred shortly after 2:30pm Eastern Standard Time on May 6, 2010. Initial reports that the crash was caused by a mistyped order proved to be erroneous, and the causes of the flash crash remain unknown.").
⁸⁶ See Mehta, supra note 69.

⁸⁷ Gregg E. Berman, U.S. Sec. & Exch. Comm'n, Market Participants and the May 6 Flash Crash (Oct. 13, 2010) (transcript available at http://www.sec.gov/news/speech/2010/spch101310geb. htm).

⁹⁰ See Tom Lauricella & Peter A. McKay, *Dow Takes a Harrowing 1,010.14-Point Trip*, WALL ST. J. (May 7, 2010, 12:01 AM), http://www.wsj.com/articles/SB10001424052748704370704 575227754131412596.

⁹¹ See Berman, supra note 87.

⁹² See Press Release, U.S. Sec. & Exch. Comm'n, SEC to Publish for Public Comment Stock-by-Stock Circuit Breaker Rule Proposals (May 18, 2010), http://sec.gov/news/press/2010/2010-80.htm.

⁹³ See Berman, supra note 87.

⁹⁵ Id. ("A consolidated audit trail would significantly aid in SRO efforts to detect and deter

Although there were suggestions that high frequency traders caused the Flash Crash, the SEC denied this accusation.⁹⁶ The SEC concluded that high frequency traders did not directly cause the day's events to occur, but they did manage to take advantage of the decline in prices.⁹⁷ However, when the International Organization of Securities Commissions investigated the events surrounding the Flash Crash, it found that HFT technology and algorithms were clearly a contributing factor.⁹⁸ There have been suggestions that the SEC should have taken other steps to regulate, including subjecting high frequency traders to heightened regulatory oversight to ensure fair dealing.⁹⁹ Others have suggested that the more the SEC interferes and attempts to solve the problems associated with the Flash Crash, the more likely events like the Flash Crash will occur.¹⁰⁰

C. Flash Boys: A Wall Street Revolt

Michael Lewis, author of three books about investing and Wall Street, released *Flash Boys: A Wall Street Revolt* on March 31, 2014.¹⁰¹ Lewis tells the story of the computer-driven world of high frequency trading.¹⁰² Reaching the best-sellers list, Lewis' story has been told to many readers outside the traditional audience of business people and investors.¹⁰³ Proposing his ideas and suggestions, he brought consumers' latent suspicions to life by personally confirming the skepticism that Wall Street and the stock market are rigged.¹⁰⁴ The push back from Wall Street banks and brokers, who classify his novel as old news, has fueled the fire behind the conversation even more.¹⁰⁵ With the technology and controversies placing high frequency trading in the

fraudulent and manipulative acts and practices in the marketplace, and generally to regulate their markets and members. In addition, such an audit trail would benefit the Commission in its market analysis efforts, such as investigating and preparing market reconstructions and understanding causes of unusual market activity.").

⁹⁶ *Id.* ("So while it does not seem that HFTs directly caused a wave of selling, HFTs did ride that wave down as prices declined.").

⁹⁷ Id.

⁹⁸ See Koba, supra note 72.

⁹⁹ Edgar Ortega Barrales, *Lessons from the Flash Crash for the Regulation of High-Frequency Traders*, 17 FORDHAM J. CORP. & FIN. L. 1195 (2012).

¹⁰⁰ Comment Letter from Steve Wunsch on Limit Up-Limit Down Plan to Address Extraordinary Market Volatility to Elizabeth Murphy (June 2, 2011), https://www.sec.gov/comments/4-631/4631-1.pdf ("The more complex the Commission makes the market, the more likely it is that surprises like the flash crash will occur.").

 ¹⁰¹ Steven Perlberg, *Michael Lewis Is Coming Out With A New Wall Street Book*, BUS. INSIDER (Jan. 14, 2014, 2:47 PM), http://www.businessinsider.com/michael-lewis-flash-boys-2014-1.
 ¹⁰² 160 CONG. REC. S1915-01 (daily ed. Apr. 1, 2014) (statement of Sen. McCain).

¹⁰³ See Pearlstein, supra note 14.

¹⁰⁴ 160 CONG. REC. S1915-01 ("Lewis' narrative appears to have struck a raw nerve among consumers, by confirming a latent belief and skepticism that Wall Street is indeed an insider's game and that the public's best interests are, at most, an afterthought.").

¹⁰⁵ See Pearlstein, supra note 14.

spotlight,¹⁰⁶ the SEC is being pressured by consumers to find new ways to regulate.¹⁰⁷ Since the Flash Crash, HFT has become faster, more intelligent, and more accurate, thus prompting more public awareness and renewed regulatory scrutiny.¹⁰⁸ Individual investors and the general public are concerned about the viability of the markets as lawsuits continue to emerge against firms for manipulative activity.¹⁰⁹

II. THE SEC'S CURRENT ATTEMPTS TO REGULATE HFT

In response to these risks, the SEC has enacted a series of regulations to address HFT. The technologies behind HFT enable a surplus of fast trades to go undetected or unrecorded,¹¹⁰ which encouraged the SEC to develop and test numerous strategies in an attempt to regulate high frequency trading.¹¹¹

One technique the SEC has implemented is the consolidated audit trail ("CAT").¹¹² CAT gathers information from all transactions relating to an order.¹¹³ It keeps a complete record from origination to execution or cancellation.¹¹⁴ It also allows the SEC to identify firms engaged in HFT.¹¹⁵ Although it has not been revealed just how helpful CAT will be to regulating and tracking high frequency trades, it is the first step toward regulation by recordkeeping.¹¹⁶

The SEC has also explored the use of a market information data analytics system ("MIDAS") in order to gain information about the offers and bids to buy and sell shares on the stock market.¹¹⁷ The SEC developed the system to promote a better understanding of the markets.¹¹⁸ MIDAS collects data from the consolidated tapes and separate proprietary feeds belonging to equity exchanges.¹¹⁹ The information gathered on MIDAS allows the SEC to analyze thousands

¹⁰⁹ Id.

¹⁰⁶ Zach Warren, *SEC Chair White Reveals Proposals to Regulate Stock Market, High-Frequency Trading*, INSIDE COUNSEL (June 6, 2014), http://www.insidecounsel.com/2014/06/06/sec-chair-white-reveals-proposals-to-regulate-stoc.

¹⁰⁷ 160 CONG. REC. S1915-01 (daily ed. Apr. 1, 2014), ("[R]egulators at the SEC and CFTC should fully investigate these issues and pursue proposals that can minimize systemic risk and bolster trust in our markets.").

¹⁰⁸ See VerHage & Gasparino, supra note 26.

¹¹⁰ Matt Prewitt, *High-Frequency Trading: Should Regulators Do More?*, 19 MICH. TELECOMM. & TECH. L. REV. 131 (2012).

¹¹¹ See Mamudi & Baker, supra note 22.

¹¹² Francesco DeLuca, *High Frequency Trading*, 32 REV. BANKING & FIN. L. 62 (2012).

¹¹³ Id.

¹¹⁴ *Id*.

¹¹⁵ Id.

¹¹⁶ *Id*.

¹¹⁷ *Id.*

¹¹⁸ *MIDAS*, U.S. SEC. AND EXCH. COMM'N, http://www.sec.gov/marketstructure/midas.html (last updated Oct. 29, 2013).

