# Regulating Innovation: High Frequency Trading in Dark Pools

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*Federal statutes regulate risk-taking by financial market intermediaries including the broker-dealers who execute trades and the securities exchange and clearinghouse platforms where trading occurs. For almost a century, these statutes have enforced norms that encourage disclosure, transparency, and fairness. In modern markets, innovation, and technology challenge these core principles of regulation. The engineering of computer-driven automated trade execution, the development of algorithmic trading, and the introduction of high frequency trading strategies accompany a number of important shifts in financial market intermediation.*

*First, a universe of private trading platforms known as alternative trading systems (ATSs) increasingly compete with and displace conventional exchanges. ATSs include a small group of platforms known as "dark pools" that engender critical benefits. Dark pools mitigate information leakage, enabling institutional investors to execute large block trade transactions without fear that imitators will replicate or that predators may prey on their trades.*

*Second, dark pools intermediate trading with limited regulatory oversight. These private pools function in a manner similar to conventional securities exchanges and clearinghouse platforms; yet, dark pools are subject to a lighter-touch regulatory framework. As a result, hidden dark pool trades enjoy reduced regulatory, compliance, and transaction costs. Unsurprisingly, the volume of dark pool transactions has grown exponentially, eclipsing conventional trading venues' market share and redefining the balance of power in the financial market ecosystem.*

*Third, fragmentation has fractured trading markets. The transition from a small body of actors with quasi-monopolistic power to a diverse body of trading venues challenges antiquated notions regarding financial intermediaries' role in facilitating price discovery, identifying market manipulation, and employing best practices for ensuring fairness and protecting the integrity of financial markets.*

*This Article argues that gaps in governance, contentious conflicts of interest, and increasingly intense fragmentation in trading markets create a growing source of underexplored concerns. An examination of the current regulatory framework reveals noteworthy perils including the potential for high volatility and significant market disruption. These concerns necessitate exploring ex ante the various enforcement measures, regulations, governance protocols, and information gathering tools already*

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*employed in markets to mitigate systemic risk concerns. This Article cautions regulators and commentators to emphasize dynamic, sustainable macroprudential regulatory solutions.*



## I. INTRODUCTION

Tales of high speed trading increasingly captivate scholars, commentators, market participants, and regulators who are thoughtful about the influence of technological

innovation in financial markets.[1] These flashy stories of fast-paced automated trading tactics have, in many instances, overshadowed the problematic perils associated with computer-based trading.

On the afternoon of May 6, 2010, prices of securities and derivatives fell almost 1,000 points in minutes—the deepest single event dip in more than one hundred years in U.S. financial markets.[2] While markets quickly recovered, records reflected that the shock affected almost 8,000 exchange traded funds (ETFs) and individual equity securities.[3] With markets already roiling that day due to unsettling news about the European debt crisis, U.S. equity markets experienced a "Flash Crash," characterized by rapid and dramatic financial product price fluctuations.[4]

Traders executed more than 20,000 trades involving 300 different stocks, ETFs, and options traded at prices that diverged significantly from their pre-crash value.[5] Shares of Sotheby's (the famous British auction house) increased from $34 to $99,999.99.[6] The prices for other financial products declined by 5%, 10%, or even 15% before recovering most, if not all, of their losses.[7] The series of events related to the crash occurred in just twenty minutes—an extraordinarily short window[8]—causing dramatic automated selling by algorithmic trading groups that led to nearly one billion dollars in losses for U.S. equity markets.[9]

Following the Flash Crash, the Federal Bureau of Investigations and financial market regulators spent years deconstructing the events that disrupted markets.[10] Reports regarding the triggering events are at best muddled; explanations directly contradict market accounts.[11] High frequency trading practices, however, appeared to be a common factor in

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1. *See* MICHAEL LEWIS, FLASH BOYS: A WALL STREET REVOLT (W.W. Norton & Company, Inc. 2014).