¹¹⁹ Id.

of stocks over periods of six months or a year.¹²⁰

In an attempt to reduce sudden price movements in stocks, the exchanges have implemented a limit up-limit down mechanism to replace the old single-stock circuit breaker pilot.¹²¹ The traditional single-stock circuit breakers were triggered by large, sudden moves in an individual stock.¹²² The new limits employed on the exchanges address overall market volatility and aim to prevent trades from occurring outside of set boundaries.¹²³ Instead of waiting for specious trading to occur, this mechanism is designed to prevent such trading before it even occurs.¹²⁴ The limit up-limit down guidelines also provide the market with a fifteen second grace period to correct itself before regulation and freezing step in.¹²⁵

Recognizing the severe impact technological mishaps could have on trading, the exchanges set safeguards to minimize potential threats that could negatively impact market efficiency and transparency.¹²⁶ Market-wide circuit breakers were aimed at combating technological fluctuations and problems that could occur in the market.¹²⁷ Circuit breakers are not just designed to regulate HFT.¹²⁸ Stock exchanges use circuit breakers to avert panic selling when large sell-offs occur.¹²⁹ The circuit breakers halt trading in all stocks when the market dips below a certain predetermined percentage.¹³⁰ When an anomalous trade pattern is detected, circuit breakers go into effect to prevent, correct, or halt trading.¹³¹

Partnering with the Financial Industry Regulatory Authority ("FINRA"), the SEC intends to deal with co-location issues and exchange infrastructure by controlling risks associated with algorithms.¹³² These controls will screen and test different trades to ensure they are in compliance with the current regulations.¹³³

Proposals for best practices in HFT regulation seek to distinguish aspects of high frequency trading that can possibly be classified as

¹²³ See Frequently Asked Questions, Limit Up-Limit Down, NASDAQTRADER.COM, http://www.nasdaqtrader.com/content/marketregulation/luld_faq.pdf (last visited Sept. 7, 2015). ¹²⁴ See DeLuca, *supra* note 112.

¹²⁰ Id.

¹²¹ See DeLuca, supra note 112.

¹²² Investor Bulletin: New Stock-by-Stock Circuit Breakers, U.S. SEC. AND EXCH. COMM'N, http://www.sec.gov/investor/alerts/circuitbreakers.htm (last updated Aug. 9, 2011).

¹²⁵ Id.

¹²⁶ See Prewitt, supra note 110.

¹²⁷ Id.

¹²⁸ *Circuit Breaker*, INVESTOPEDIA, http://www.investopedia.com/terms/c/circuitbreaker.asp (last visited Sept. 7, 2015).

¹²⁹ Id.

¹³⁰ See DeLuca, supra note 112.

¹³¹ See Prewitt, supra note 110.

¹³² See Korsmo, *supra* note 42.

¹³³ *Id*.

market manipulation¹³⁴ from normal trading activities.¹³⁵ One proposal to determine whether activities violate best practices is to test algorithms used by HFT firms before they enter the real market.¹³⁶ This approach could potentially prevent market inaccuracies, volatilities, and technological missteps.¹³⁷

The SEC proposed and implemented Regulation Systems Compliance and Integrity ("Regulation SCI") in order to test the trading systems used by brokers.¹³⁸ Regulation SCI requires SCI entities to ensure their systems have the correct levels of capacity and security to maintain their capabilities and promote the maintenance of the markets.¹³⁹ SCI entities are also required to perform mandated testing of their operations and disaster recovery plans.¹⁴⁰ When SCI events¹⁴¹ occur, the entities involved must take corrective action and notify the SEC.¹⁴² Recently, the SEC voted to adopt more rules to further strengthen the technology infrastructure of the securities markets and Regulation SCI.¹⁴³ The efforts will impose requirements on certain traders and reduce the occurrence of issues within the operating systems.¹⁴⁴ When problems do occur, updated corrective actions will be imposed.¹⁴⁵ Notifications about systems issues and annual reviews of automated systems will also be more thoroughly communicated to participants.146

Registration and reporting requirements for large traders could enable the SEC to keep track of the trades being processed and

¹³⁴ *Manipulation*, U.S. SEC. & EXCH. COMM'N, http://www.sec.gov/answers/tmanipul.htm (last updated Mar. 28, 2008) ("Manipulation is intentional conduct designed to deceive investors by controlling or artificially affecting the market for a security. Manipulation can involve a number of techniques to affect the supply of, or demand for, a stock.").

¹³⁵ See Korsmo, supra note 42.

¹³⁶ Id.

¹³⁷ Id.

¹³⁸ GARY SHORTER & RENA S. MILLER, CONG. RESEARCH SERV., R43608, HIGH-FREQUENCY TRADING: BACKGROUND, CONCERNS, AND REGULATORY DEVELOPMENTS (2014).

¹³⁹ *Regulation Systems Compliance and Integrity*, U.S. SEC. AND EXCH. COMM'N, http://www.sec.gov/rules/final/2014/34-73639.pdf (last updated Nov. 19, 2014). ("Regulation SCI will require SCI entities to establish written policies and procedures reasonably designed to ensure that their systems have levels of capacity, integrity, resiliency, availability, and security adequate to maintain their operational capability and promote the maintenance of fair and orderly markets, and that they operate in a manner that complies with the Exchange Act.").

¹⁴⁰ Id.

¹⁴¹ *Id.* (SCI events are "defined to include systems disruptions, system compliance issues, and systems intrusions.").

¹⁴² *Id*.

¹⁴³ Press Release, U.S. Sec. and Exch. Comm'n, *SEC Adopts Rules to Improve Systems Compliance and Integrity* (Nov. 19, 2014), http://www.sec.gov/News/PressRelease/Detail/ PressRelease/1370543496356.

¹⁴⁴ Id.

¹⁴⁵ Id.

¹⁴⁶ Id.

cancelled by HFT firms.¹⁴⁷ The Large Trader Rule also enables the SEC to identify and obtain trading information on firms or traders that conduct a substantial amount of trading activity.¹⁴⁸ To qualify under the rule as conducting a substantial amount of activity, trading is measured by either volume or market value.¹⁴⁹ Fees on large order cancellations have also been implemented by NASDAQ and Direct Edge, two prominent exchanges.¹⁵⁰

Under SEC Rule 15c3-5, HFT firms are prohibited from receiving naked access.¹⁵¹ Naked access is a form of unfiltered access to an exchange or an ATS.¹⁵² Broker-dealers provide their customers with unfiltered access by giving them a special pass, called a market participant identifier, to access the markets.¹⁵³ Their customers use the pass to gain direct access to the exchange.¹⁵⁴ Rule 15c3-5 requires firms to maintain risk management controls and supervisory procedures.¹⁵⁵ The broker-dealers are also responsible for maintaining a system to regularly evaluate the effectiveness of the controls placed on the system.¹⁵⁶ Broker-dealers are responsible for promptly addressing the issues and annually certifying that their procedures comply with the rule.¹⁵⁷

III. PROBLEMS TRADITIONAL REGULATION FACES IN GOVERNING HFT

The SEC has been adapting to the changing environment of HFT with more precautions and regulations, but it is limited in its ability to detect and monitor all of the daily trades on the different exchanges. The volume of information leaves policymakers facing "an uphill battle in which regulatory fixes quickly become obsolete as the trading firms' approaches and algorithms adapt almost as rapidly as information travels on their fiber-optic cables."¹⁵⁸ Once the SEC spends time and effort to develop and promulgate a regulation or new rule, the regulation

¹⁴⁷ SHORTER & MILLER, *supra* note 138.

¹⁴⁸ Large Trader Rule, U.S. SEC. & EXCH. COMM'N, http://www.sec.gov/rules/proposed/2010/34-61908.pdf (last updated Apr. 14, 2010).

¹⁴⁹ Id.

¹⁵⁰ See Prewitt, supra note 110.

¹⁵¹ SHORTER & MILLER, supra note 138.

¹⁵² Rule 15-c3-5—Risk Management Controls for Brokers or Dealers with Market Access, U.S. SEC. & EXCH. COMM'N, http://www.sec.gov/rules/final/2010/34-63241-secg.htm (last updated Jan. 6, 2011).

¹⁵³ SEC Adopts New Rule Preventing Unfiltered Market Access, AUTOMATED TRADER http://www.automatedtrader.net/headlines/60563/sec-adopts-new-rule-preventing-unfiltered-market-access (last visited Sept. 7, 2015).

¹⁵⁴ Id.

¹⁵⁵ Rule 15-c3-5—Risk Management Controls for Brokers or Dealers with Market Access, supra note 152.

¹⁵⁶ Id.

¹⁵⁷ Id.

¹⁵⁸ 160 CONG. REC. S1915-01 (daily ed. Apr. 1, 2014).

may be obsolete when applied to HFT activity.

The SEC is tasked with effectively maintaining regulatory oversight of the markets while also implementing relevant rules. With new technology continuously developing, "regulators are outmatched by the rapid advances in high-speed trading."¹⁵⁹ Although the SEC faces a tough technological and speed battle, it continues to impose new regulations and develop new strategies to better ensure the trading platform remains fair.

The SEC's past proposed and implemented regulations have not been a match for the continuously changing technological landscape of the stock market.¹⁶⁰ The highly innovative strategies used by high frequency traders make it more difficult for regulatory agencies to differentiate between acceptable trading practices and market manipulation.¹⁶¹ Therefore, the SEC must also use highly innovative technology to better monitor and regulate high frequency trading activities. As with any new technological advance, financial cost is quick to follow.¹⁶² The SEC encounters financial difficulties that HFT firms do not experience.¹⁶³ Firms have the capital to recruit the best coders and programmers to develop the newest edition of highly technical algorithms. They can spend hundreds of thousands of dollars creating one new algorithm because it has the potential to make the firm millions in return. The SEC lacks such resources but must craft an equally technical approach to challenge HFT firms directly in order to regulate effectively and preserve the integrity of the markets.¹⁶⁴

The SEC has taken its first steps toward a technology-driven approach to target concerns raised by HFT.¹⁶⁵ Recently, the SEC requested a twenty-five percent budget increase to specifically police

^{159 155} CONG. REC. S9308-02, 9316 (daily ed. Sept. 14, 2009).

¹⁶⁰ Prewitt, *supra* note 110, at 155 ("Regulators currently lack the ability to effectively monitor and analyze HFT activity.").

¹⁶¹ Peter J. Henning, *Why High-Frequency Trading Is So Hard to Regulate*, N.Y. TIMES DEALBOOK (Oct. 20, 2014, 1:40 PM), http://dealbook.nytimes.com/2014/10/20/why-high-frequency-trading-is-so-hard-to-regulate/ ("The challenge in pursuing charges against these [HFT] firms is that they are taking advantage of changes in the technology underpinning the markets to profit from quick trades, which is not illegal.").

¹⁶² Adam Brown, SEC Asks For 25 Percent Budget Increase to Police High-Frequency Trading, IR MAGAZINE (Apr. 3, 2014), http://www.irmagazine.com/articles/stock-exchangeslistings/20129/sec-asks-25-percent-budget-increase-police-high-frequency-trading/.

¹⁶³ How the Bitcoin Protocol Could Help Stop Insider Trading, ESTIMIZE (Apr. 25, 2014, 11:17 AM), http://blog.estimize.com/post/83820475098/how-the-bitcoin-protocol-could-help-stop-insider.

¹⁶⁴ Joel Schectman, *The Morning Risk Report: Future of High Frequency Trading Regulation is Murky*, WALL ST. J. (Oct. 30, 2014, 7:20 AM), http://blogs.wsj.com/riskandcompliance/2014/10/30/the-morning-risk-report-future-of-high-frequency-trading-regulation-is-murky/ ("The SEC's [sic] is still catching up with the private sector's technology . . . [b]ut you should certainly expect to see more on action this front.").

¹⁶⁵ See Warren, supra note 106.

high frequency trading.¹⁶⁶ With the hopeful increase in budget, the SEC plans to invest in more sophisticated technological tools and platforms.¹⁶⁷ Recognizing the need for more effective technology to monitor and regulate HFT firms, the SEC continues to modernize its IT systems and infrastructure.¹⁶⁸ Specifically, the budget increase would allow the commission to upgrade and expand its "array of data-analytics tools, enhance information security, create a central repository for collected data, improve the commission's website and create an automated 'triage' system to help process tips and complaints."¹⁶⁹

Basic upgrades to the SEC's technology and information systems will produce better oversight of HFT activity on the exchanges. Facilitating the process for complaints and tips could encourage more people to report fraudulent activity to the commission. However, the SEC must move beyond basic upgrades and take further steps toward developing innovative technologies for regulation.¹⁷⁰ The SEC's past requests and implemented methods show that it is willing to adopt innovative ideas to use in connection with its traditional rules and regulations. With the ease and availability of technology, the SEC does not have to regulate alone. HFT firms must also use technology to self-regulate the market and report evidence of wrongdoing.

IV. PROPOSAL

A. Blockchain Technology

Historically, traditional SEC paper regulations have been the solution for market concerns.¹⁷¹ However, with new advances being configured each day for lower costs, technology should regulate HFT. Over time, law reacts to the push and pull of technology.¹⁷² Pushes accelerate new technological innovations and pulls decelerate it.¹⁷³

¹⁶⁶ See Brown, supra note 162.

¹⁶⁷ Id.

¹⁶⁸ Id.

¹⁶⁹ Id.

¹⁷⁰ Keri Geiger & Sam Mamudi, *HFT Firm Fined \$1 Million for Manipulating Nasdaq*, BLOOMBERG BUS. (Oct. 16, 2014, 5:49 PM), http://www.bloomberg.com/news/2014-10-16/athena-to-pay-1-million-in-sec-hft-manipulation-case.html ("There's no question they're looking over market information much closer than they have ever been . . . I don't think the oversight on trading is going to relax anytime soon.").

¹⁷¹ The Investor's Advocate: How the SEC Protects Investors, Maintains Market Integrity, and Facilitates Capital Formation, U.S. SEC. AND EXCH. COMM'N, http://www.sec.gov/about/ whatwedo.shtml (last updated June 10, 2013).

¹⁷² V. Ryan, *What is Technology Push? What Is Market Pull? Revision Cards*, TECHNOLOGYSTUDENT, http://www.technologystudent.com/prddes1/revcardtec1.html (last visited Jan. 24, 2015).

¹⁷³ John M. Golden, Innovation Dynamics, Patents, and Dynamic-Elasticity Tests for the Promotion of Progress, 24 HARV. J. L. & TECH. 47 (2010).

Although the law is generally slow to adapt new technologies,¹⁷⁴ the SEC should take this opportunity to lead the way toward embracing technological innovations.

As the speed and sophistication of HFT will likely continue to increase in the coming years, technology will enable these trades to occur but will also be used to regulate. Those involved on both ends of trading and regulation will benefit most from a comprehensive record of all trades completed each day.¹⁷⁵ Regulators should adopt a blockchain public ledger,¹⁷⁶ which records trades and identifies possible violations to monitor HFT practices.¹⁷⁷ Blockchain technology was developed to serve in part as a public ledger that records all bitcoin transactions made through an online network of decentralized users.¹⁷⁸ Bitcoin is a digital currency that uses peer-to-peer technology to manage transactions made over a public, open-source network.¹⁷⁹ Unlike other currencies, bitcoin transactions are executed without the use of banks.¹⁸⁰

In traditional blockchain protocol, all bitcoin transactions are publicly recorded and viewable.¹⁸¹ A record of how many bitcoins each person possesses and the transfers he or she makes is publicly available.¹⁸² A blockchain is comprised of several linear blocks.¹⁸³ Once a transaction is completed, it is verified and transferred permanently into the blockchain.¹⁸⁴ The latest, most recent added block is known as the current block, containing information about the most recent transaction.¹⁸⁵ Comparable to a banking statement, the block transactions are recorded chronologically in a linear or chain-like manner.¹⁸⁶ Each user utilizes a pseudonym name¹⁸⁷ or public address

¹⁷⁴ Stephanie D. Alexander, *How Bitcoin Will Bring About A Legal Practice Revolution*, LAW360 (June 4, 2014, 4:47 PM), http://www.law360.com/articles/544306/how-bitcoin-will-bring-about-a-legal-practice-revolution.

¹⁷⁵ Consultation Report, supra note 43 ("Having sophisticated systems or algorithms that monitor trading and detect patterns is a necessity in this environment of high speed and complex trading in order to maintain market integrity and confidence.").

¹⁷⁶ Jonathan Camhi, *Banks, Bitcoin & the Blockchain*, INFORMATIONWEEK (Nov. 4, 2014, 8:00 AM), http://www.banktech.com/security/banks-bitcoin-and-the-blockchain/d/d-id/1317184 (Blockchain is "the first open-source financial database that records everything that happens on the Bitcoin network and verifies all of that activity with a third party.").

¹⁷⁷ Cade Metz, *Overstock's Radical Plan to Reinvent the Stock Market with Bitcoin*, WIRED (July 30, 2014, 6:30 AM), http://www.wired.com/2014/07/overstock-and-cryptocurrency.

¹⁷⁸ *Blockchain*, INVESTOPEDIA, http://www.investopedia.com/terms/b/blockchain.asp (last visited Sept. 7, 2015).