2. CFTC & SEC, FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010, at 1 (Sept. 30, 2010), https://www.sec.gov/news/studies/2010/marketevents-report.pdf. *See also* The Economist Online, *What caused the flash crash? One big, bad trade*, ECONOMIST (Oct. 1, 2010), http://www.economist.com/blogs/newsbook/2010/10/what_caused_flash_crash.

3. *Id.*

4. *Id.*

5. *Id.*

6. *See* SCOTT PATTERSON, DARK POOLS: HIGH SPEED TRADERS, A.I. BANDITS AND THE THREAT TO THE GLOBAL FINANCIAL SYSTEM 233–78 (2012); *see also* Tom C.W. Lin, *The New Investor*, 60 UCLA L. REV. 678, 689-92, 704 (2013); Scott S. Powell & Rui Gong, Wall Street's New Race Toward Danger, BARRON'S, Mar. 8, 2010, at W45.

7. CFTC & SEC, *supra* note 2, at 1.

8. *Id.* at 2. *See also* Matt Phillips, *"Nasdaq: Here's Our Timeline of the Flash Crash"*, WALL ST. J., May 11, 2010, *available at* https://blogs.wsj.com/marketbeat/2010/05/11/nasdaq-heres-our-timeline-of-the-flash-crash/.

9. Michael Mackenzie & Aline van Duyn, *'Flash crash' was sparked by single order*, FIN. TIMES (Oct. 1, 2010), https://www.ft.com/content/8ee1a816-cd81-11df-9c82-00144feab49a; CFTC & SEC, *supra* note 2, at 2.

10. Jonathan Spicer et al., *Insight: SEC Tightens Leash on Exchange Post "Flash Crash"*, REUTERS (Jan. 12, 2012), http://www.reuters.com/article/2012/01/12/us-sec-exchanges-leash-idustre80b1ya20120112 (noting that regulators delayed a report on the crash almost five months to gather more data); Gregg E. Berman, Senior Advisor to the Dir., Div. of Trading & Mkts, SEC, Speech at the Annual SIFMA Market Structure Conference (Oct. 13, 2010), http://www.sec.gov/news/speech/2010/spch101310geb.htm (describing the difficulty of obtaining trading data from May 6, 2010 in the months after the crash); The Economist Online, *supra* note 1 (discussing a trade that caused the Flash Crash).

11. CFTC & SEC, *supra* note 2, at 3–6; Mackenzie & van Duyn, *supra* note 9 (discussing Flash Crash causation); but *see* Nathaniel Popper & Jenny Anderson, Trader *Arrested in Manipulation That Contributed to*

almost all explanations of the Crash.

Initially, the Securities Exchange Commission (SEC) and the Commodities Future Trading Commission (CFTC) concluded that an automated algorithm blindly deployed trade orders for a single institutional investor (Waddell & Reed) rapidly executing the sale of 75,000 E-Mini S&P 500 future contracts (valued at approximately $4.1 billion) and triggering the ephemeral crash.[12] Several years later, in 2015, the Department of Justice and the CFTC investigations revealed that a rogue London-based futures trader—Navinder Singh Sarao—had manipulated the E-Mini S&P 500 by using an algorithm to flood the Chicago Mercantile Exchange (CME) with sell orders for E-Mini S&P 500 stocks.[13]

Using a high-frequency trading (HFT) strategy known as "spoofing," Sarao entered tens of millions of dollars of orders intended to drive down the price of certain futures contracts.[14] After submitting sell orders, he entered orders to buy the same contracts at artificially depressed prices.[15] Contemporaneously, he cancelled the original sell orders that drove the prices downward before any such orders closed.[16] In an effort to manipulate the market, he submitted orders intending to withdraw the same orders before an exchange or clearinghouse closed the trade.[17]

Sarao never intended to sell, but his sell orders influenced trading across international financial markets.[18] After several years of successfully implementing this strategy before and after the Flash Crash, Sarao generated $50 million in profits.[19] In November of 2016, Sarao pled guilty to one count of wire fraud and one count of "spoofing," a tactic that Sarao employed during the crisis to manipulate the market prices of listed securities.

While regulators continue to disentangle the events of the Flash Crash, the effect of this kind of disruption on markets is indisputably clear. The crash, characterized by high volatility, created a liquidity crisis, a panic among investors regarding the stability of the market and the accuracy of financial product prices.[20] In a period of several minutes, wild automated selling by algorithmic and automated computer trades consumed nearly one

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*2010 'Flash Crash'*, N.Y. TIMES, Apr. 21, 2015, https://www.nytimes.com/2015/04/22/business/dealbook/trader-in-britain-arrested-on-charges-of-manipulation-that-led-to-2010-flash-crash.html?smid=tw-dealbook&seid=auto.

12. CFTC & SEC, *supra* note 2, at 3–6.

13. *See e.g.*, Press Release, CFTC, *CFTC Charges U.K. Resident Navinder Singh Sarao and His Company Nav Sarao Futures Limited PLC with Price Manipulation and Spoofing* (Apr. 21, 2015), http://www.cftc.gov/PressRoom/PressReleases/pr7156-15.

14. For a description of controversial high frequency trading ("HFT") strategies, *see infra* Part VI.C.3.

15. Andrew Trotman, *What happened during the Flash Crash?*, TELEGRAPH (Apr. 21, 2015), http://www.telegraph.co.uk/finance/financial-crime/11553696/What-happened-during-the-Flash- Crash.html.

16. *Id.*

17. Lindsay Whipp & Kara Scannell, *'Flash-crash' trader Navinder Sarao pleads guilty to spoofing*, FIN. TIMES (Nov. 9, 2016), https://www.ft.com/content/a321031a-a6cb-11e6-8898-79a99e2a4de6 (discussing a futures trader's part in the Flash Crash).

18. *Id.*

19. *Id.*; *see also* CFTC & SEC, *supra* note 2, at 2.

20. Spicer, *supra* note 10 (noting that regulators delayed a report on the crash almost five months to gather more data); Berman, *supra* note 10 (describing the difficulty of obtaining trading data from May 6, 2010 in the months after the crash); *see also* Wallace Turbeville, *Reign of the High-Frequency Trading Robots*, U.S. NEWS & WORLD REP. (Oct. 18, 2013), http://www.usnews.com/opinion/blogs/economic-intelligence/2013/10/18/how-high-frequency-trading-is-taking-over-markets (detailing concerns over HFT and how HFT actually makes markets less efficient by making them more volatile).

trillion U.S. dollars in value from U.S. equity and derivatives markets.[21]

The Flash Crash illustrates two noteworthy concerns. First, a revolution in innovation, in this case automated execution programs and algorithmic computer programs, characterizes modern financial markets.[22] The rapid erosion in liquidity that resulted at least in part from the implementation of innovative trading technology demonstrates the potential for emerging alternatives to disrupt markets.[23]

Coupled with the development of lightning fast, computer-based trading strategies, markets have witnessed marked growth in the number and diversity of trading venues. Fragmentation has intensified competition among trading platforms, exchanges and alternative trading venues in the market for clearing and settlement of securities, and derivatives trades. Electronic communication networks enable market participants to execute transactions at the "speed of light." A "race to zero" has emerged; market participants compete to decrease the time that elapses between the moment that a trader signals an interest to buy or sell a security, commodity or derivative and the moment when an exchange or clearinghouse confirms that the trade is settled.[24]

Second, contemporaneous with these changes, a transformation in the ecosystem of trading venues has engendered grave concerns about market stability.[25] This metamorphosis leaves markets vulnerable to manipulation and perhaps, more disconcertingly, to volatility. Simply stated financial markets are fragile, and when extreme volatility arises in markets, severe consequences for funding liquidity and market operations may follow. The risk of market disruption may lead to an economic downturn or recession and create spillover effects that may impact many segments of the economy.[26]

These concerns regarding market fragility are particularly disconcerting for a class of alternative trading systems (ATSs) colorfully described as "dark pools." The number and size of dark pools rises steadily each year.[27] To date, there are forty dark pools operating in the United States.[28] The increase in number of dark pools operating in financial markets parallels a shift in market trading volume away from conventional securities exchanges to dark pools.