¹⁷⁹ BITCOIN, https://bitcoin.org/en/ (last visited Jan. 24, 2014).

¹⁸⁰ What is Bitcoin?, CNN MONEY, http://money.cnn.com/infographic/technology/what-isbitcoin/ (last visited Sept. 7, 2015).

¹⁸¹ See How the Bitcoin Protocol Could Help Stop Insider Trading, supra note 163.

¹⁸² Id.

¹⁸³ See Blockchain, supra note 178.

¹⁸⁴ *Id*.

¹⁸⁵ Id.
186 Id.

^{107 117}

¹⁸⁷ Who is Satoshi Nakamoto?, COINDESK, http://www.coindesk.com/information/who-is-

key when making transfers, thereby enabling the user's identity to remain confidential.¹⁸⁸

If the blockchain approach is used across stock markets, every trade will automatically appear on a public ledger.¹⁸⁹ The system would operate on its own, posting trades to the blockchain as they are verified. When regulators or traders identify suspicious or illegal activity, the SEC will be able to pinpoint the individual or firm responsible.¹⁹⁰ The transparency of the blockchain will also enable regulators and traders to conduct statistical analyses in real time.¹⁹¹ All of the traders would be pseudonymous to each other on the public ledger through different names, but the SEC would hold a master list or public key¹⁹² of the true identities.¹⁹³ The pseudonymous private keys that will be issued to investors will allow traders and regulators to operate as they normally do under the current system.¹⁹⁴ Regulators will be able to detect illegal activity and remove bad actors from participating in the markets by revoking their private keys.¹⁹⁵ The technical approach will enable the SEC to better regulate the markets and ensure that everyone has the opportunity to fairly participate while identifying and punishing those who do not play by the rules.¹⁹⁶

In addition to its pseudonymous capabilities, blockchain technology can eliminate the practice of "front running" in which traders automatically buy stock at prices lower than the buyer's bid, thereby squeezing out other traders positioned physically farther away or those employing less sophisticated algorithms.¹⁹⁷ With a blockchain public ledger, firms cannot enjoy the benefit of positioning themselves closer to the servers because there are no servers.¹⁹⁸ Although faster

satoshi-nakamoto/ (last updated May 20, 2015) (noting that even the creator of bitcoin remains pseudonymous to this day under the alias name Satoshi Nakamoto).

¹⁸⁸ See How the Bitcoin Protocol Could Help Stop Insider Trading, supra note 163.

¹⁸⁹ Id.

¹⁹⁰ Id.

¹⁹¹ Decentralized Autonomous Society, supra note 60.

¹⁹² See James-Lubin, *supra* note 16. The public key involves "an Identity Based Encryption (IBE) scheme" where "an entity with a master-key... acts a[s] a central issuer for private keys that can be associated to public addresses—which can either be pseudonymous keys, or plaintext names." *Id.*

¹⁹³ *How the Bitcoin Protocol Could Help Stop Insider Trading, supra* note 163 ("Everyone would still be pseudonymous until the SEC is handed a complaint, then it could . . . crack down on the illegal activity discovered by other traders.").

¹⁹⁴ Id.

¹⁹⁵ See James-Lubin, supra note 16.

¹⁹⁶ Rob Peters, *High-Frequency Trading Firm Fined by SEC for Price Manipulation*, INTELLIGIZE (Oct. 17, 2014), http://www.intelligize.com/blog/rules-regulations/high-frequency-trading-firm-fined-by-sec-for-price-manipulation/ (quoting then-SEC Chair Mary White: "[w]hen high frequency traders cross the line and engage in fraud we will pursue them as we do with anyone who manipulates the markets").

¹⁹⁷ See James-Lubin, supra note 16.

¹⁹⁸ Decentralized Autonomous Society, supra note 60.

Internet service may provide a faster time, HFT firms will no longer be able to profit from physical proximity strategies.¹⁹⁹ In addition to "limit order"²⁰⁰ guidelines, blockchain technology can decrease insider front running by executing orders at the price requested and nothing less.²⁰¹ By eliminating the additional profit potential from front running, the blockchain method could make the markets less vulnerable to predatory behavior by high frequency traders.²⁰²

B. Cost and Ease of Implementation

The SEC's mission is challenged by monetary and labor restrictions, but a blockchain record will circumvent these shortcomings. As evidence, the blockchain is already effectively employed in other areas of business and technology²⁰³ and has been operating since 2009.²⁰⁴ Companies across different industries are beginning to facilitate the blockchain technology and apply its system to existing business models.²⁰⁵ For example, Overstock.com recently unveiled a blockchain-based decentralized stock exchange.²⁰⁶ This cryptosecurity²⁰⁷ is issued on a decentralized exchange and operates similarly to the way bitcoins are exchanged with no intermediaries.²⁰⁸ In addition, Coinsetter, a forward-thinking company, has already signaled its interest in establishing a blockchain-based exchange with a peer-to-peer traceable system.²⁰⁹

Ideas about future industries where blockchain can be implemented are abounding, showing that the technology has endless

¹⁹⁹ Id.

²⁰⁰ *Limit Order*, INVESTOPEDIA, http://www.investopedia.com/terms/l/limitorder.asp (last visited Sept. 7, 2015) (a limit order is "an order placed with a brokerage to buy or sell a set number of shares at a specified price or better").

²⁰¹ Id.

²⁰² Daniel Larimer, *Overstock to Cryptostock*, LTB NETWORK (Aug. 12, 2014), https://letstalkbitcoin.com/blog/post/overstock-to-cryptostock.

²⁰³ 160 CONG. REC. S1915-01 (daily ed. Apr. 1, 2014) ("[I]nherent limitations . . . exist in regulating an issue as complex as HFT. The technology and resources readily available to trading firms easily dwarf those available to our government's primary regulators.").

²⁰⁴ What is Bitcoin?, supra note 180 ("Bitcoin is a new currency that was created in 2009 by an unknown person using the alias Satoshi Nakamoto.").

²⁰⁵ See 160 CONG. REC. S1915-01.

²⁰⁶ Pete Rizzo, *Overstock Unveils Blockchain Trading Platform at Nasdaq Event*, COINDESK, (Aug. 5, 2015, 2:19 PM), http://www.coindesk.com/overstock-unveils-blockchain-trading-platform-to/.

²⁰⁷ Drew Cordell, *Overstock.com to Offer World's First Cryptosecurity on Bitcoin Blockchain*, BITCOINMAGAZINE (June 8, 2015, 5:11 PM), https://bitcoinmagazine.com/articles/overstockcom-offer-worlds-first-cryptosecurity-bitcoin-blockchain-1433797910.

²⁰⁸ Michael del Castillo, *The Man Who Would Undo Wall Street by Offering Overstock.com* '*Cryptosecurities*', UPSTART BUS. J. (Aug. 1, 2014, 11:10 AM), http://upstart.bizjournals.com/ entrepreneurs/hot-shots/2014/08/01/the-man-who-would-undo-wall-street-by-offering.html.

²⁰⁹ Yessi Bello Perez, *Blockchain Project Aims to Bring Speed, Transparency to Wall Street Trading*, COINDESK (Feb. 26, 2015, 11:17 AM), http://www.coindesk.com/blockchain-technology-to-improve-outdated-wall-street-trading/.

possibilities.²¹⁰ Bitcoin has created a platform for new markets to emerge.²¹¹ For example, blockchain technology could successfully replace older forms of technology for the Internet's Domain Name System, crowdfunding, email service, and social networks.²¹² If the blockchain protocol gains support in varying industries, it could rival Google, Facebook, and cloud computing.²¹³ While some do not believe bitcoin currency will have a long future, many nonetheless endorse the blockchain platform.²¹⁴

The decrease in the cost and physical space of storing digital information will also enable the SEC to keep a digital record in a cost-effective way.²¹⁵ The blockchain technology used for bitcoin trades has experienced only a few minor technical issues.²¹⁶ The platform has been operating without any major disruptions, and it has not been compromised by any suspicious activity or hacking.²¹⁷ Despite minor issues, customer funds known as wallets²¹⁸ were never at risk for theft or loss.²¹⁹ The technological architecture of blockchain ensures that those behind the system do not have access to the unencrypted keys.²²⁰ The level of security inherent in the blockchain system makes it a viable option for stock market recordkeeping.²²¹

The time-stamped record on the blockchain protects against bitcoin overspending and the alteration of already posted transaction records.²²² The tracked process would enable the SEC to monitor when trades are

²¹⁹ See Margaret, supra note 216.