In 2009, dark pools facilitated the execution of 7.2% of equity securities transactions.[29] By 2016, dark pools had captured over 40% of the equity securities trading volume—meaning these entities now facilitate the execution of almost half of listed securities transactions (NMS stocks).[30] In recent years, investigations have revealed that firms employing computer-based high frequency trading (HFT) strategies have gained access to dark pools and that these firms are now preying on investors executing transactions in dark pools.[31]

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21. Mackenzie & van Duyn, *supra* note 9 (discussing Flash Crash causation).

22. *See infra* Part III.A.

23. *See infra* Part II.A.

24. *See infra* Part III.A.

25. *See infra* Part IV.

26. *See infra* Part IV.

27. *See* Regulation of Non-Public Trading Interest, 74 Fed. Reg. 61,208, 61,209 (Nov. 23, 2009) (to be codified at 17 C.F.R. pt. 242).

28. *See infra* Part III.A.

29. *Id.*

30. *See* Sayena Mostowfi & Valerie Bogard, *TABB Equity Digest: Q1-2016*, TABB GROUP (June 2, 2016), https://research.tabbgroup.com/report/v14-033-tabb-equity-digest-q1-2016.

31. *See e.g.*, Phillip Inman, *Barclays Allegations and Inside the Murky World of Dark Pools*, GUARDIAN

Because dark pool operators reveal limited—if any—details regarding the identity of participating traders, the substance of their transactions and even the size of hidden transactions their trading platforms are characterized by opacity.[32] Flash Crash investigations suggest that computer-driven or automated trading may significantly influence markets. Noting the potential dominance of dark pools and the opacity that characterizes these venues, commentators increasingly inquire whether it may be necessary to adapt or adopt regulation to respond to the use of innovation and evolving technology in emerging trading venues such as dark pools.

A contested debate has emerged regarding the benefits of regulating HFT trading and the use of HFT trading in dark pools.[33] The debate regarding regulation of dark markets has focused on important issues such as fairness, price discovery, and transparency. Regulators, commentators and scholars have, however, focused too little attention on the cross-market impact of high frequency trading in dark pools.

While a growing body of literature explores the contours of technology and innovation in financial markets,[34] this Article raises critical questions regarding potential concerns that arise as a result of increased competition among trading venues, the sizeable market share captured by ATSs and the noteworthy fragmentation that unregistered and under-regulated trading venues engender. This Article contends that technologically enhanced trading in dark pools increases volatility, undermines fairness, and leaves markets vulnerable to catastrophic concerns.

This Article makes three critical contributions. First, this Article contends that innovation in trading transforms markets and trading strategies. Second, no current regulatory framework clearly establishes the approach for addressing the impact of these innovative changes in the context of unregulated or lightly regulated alternative trading systems. Third, in the event of a volatility crisis, this Article argues that regulation designed for conventional trading strategies and venues fail to protect investors, market integrity, and market stability. To address these concerns *ex ante*, this Article suggests creating a pathway for channeling information.

This Article argues that the transformation of trading markets obligates regulators to carefully consider the limits of existing financial market oversight, reliance on a traditional, self-regulatory responses to pernicious conflicts of interest, and conventional tools for addressing innovation in the development of trading strategies and emerging alternatives venues. This Article proposes envisioning Regulation Systems Compliance and Integrity (Reg SCI) through a broader lens to create a formal framework designed to better monitor volatility across securities markets. To ensure the most effective use of trade market data analytics, this Article argues that the programmers, analysts and economists operating within the SEC collaborate with the Office of Financial Research to comprehensively monitor risk and volatility in the financial markets trading ecosystem.