²¹⁰ Steve Shanafelt, *The 84 Alternative Uses of the Blockchain*, BITCOINX (Mar. 22, 2014), http://www.bitcoinx.com/84-alternate-uses-blockchain/.

²¹¹ Kevin Kelleher, *Shape the Future: Q&A: Gavin Andresen, Chief Scientist, Bitcoin Foundation*, FORTUNE (Jan. 22, 2015, 9:00 PM), http://fortune.com/2015/01/22/qa-gavin-andresen-bitcoin-foundation/.

²¹² See Shanafelt, supra note 210.

²¹³ Id.

²¹⁴ Rob Wile, *Satoshi's Revolution: How the Creator of Bitcoin May Have Stumbled onto Something Much, Much Bigger*, BUS. INSIDER (Apr. 22, 2014, 11:50 AM), http://www.businessinsider.com/the-future-of-the-blockchain-2014-4.

²¹⁵ Devin W. Ness, *Information Overload: Why Omnipresent Technology and the Rise of Big Data Shouldn't Spell the End for Privacy as We Know It*, 31 CARDOZO ARTS & ENT. L.J. 925, 933 (2013).

²¹⁶ Alyson Margaret, *Detailed Update on Service Outage, Plus Estimated Down Time*, BLOCKCHAIN (Mar. 18, 2014), https://blog.blockchain.com/2014/03/18/update-plus-estimated-down-time/.

 $^{^{217}}$ *Id.* ("On Monday March 17th, Blockchain services experienced a series of technical issues that originated from a database error and resulted in suspension of services.... This was not the result of hacking or attacks, or of any suspicious activity. It was simply the result of an obscure bug and a combination of technical factors that expressed this bug under heavy load.").

²¹⁸ BLOCKCHAIN, https://blockchain.info/wallet (last visited Jan. 24, 2015) ("My Wallet is a free online bitcoin wallet, which you can use to make worldwide payments for free. We make paying with bitcoins easy and secure . . .").

²²⁰ Id.

²²¹ See James-Lubin, supra note 16.

²²² Bitcoin Developer Guide, BITCOIN, https://bitcoin.org/en/developer-guide#block-chain (last visited Sept. 7, 2015)

being made and discover specific points in time when issues arise. Using its public key, the SEC would trace the error back to a specific firm or trader and quickly enforce its regulations and impose punishments.²²³ If the blockchain ledger is implemented with smart contracts,²²⁴ which execute automatically once their terms are satisfied, regulatory compliance can be codified in the smart contract code associated with an offering.²²⁵ Stock sales will not be completed unless the pre-programmed conditions of compliance are triggered.²²⁶ If blockchain technology continues to evolve, it may also solve the HFT issue in which withdrawn bids and asks are not placed and simply disappear.²²⁷ A blockchain record of withdrawn trades could even more accurately regulate HFT and prevent manipulative behavior.

C. Faster Detection of Wrongdoing

Although the SEC has proposed and implemented regulations which record and track trades on the market, the blockchain approach is different because it will enable the SEC to conduct investigations faster and enable a decision, and possibly a sanction, to occur more quickly.²²⁸ The public blockchain ledger will allow regulators and market participants to notice inconsistencies within the market and take action to remedy the situation.²²⁹ If self-regulation is successful, the SEC will be able to take a hands-off approach until regulatory enforcement is necessary.²³⁰ A more seamless detection of wrongdoing will create a ripple effect in the world of HFT. Deterrence may quickly set in if the fines are substantial. While blockchain technology may eliminate the need for intermediaries such as banks and the Depository Trust and Clearing Corporation ("DTCC"),²³¹ regulators cannot be eliminated.²³² The markets would become too unstable if they depended solely on computer systems without any overarching regulatory power.²³³ As with

²²³ See James-Lubin, supra note 16.

²²⁴ Jay Cassano, What Are Smart Contracts? Cryptocurrency's Killer App, FAST CO. (Sept. 17, 2014), http://www.fastcolabs.com/3035723/app-economy/smart-contracts-could-be-cryptocurrencys-killer-app.

²²⁵ See James-Lubin, supra note 16.

²²⁶ See Cassano, supra note 224.

²²⁷ Richard Finger, *High Frequency Trading: Is It a Dark Force Against Ordinary Human Traders And Investors?*, FORBES (Sept. 30, 2013, 8:41 AM), http://www.forbes.com/sites/richardfinger/2013/09/30/high-frequency-trading-is-it-a-dark-force-against-ordinary-human-traders-and-investors/.

²²⁸ Peters, *supra* note 196 (quoting Andrew J. Ceresney, director of the SEC's division of enforcement, in reference to the SEC's first HFT fine against Athena Capital Research: "[t]here's no question that these investigations take time, especially given the complex activity in this case").

²²⁹ See James-Lubin, supra note 16.

²³⁰ See How the Bitcoin Protocol Could Help Stop Insider Trading, supra note 163.

²³¹ See James-Lubin, supra note 16.

²³² See Kelleher, supra note 211.

²³³ Id.

many innovative systems at early stages, overregulation can stunt the growth of the development.²³⁴ Therefore, the SEC must continue to regulate this new system, but it must not overregulate and cause a nonstarter.

Currently, the SEC regulates the majority of the securities industry.²³⁵ When only the SEC can view records of cancelled and executed trades, only the SEC can regulate and prosecute those transactions. The SEC's limited financial and employee resources also limit its ability to regulate and prosecute.²³⁶ Having a more accurate and conclusive collection of all trades on a public ledger will enable firms to self-regulate the transactions.²³⁷ When traders notice a suspicious trade posted on the public ledger, they can file a complaint with the SEC, which will then pursue the claim and enforce the laws.²³⁸ Traders have an incentive to self-regulate and report suspicious activity because they stand to lose money when proper practices are not followed and the markets become susceptible to illegal trades.²³⁹ As mentioned above, traders not only have the incentive but also the means and resources to aid in regulation. Collectively, traders and the SEC can monitor and identify suspicious activity through the public ledger system.

If regulators are unable to sift through the lines of coded data from both the blockchain record and individual firms' records, the SEC should hire experts.²⁴⁰ Under the proposed approaches to regulating HFT mentioned above, the SEC could potentially receive blockchain information, individual trade data, and algorithmic trading strategies. The SEC will need specialists to thoroughly investigate the information provided to it through these new mechanisms. If the SEC cannot

²³⁴ Trond Undheim, *Why Banks Fear Bitcoin*, FORTUNE (Nov. 20, 2014, 9:22 AM), http://fortune.com/author/trond-undheim/ ("However, countries that over-regulate a disruptive innovation in its infancy will only lose out on the first waves of that innovation.").

²³⁵ Michael Schmidt, *Financial Regulators: Who They Are And What They Do*, INVESTOPEDIA, http://www.investopedia.com/articles/economics/09/financial-regulatory-body.asp (Oct. 29, 2008).

²³⁶ Troy A. Paredes, Comm'r, U.S. Sec. and Exch. Comm'n, Speech by SEC Comm'r: Remarks at "The SEC Speaks in 2009" (Feb. 6, 2009) (transcript available at http://www.sec.gov/news/speech/2009/spch020609tap.htm).

²³⁷ See James-Lubin, supra note 16.

²³⁸ See How the Bitcoin Protocol Could Help Stop Insider Trading, supra note 163.

²³⁹ *Id.* ("Other traders obviously have a much stronger incentive than the SEC to be vigilant and proactive in eradicating insider trading because they're the ones who stand to lose money when it goes undetected.").

²⁴⁰ Brown, *supra* note 162 (SEC Chair wants to "hire an additional 316 people for the regulator's office of compliance inspections and examinations to examine more registered firms as well as crowdfunding portals, swap-market participants and private fund advisers. She further aims to hire 45 people, mainly financial economists, for risk assessment work and to add staff in the division of corporation finance, the division of investment management, and elsewhere." With the proposed budget increase, the SEC will have the resources available to fill some of these new positions by market and computer specialist to understand and relay the HFT firm information to SEC regulators.).

perform a proper evaluation, the information gathered will be meaningless and regulatory action will be stunted. The added layer of self-monitoring would relieve the SEC from some regulatory and financial pressures.²⁴¹

D. HFT Technology in the Future

The technology that supports and enables high frequency trading is unique and innovative. Although the SEC should regulate unfair trading practices, it should be careful not to overregulate and prohibit the growth of innovative technology. Regulators should not curb technological expansion within the markets. Instead, regulators should ensure that technological progress brings benefits to long-term investors.²⁴² The blockchain method will enable the SEC to embrace recent developments and trends in stock market trading while adapting its own technological approach to regulation. Trading will occur as it normally would, but a record will be kept and continually updated as new trades are placed. Traders may still develop faster and smarter algorithms and deploy them on the stock market. However, a blockchain may be a beneficial obstacle in the need for speed in trading.²⁴³ A blockchain method can ensure the legitimacy of the trade and can eliminate front running and thus the benefit traders receive from placing orders faster than others on the market.²⁴⁴ The effects of the algorithms and trades completed will be saved and displayed within the blockchain ledger.²⁴⁵

While addressing HFT and concerns about its regulation, SEC Chair Mary Jo White expressed her desire to "not roll back the technology clock" on algorithmic trading while still evaluating the effects computer-driven trading has on investors.²⁴⁶ The blockchain method will not hamper the technology that makes HFT possible. Compared to other possible solutions, the blockchain method will not drastically slow down HFT nor will it interfere with current trading strategies and activities.²⁴⁷ The blockchain system can cause highly technical trading to resemble traditional trading by eliminating the additional profit that is associated with being the fastest trader.²⁴⁸ Trading will operate as it always has, and the ledger will enable an

²⁴¹ Stavros Gadinis & Howell E. Jackson, *Markets as Regulators: A Survey*, 80 S. CAL. L. REV. 1239 (2007).

²⁴² 155 CONG. REC. S9308-02, 9316–17 (daily ed. Sept. 14, 2009).

²⁴³ See James-Lubin, supra note 16.

²⁴⁴ Id.

²⁴⁵ Id.

 ²⁴⁶ Mary Jo White, Chair, U.S. Sec. and Exch. Comm'n, *Enhancing Our Equity Market Structure*, Sandler O'Neill & Partners, L.P. Global Exchange and Brokerage Conference (June 5, 2014), (transcript available at http://www.sec.gov/News/Speech/Detail/Speech/1370542004312).
 ²⁴⁷ See James-Lubin, *supra* note 16.

²⁴⁸ Id. See Larimer, supra note 202.

automatic reporting system to cache and store trade history.²⁴⁹

E. Possible Downfalls to the Blockchain Method

In a traditional bitcoin trade, it could take up to a few hours for a trade to be posted to the public ledger.²⁵⁰ Although the trade is eventually placed, the posting of the completed trade is delayed.²⁵¹ If this speed cannot be made quicker for posted trades, the blockchain public ledger method may not be as effective for regulation and oversight of stock market trading. Especially in HFT,²⁵² where trades are made increasingly fast in milliseconds,²⁵³ the posting of the trades to the ledger could be so delayed as to render it useless. However, if trades can be posted more quickly to the blockchain than typical bitcoin transactions, this method will still be viable. Given the innovative nature of the blockchain method, the growth it has shown in its early stages, and the increased funding in its infrastructure, it is likely the will continue improving.²⁵⁴ technology Apart from extreme circumstances, a minimal delay in trade posting would not affect the SEC's ability to regulate.²⁵⁵ Regulators would still be able to identify bad behavior, possibly faster than they currently can enforce their regulations.²⁵⁶ In addition, the delay in posting and verifying the transaction could benefit and improve the integrity of trading. When transactions are completed, the blockchain confirms the occurrence to the rest of the market.²⁵⁷ The additional time separates legitimate trades from invalid transactions.²⁵⁸ Although the additional time may affect the SEC's reaction to regulation, the integrity of the market may increase and therefore provide fewer instances where SEC regulation is even necessary.

Traders and regulators may be skeptical of employing and trusting a public ledger to maintain a list of all trades conducted.²⁵⁹ Some may

²⁴⁹ See Larimer, supra note 202.

²⁵⁰ Metz, *supra* note 177 ("There's some latency in settling a bitcoin trade. It can take anywhere from several seconds to hours to get a transactions [sic] completed. . . . In a world where people want to trade quickly, putting that kind of a delay into the system could make it a non-starter."). ²⁵¹ *Id*.

²⁵² See Bajpai, supra note 57.

²⁵³ Algorithm, MERLINCRYPTION, http://www.merlincryption.com/Algorithm.html (last visited Sept. 7, 2015).

²⁵⁴ Jon Southurst, *Blockchain to Grow Further After Closing \$30.5 Million Funding Round*, COINDESK (Oct. 7, 2014, 6:21 PM), http://www.coindesk.com/blockchain-grow-further-closing-30-5-million-funding-round/.

²⁵⁵ See Schectman, supra note 164.

²⁵⁶ See James-Lubin, supra note 16.

²⁵⁷ See Metz, supra note 177.

²⁵⁸ Id.

²⁵⁹ Jon Tullett, *Bitcoin and the Death of Trust*, ITWEB (Mar. 6, 2014), http://www.itweb.co.za/index.php?option=com_content&view=article&id=71450 ("Any currency, alternative or not, can only succeed if it is trusted by the community. No matter how mathematically sound it may be, Bitcoin can only succeed if its own users trust each other, and

find it more trusting than an intermediary, while others may not trust a completely technological system at all.²⁶⁰ However, as more industries adopt the blockchain, more people will likely become comfortable trusting decentralized third parties and the system itself.²⁶¹ This acceptance will generally spread through all areas employing blockchain technology, including the stock market. Evidence of the growing acceptance of the technology behind bitcoin cryptocurrency and the blockchain is in the increasing number of businesses accepting bitcoin for payment. ²⁶² Included among an estimated 80,000 businesses²⁶³ accepting bitcoin are Overstock.com, PayPal, Dish, and Dell.²⁶⁴ Just as these businesses find benefits to accepting bitcoin as payment,²⁶⁵ traders and investors will eventually see the benefits in the blockchain technology behind bitcoin transactions.²⁶⁶

Individuals are also using bitcoin as a form of payment.²⁶⁷ An increasing number of individuals using bitcoin are particularly from "low-trust" societies²⁶⁸ like South America.²⁶⁹ In low-trust societies, many people do not have credit cards.²⁷⁰ These societies view bitcoin as an opportunity to participate in cryptocurrency for economic self-determination.²⁷¹ Bitcoin eliminates the need for centralized authority and provides consumers with a source of legitimacy in a networked trust.²⁷²

The trustless system, while beneficial for some users and businesses, could present new challenges to the SEC to maintain the

²⁶² See Camhi, supra note 176.

²⁷¹ Id.

more broadly, if outsiders (online services, retailers, even banks and financial regulators) trust it enough to transact with it.").

²⁶⁰ See Camhi, supra note 176.

²⁶¹ Steven McKie, *The Rise of Alternative Blockchains and the Future of Digital Currency*, MONEY & TECH (Sept. 5, 2014, 10:44 AM), http://moneyandtech.com/rise-alternative-blockchains-future-digital-currency/.

²⁶³ Kim Lachance Shandrow, *5 Reasons Merchants Should Start Accepting Bitcoin Now*, ENTREPRENEUR (Sept. 4, 2014), http://www.entrepreneur.com/article/237026.

²⁶⁴ Kathleen Caulderwood, PayPal Joins Dell, DISH, Expedia, Overstock to Accept Bitcoins As Payment, INT'L BUS. TIMES (Sept. 9, 2014, 10:44 AM), http://www.ibtimes.com/paypal-joinsdell-dish-expedia-overstock-accept-bitcoins-payment-1682812.
²⁶⁵ Id.

²⁶⁶ Chris Isidore, *First U.S.-Based Bitcoin Exchange Opens*, CNN MONEY (Jan. 26, 2015, 10:24 AM), http://money.cnn.com/2015/01/26/investing/bitcoin-exchange-coinbase/. As evidence of the growing acceptance of the blockchain, the first bitcoin exchange opened in the U.S. on January 26, 2015. *Id.*

²⁶⁷ See Camhi, supra note 176.