Part II of this Article examines the role of trading venues in financial markets. It reviews developments related to the transformation of national and international securities, commodities, and derivatives trading platforms. Parts III and IV then identify significant

(June 26, 2014), https://www.theguardian.com/business/2014/jun/26/barclays-allegations-dark-pool-trading-system-private.

32. *See infra* Part III.A.

33. *See infra* Part V.A.

34. *See infra* Part IV.A.

transitions in the ownership structure of these organizations as well as crises and later consolidation among the "lit" exchanges and platforms. Parts V and VI examine the rise of computer-based trading, HFT, and dark pools as well as early efforts to regulate alternative trading systems and alternative trading venues. Part VII presents a modest proposal for enhancing the transparency in dark pools.

## II. REGULATING TRADING ENTITIES

The New York Stock Exchange (NYSE) is among the largest, most well-known, and celebrated equities securities exchanges in the world. More than 2,800 companies list their shares on the NYSE and the daily trading volume ranges from $20 billion to almost $120 billion in listed shares. Over 3,100 companies list their shares for trading on the NASDAQ and share trading volumes have surpassed $2 billion in listed shares traded daily.[35] This Part explores the economic, informational, operational, and regulatory functions of exchanges and clearinghouse platforms.

Section A argues that exchanges centralize trading, engendering a wealth of economic benefits including price discovery, price accuracy, and liquidity. Section B offers a brief survey of the self-regulatory framework that endows exchanges with significant responsibility for governance. This Section concludes with a word of caution—antiquated perceptions of self-governance may not offer an effective response to emerging questions regarding the evolution of financial intermediaries.

### *A. The Economics of Trading*

Securities exchanges and clearinghouses perform a critical role in capital markets, and enhance efficiency in modern economies.[36] Securities exchanges enable issuers or corporations to list their securities at the time of an initial public offering of registered securities.[37] These trading venues facilitate the execution of transactions by matching buyers and sellers of securities, and clearing and settling trading transactions.[38]

By creating a forum for transactions among buyers and sellers of securities, commodities, derivatives, and other financial products, exchanges and clearinghouse platforms facilitate the transfer of capital among investors and firms that seek to raise capital.[39] Centralized trading engenders critical economic benefits such as price discovery,

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35. *The Evolution of NASDAQ*, NASDAQ, http://business.nasdaq.com/discover/nasdaq-story/our-heritage/index.html (last visited Aug. 14, 2017).

36. Section 3(a)(1) of the Exchange Act describes an "exchange" as "any organization, association, or group of persons, whether incorporated or unincorporated, which constitutes, maintains, or provides a market place or facilities for bringing together purchasers and sellers of securities or for otherwise performing with respect to securities the functions commonly performed by a stock exchange as that term is generally understood, and includes the market place and the market facilities maintained by such exchange." 15 U.S.C. § 78c(a)(1) (2012).

37. *See* Ioannis Kokkoris & Rodrigo Olivares-Caminal, *Some Issues on Cross-Border Stock Exchange Mergers*, 29 U. PA. J. INT'L L. 455, 463 (2007). Issuers—large corporations that solicit investments by distributing securities in public offerings—often elect to list their securities on exchange platforms to facilitate secondary market trading.

38. *See* Kristin N. Johnson, *Things Fall Apart: Regulating the Credit Default Swap Commons*, 82 U. COLO. L. REV. 167, 187 (2011) (describing the network effects in financial markets); Kokkoris & Olivares-Caminal, *supra* note 37, at 463.

39. THOMAS LEE HAZEN, PRINCIPLES OF SECURITIES REGULATION 365 (4th ed. 2017) [hereinafter HAZEN, PRINCIPLES].

price accuracy, and liquidity. Each of these benefits reduces transaction costs and enhances efficiency in financial markets.