²⁶⁸ Richard Wike, *Where Trust is High, Crime and Corruption are Low*, PEWRESEARCHCENTER (Apr. 15, 2008), http://www.pewglobal.org/2008/04/15/where-trust-is-high-crime-and-corruption-are-low/.

²⁶⁹ Nozomi Hayase, *The Blockchain and the Rise of Networked Trust*, COINDESK (Nov. 22, 2014, 2:33 PM), http://www.coindesk.com/blockchain-rise-networked-trust/.

²⁷⁰ Id.

²⁷² Id.

transparency and integrity of the markets.²⁷³ The SEC would need to ensure that the decentralized system is truly trustless.²⁷⁴ The decentralized system could present an opportunity to some users or firms to take advantage of the system by having faster and stronger computers.²⁷⁵ By having faster computers, these users would be the first ones to complete the verification computation and add the block to the blockchain.²⁷⁶ If the faster users collude, the integrity and fairness of the system could be compromised.²⁷⁷

V. REGULATORY IDEAS FROM ABROAD

As further insight into regulating HFT practices, the SEC should also look to other countries' solutions for combating and regulating HFT activities.²⁷⁸ The United States is not alone in its battle to ensure the markets remain fair and open.²⁷⁹ The regulatory and deregulatory initiatives other countries have taken can be helpful in structuring the United States' regulatory reform for HFT in addition to adopting a blockchain public ledger.

A. The United Kingdom

While the SEC has the power to regulate and enforce a blockchain spreadsheet, HFT firms also have the ability to engage in self-regulation and risk-management.²⁸⁰ Borrowing a regulatory response to HFT from the United Kingdom, the United States stock markets should have a combination of exchange monitoring, regulatory analysis of market risks, and industry self-reporting of suspicious activity.²⁸¹ The SEC should require trading venues to use their infrastructure to store data that can be turned over to regulators on demand.²⁸² In addition, firms should be required to submit suspicious order reports when they recognize them through their general trading practices.²⁸³ The self-kept logs can act as a backup record and additional layer of protection. If

²⁷⁶ Id.

²⁸¹ Id.

²⁸² Id.

²⁷³ Evan Faggart, *Ethereum: Making The Entire World Trustless*, DEEPDOTWEB (Aug. 18, 2014), http://www.deepdotweb.com/2014/08/18/ethereum-making-entire-world-trustless/.

²⁷⁴ Vitalik Buterin, *Trustless Bitcoin Anonymity Here at Last*, BITCOIN MAG. (Aug. 28, 2013), https://bitcoinmagazine.com/6630/trustless-bitcoin-anonymity-here-at-last/.

²⁷⁵ Decentralized Autonomous Society, supra note 60.

²⁷⁷ JP Williams, *SuperCoin: A Trustless Decentralized Anonymous P2P Network*, COINTELEGRAPH (Aug. 1, 2014, 12:44 PM), http://cointelegraph.com/news/112195/supercoin-a-trustless-decentralized-anonymous-p2p-network.

²⁷⁸ See Bell & Searles, supra note 19.

²⁷⁹ Id.

²⁸⁰ Martin Wheatley, CEO of the Fin. Conduct Auth., Regulating High Frequency Trading, Address at the Global Exchange and Brokerage Conference in New York (Apr. 6, 2014) (transcript available at http://www.fca.org.uk/news/regulating-high-frequency-trading).

²⁸³ Id.

either the self-regulatory data or the blockchain ledger is inconclusive, the alternative method should fill in the missing pieces.

The monetary and societal risks are too great for the SEC to regulate alone.²⁸⁴ Those who have a monetary stake in the stock market are more likely to value its continued efficiency. The approach toward regulating HFT firms and ensuring that practices remain legal is a cooperative investment by both regulators and industry players.²⁸⁵ The SEC maintains a societal commitment to assure fair practices and regulatory standards are being met on the various exchanges. Industry players have a financial stake in developing the most advanced algorithms.²⁸⁶ High frequency trading firms rely on the integrity and efficiency of the market to employ these computer programs and execute trades.²⁸⁷ The algorithms are only effective if the stock market performs properly.²⁸⁸ Together, firms and regulators can accommodate the technological advances of the market without compromising newly developed approaches or market fairness.²⁸⁹ Enabling HFT firms and regulators to develop the new procedures together will increase investor confidence in the markets, an aspect beneficial to both parties.²⁹⁰

Another unique idea employed by the United Kingdom expands upon a procedure from accounting known as FIFO.²⁹¹ The first-in, firstout procedure that most exchanges use processes orders in the order it receives them.²⁹² The first firm to place the order is the first to have it cleared.²⁹³ In a world where fractions of a second make all of the difference, HFT firms are continually competing to be the first firm to place an order.²⁹⁴ Expanding on this procedure, the United Kingdom

²⁸⁴ Prewitt, *supra* note 110 ("In calibrating [the] trade-off, a judgment would need to be made on the social value of split-second trading and liquidity provision and whether this more than counterbalances the greater market uncertainty it potentially engenders. At times, the efficiency of financial markets and their systemic resilience need to be traded off. This may be one such moment. Historically, the regulatory skew has been heavily towards the efficiency objective. Given today's trading topology, it may be time for that to change.").

²⁸⁵ Wheatley, *supra* note 280 ("[T]he challenge here becomes a shared one.").

²⁸⁶ See Iati, supra note 53.

²⁸⁷ *Id.* ("[B]ecause high-frequency trading depends on ridiculously precise interaction of markets and mathematical correlations between securities, traders need to regularly adjust code...to reflect the subtle changes in the dynamic market.").

²⁸⁸ Id.

²⁸⁹ See Wheatley, supra note 280.

²⁹⁰ Andrew J. Keller, *Robocops: Regulating High Frequency Trading After the Flash Crash of* 2010, 73 OHIO ST. L.J. 1457 (2012) ("While regulatory agencies would restore confidence through the appearance of an effective regulatory regime, HFT firms best serve their interests by becoming more transparent in their practices.").

²⁹¹ Inventory Valuation for Investors: FIFO and LIFO, INVESTOPEDIA, http://www.investopedia.com/articles/02/060502.asp (last visited Sept. 7, 2015) (The first-in, first-out (FIFO) inventory accounting method "assumes that the first unit making its way into inventory is the first sold.").

²⁹² See Bell & Searles, supra note 19.

²⁹³ Id.

²⁹⁴ Id.

aims to eliminate the incentive to be the first firm placing the order by instead bundling the orders received.²⁹⁵ The first placed order will be randomly selected from the earliest group of orders received.²⁹⁶ By still allowing speed to be a factor, this approach incorporates the incentive to be in the first group instead of the very first order.²⁹⁷ With intentions of developing a fairer marketplace, the United Kingdom hopes that this new practice will have an impact on slowing down HFT while still letting technology and algorithms process orders.²⁹⁸

The United States could benefit from the modified first-in, first-out approach because it still allows traders to compete for the trade by configuring the best and fastest algorithms, but it also employs a random aspect. Under this process, the speed of a particular algorithm would not have as big of an impact on overall trading. Each algorithm and trade would still be subject to a random selection process. This could become an overlay to blockchain and potentially remove some of the competition to execute the fastest trade. However, if algorithms develop a way around this procedure, the process would be right back where it started and the fastest firm would always get the trade. Allowing the technology to perform at its highest potential but subjecting it to a final computer-selected execution could be the happy medium for firms and regulators. Enabling randomness would ensure that the market is not "rigged" and that each trade in a bundle is treated the same.

A more controversial tactic that some countries have implemented is a tax on incorrectly placed and retracted trades.²⁹⁹ A financial transactions tax ("FTT")³⁰⁰ can have varied transactional amounts and can be placed on the sale of securities, unfilled orders, derivatives, repossessions, currency trades, and other financial transactions.³⁰¹ Comparable to a cigarette tax, an FTT brings in additional revenue and discourages dangerous behavior.³⁰² If applied to incorrect or recalled high frequency trades, the tax could diminish profit margins and reduce HFT behavior.³⁰³

³⁰¹ Id.

³⁰² Id.