Because of their role matching buyers and sellers, exchanges are an organic repository of real-time information regarding market transactions. Exchanges aggregate information regarding bids and asks[40] as well as the economic impact of new information on securities pricing. Based on the supply and demand dynamic, price discovery establishes the current market share price for a given security. According to economists, the greater the number of trades or indications of interest ("IOI")[41] regarding a security for a given period, the more accurate the security's market price. Consequently, exchanges contribute to the efficient functioning of financial markets by offering a most valuable service—price discovery.[42]

Centralized exchanges also enable market participants to determine the most accurate price for a security or commodity.[43] Confirmations regarding purchases and sales of securities; commodities and derivatives contracts; and exchanges and clearinghouses contribute significantly to greater price accuracy.[44]

Share price reflects forward-looking predictions regarding an issuer's likely performance as measured by anticipated future cash flows, distributions of dividends, or appreciation in the value of shares.[45] More accurate securities prices reduce the cost of raising capital, enhance the quality of securities sold in financial markets, and facilitate the efficient allocation of society's resources.[46] Though many debate the best approach for measuring share price accuracy, few dispute the benefits of ensuring accurate market pricing.

Accurate share pricing influences other economic attributes of a well-functioning market. U.S. capital markets are highly-liquid—shares listed on a registered U.S. securities exchange are easily sold for cash.[47] In liquid markets, buyers or sellers quickly identify

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40. A bid represents the maximum price that a buyer will pay to purchase a security and an ask price represents the minimum price that a seller will accept. *See also* Stanislav Dolgopolov, *Insider Trading and the Bid-Ask Spread: A Critical Evaluation of Adverse Selection in Market Making*, 33 CAP. U. L. REV. 83, 88–89 (2004) (citations omitted) (defining the bid-ask spread as "the difference between the market maker's 'sell' and 'buy' prices," which "represents the 'price for immediacy' and the 'cost of trading and the illiquidity of a market'").

41. *See* 17 C.F.R. § 230.255(c) (2015). *See also Financial Glossary: Indication of Interest*, NASDAQ, http://www.nasdaq.com/investing/glossary/i/indication-of-interest (last visited Aug. 1, 2017) (defining indications of interest as "[a] dealer's or investor's interest in purchasing (not commitment to buy) securities that are still in the underwriting stage and are being registered by the SEC").

42. *See* Merritt B. Fox et al., *The New Stock Market; Sense and Nonsense*, 65 DUKE L. J. 191, 222 (2015) and Nazli Sila Alan & Robert A. Schwartz, *Price Discovery: The Economic Function of a Stock Exchange*, 39 J. PORTFOLIO MGMT. 125 (2013) (defining an exchange according to its primary function of price discovery).

43. Jerry W. Markham & Daniel J. Harty, *For Whom the Bell Tolls: The Demise of Exchange Trading Floors and the Growth of ECNs*, 33 J. CORP. L. 865, 882–85 (2008).

44. In addition to consolidating information regarding the prices at which trades are executed, exchanges and clearinghouses communicate the amount of time that lapsed between an offer to buy or sell a security.

45. *See* Merritt B. Fox et. al., *Law, Share Price Accuracy, and Economic Performance: The New Evidence*, 102 MICH. L. REV. 331, 344–45 (2003) (discussing share price accuracy).

46. *See* Stephen Bainbridge, *The Insider Trading Prohibition: A Legal and Economic Enigma*, 38 U. FLA. L. REV. 35, 42–43 (1986) (citations omitted) (describing how accurate securities prices benefit both society and corporations).

47. ANTHONY SAUNDERS & MARCIA MILLON CORNETT, FINANCIAL MARKETS AND INSTITUTIONS 12 (5th ed. 2012) (defining liquidity "as the ease with which an asset can be converted into cash at its fair market value").

counterparties willing to contract for the sale or purchase of a security.[48] Liquidity generally describes the amount of time and effort that is required to identify a ready and willing counterparty to a securities trade at a relatively stable price without sensitivity to the volume of the purchase or sale order.[49] For highly liquid securities, one might expect that a broker who places an order to purchase the relevant securities will promptly receive confirmation that a counterparty accepts her bid (maximum price) at the stated asking price (minimum price).