²⁹⁵ Id.

²⁹⁶ Id.

²⁹⁷ Id.

²⁹⁸ See Bell & Searles, *supra* note 19. ("It remains to be seen whether the race to be *among* the first rather than *the* first will have any impact on slowing HFT, as there still remain strong incentives to gather information quickly.").

²⁹⁹ *Id.* (The UK set a financial transaction tax at a level equal to the profit made on a high frequency trade.).

³⁰⁰ Lee Sheppard, *A Tax to Kill High Frequency Trading*, FORBES (Oct. 16, 2012, 12:08 PM), http://www.forbes.com/sites/leesheppard/2012/10/16/a-tax-to-kill-high-frequency-trading/ ("A FTT is a tiny tax, usually only a few basis points, levied on transactions in financial assets, and generally collected by a clearinghouse.").

³⁰³ Id.

The additional cost of making a trade or recalling an incorrect trade could reduce the number of speculative trades placed.³⁰⁴ The revenue generated from the tax could also eliminate some of the SEC's financial and budget constraints.³⁰⁵ However, the FTT has been met with mixed reactions over the years as different forms of the tax have been proposed.³⁰⁶ A tax specifically targeted at HFT activity would not likely be a viable solution in the United States. One reason is that the high taxes levied would not increase investor willingness to trade on the United States markets.³⁰⁷ If investors can trade on markets where they will not be subject to a tax, they may take their money to a different country and a different exchange.³⁰⁸ In addition, the tax could slow down the innovative nature of HFT and place more financial constraints on traders at all levels.³⁰⁹

B. Germany

Another country that has taken a proactive approach to HFT regulation is Germany. Germany has given its regulators the right to request descriptions of trading strategies and parameters.³¹⁰ If an algorithmic trading strategy is determined to be undesirable by regulators, it will be rejected.³¹¹ The regulators are then able to oversee all trading activity and determine where issues originated.³¹²

Although this practice works well in Germany, it may be viewed as overly burdensome in the United States. On United States stock exchanges, proprietary algorithms are worth a considerable amount to the firms that create and execute them.³¹³ The SEC wants to obtain as much information from firms as possible, and it has asked exchanges to develop proposed rule changes that will enhance disclosure of data feeds.³¹⁴ However, the SEC may not have the skills nor the resources

³⁰⁹ Id.

³⁰⁴ Bob Adelmann, Senator Tom Harkin Tries to Revive His High-Frequency Trading Tax Bill, NEW AM. (Nov. 30, 2012), http://www.thenewamerican.com/usnews/congress/item/13794senator-tom-harkin-tries-to-revive-interest-in-his-high-frequency-trading-tax-bill. ³⁰⁵ Id

³⁰⁶ Richard T. Page, Foolish Revenge or Shrewd Regulation? Financial-Industry Tax Law Reforms Proposed in the Wake of the Financial Crisis, 85 TUL. L. REV. 191 (2010). ³⁰⁷ Id.

³⁰⁸ *Id.* ("[S]ome parties would be deterred from transacting.")

³¹⁰ See Bell & Searles, supra note 19.

³¹¹ Id.

³¹² *Id*.

³¹³ See Iati, *supra* note 53 ("[A]ny other proprietary trading firm . . . could indeed lose tens of millions of dollars from its proprietary trading if their strategies are stolen.").

³¹⁴ Matt Levine, *SEC Will Keep Thinking About High Frequency Trading*, BLOOMBERGVIEW (June 5, 2014, 3:53 PM), http://www.bloombergview.com/articles/2014-06-05/sec-will-keep-thinking-about-high-frequency-trading ("I am also asking the exchanges and FINRA to consider including a time stamp in the consolidated data feeds that indicates when a trading venue, for example, processed the display of an order or execution of a trade . . . And I am asking the exchanges to develop proposed rule changes to disclose how—and for what purposes—they are

required to investigate algorithmic trading strategies.³¹⁵ Even if it did, the lag between identifying a particular strategy and rectifying the situation could be too great to make an effective difference on the exchange.³¹⁶ The determination of which algorithmic trading strategies are undesirable and which are not could also be too difficult for regulators to determine.³¹⁷ If HFT firms find their strategies being continually rejected, they may relocate to a different exchange or a different country. While this particular strategy may not be met with accepting attitudes in the United States, the SEC should still strive to obtain less confidential information from the firms.

Germany requires high frequency traders to maintain riskmanagement procedures and record all of the algorithms they use.³¹⁸ A log created by the firms of all the algorithms used and all the trades executed could be more favorable to the American markets and firms. This approach will allow the firms to keep their proprietary algorithms confidential except in times of market mishaps.³¹⁹ If something similar to the Flash Crash occurs again, regulators would be able to access the day's information and decipher the sequence of events.³²⁰

Similar to the self-kept logs of data relating to specific trades, this approach can also serve as a secondary resource if the main blockchain database ever fails or becomes a victim of a technological bug. In addition, it would allow traders to maintain an additional level of anonymity and protection. The firms would not be required to turn over their algorithm logs until a problem has occurred. Up until that point, the logs and algorithms will remain secret and will continue to be employed on the exchanges. The logs will also protect the HFT firms because only the SEC will have the power to demand access to the records. As with the proposed blockchain ledger, it is in the best interest of traders and regulators to maintain logs and make them available for inspection.³²¹ The increased transparency³²² of the stock markets can

using data feeds.").

³¹⁵ See Paredes, supra note 236.

³¹⁶ See Schectman, supra note 164 ("The regulatory lag on high-frequency trading poses risks for companies.").

³¹⁷ Peter Henning, *Why High-Frequency Trading Is So Hard to Regulate*, DEALBOOK (Oct. 20, 2014, 1:40 PM), http://dealbook.nytimes.com/2014/10/20/why-high-frequency-trading-is-so-hard-to-regulate/?_r=0 ("[R]egulators can find it difficult to draw the line between acceptable trading strategies and manipulation because of the complexity of the strategies.").

³¹⁸ See Bell & Searles, supra note 19.

³¹⁹ Id.
³²⁰ Id.

³²⁰ Id. 321 Id.

³²¹ Id

³²² *Transparency*, INVESTOPEDIA, http://www.investopedia.com/terms/t/transparency.asp (last visited Sept. 7, 2015) ("Transparency helps to prevent the corruption that inevitably occurs when a select few have access to important information, allowing them to use it for personal gain." Transparency means "the extent to which investors have ready access to any required financial information about a company . . . [c]lassically defined as when 'much is known by many,'

enable the exchanges to operate more efficiently, causing higher revenues for traders and better regulatory oversight for government officials.

CONCLUSION

Technological advances have forever shaped and changed the United States stock markets. Computer driven algorithms are the driving force behind most trades placed on the various exchanges. In most cases, the speed and programming of algorithms have enabled firms to profit significantly from their proprietary systems and programs. The SEC faces the growing challenge of regulating HFT and maintaining efficient and reliable markets. By implementing a blockchain public ledger and borrowing regulatory ideas from abroad, the SEC can more effectively regulate HFT. The transparency and accountability available through a public blockchain will allow traders and regulators to monitor trades and ensure fair access to all market participants.

The decentralized and automatic nature of bitcoin technology has influenced the way contracts are entered into and executed.³²³ Once the conditions written into a smart contract are satisfied, the code automatically unlocks and executes the contract.³²⁴ The trustless contracts therefore have the potential to replace not only traditional paper contracts, but also party involvement and adjudicators in law generally.³²⁵ As technology continues to develop and expand to conventional legal arenas, the next issue to explore is whether trustless self-executing contracts will ever entirely exist without any human component. Although smart contracts may enhance and forever change the way the law and businesses operate, traditional concerns, such as the asymmetry of information, still exist. To determine whether smart contracts solve more problems than they create, consumers and regulators must embrace the technological innovations and strive toward operating in "smarter" contexts.

Christina Batog*

325 Id.

transparency is one of the silent prerequisites of any free and efficient market.").

³²³ Alyssa Hertig, *Code As Law: How Bitcoin Could Decentralize the Courtroom*, MOTHERBOARD (July 3, 2014, 12:34 PM), http://motherboard.vice.com/read/code-as-law-how-bitcoin-could-decentralize-the-courtroom.

³²⁴ Id.

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