Consider a broker seeking to buy shares of IBM common stock on the NYSE. Within milliseconds of a broker placing an order to buy 1,000 shares at a price that is currently reported as the going sales prices for IBM's shares, we expect the broker to be able to execute the order and receive prompt confirmation of the transaction.[50]

Serving as auction houses, exchanges match parties interested in buying a particular security, commodity or standardized derivative contract with a party interested in selling the same fungible financial product. A network externality arises; as the number of brokers and dealers executing transactions on a single exchange platform increases, the time required to identify counterparties and execute trades decreases.[51] Consequently, the efficiencies and economies of scale decrease transaction costs.

### *B. Self-Regulation and Its Challenges*

More than a century before Congress enacted federal laws to regulate securities and commodities markets,[52] exchange and clearinghouse members introduced informal policies and procedures to establish a set of rules for industry governance.[53] On May 17, 1792, twenty-four securities brokers signed the Buttonwood Agreement creating the entity that would become the NYSE.[54] With its early entry into the market and noteworthy lead in defining the market, the NYSE offered many of the economic benefits described in Section A. As the industry has developed, fledgling brokerage firms and formal exchange and clearinghouse platforms adopted and enforced governance measures designed to establish operational procedures, manage conflicts and mitigate risk.[55]

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48. *Id.* at 14.

49. *See* William C Dudley, President and CEO, Federal Reserve Bank of New York, Remarks at the Federal Reserve Bank of Atlanta 2016 Financial Markets Conference (May 1, 2016) (describing market and funding liquidity). Market liquidity refers to "the cost—both in expense and time—of buying or selling an asset for cash. Market liquidity reflects a number of factors, including any direct transaction expense, such as brokerage costs; the price the transaction is executed at relative to the midpoint of the bid-ask spread; how much, if at all, the transaction moves the market price; and the immediacy or speediness with which the transaction can be completed." *Id.* In addition, funding liquidity refers to the "ability of a financial entity to raise cash by borrowing on either an unsecured or a secured basis." *Id. See also* Johnson, *supra* note 38, at 188 (describing liquidity in relation to securities exchange networks).

50. For a careful examination of the benefits of the accuracy of public companies' stock prices, *see generally* Kevin Haeberle, *Stock-Market Law and the Accuracy of Public Companies' Stock Prices*, 2015 COLUM. BUS. L. REV. 121 (2015).

51. Johnson, *supra* note 38, at 188.

52. New York State legislature, for example, adopted the Stock Jobbing Act in 1829. *See* Stock Jobbing Act, 1 N.Y. REV. STAT. 710, tit. 19, art. 2, § 6 (1829).

53. HAZEN, PRINCIPLES, *supra* note 39, at 14.

54. Ellen Terrell, *History of the New York Stock Exchange*, LIBR. OF CONGRESS BUS. REFERENCE SERVS. (Oct. 2012), https://www.loc.gov/rr/business/hottopic/stock_market.html; Markham &. Harty, *supra* note 43, at 868–69.

55. Markham & Harty, *supra* note 43, at 903–04.

Relying solely on market participants, however, revealed gaps in the regulatory framework. Some argued that market participants failed to enforce regulation, shirking their obligation to monitor, investigate, and prosecute regulatory infractions or more significant violations such as market manipulation.[56] Indisputably, individual market participants had incentives to capture benefits or engage in forms of arbitrage while externalizing the costs of their behavior. Thus, market participants acted opportunistically, manipulated markets, and deceived investors. Responding to the threat of fraudulent practices and misconduct, state legislatures developed a patchwork of blue sky laws.[57] The self-governing measures developed by industry participants, states, and federal regulation seamlessly woven into a singular framework centered on transparency disclosure obligations for over eighty years.

In the wake of the stock market crash of 1929, the U.S. Senate Committee on Banking and Currency initiated hearings on the causes of the crash.[58] By the spring of 1932, after the two originally designated Committee reporters were terminated and a third resigned; Ferdinand Pecora, an assistant district attorney for New York, penned the final report.[59] Pecora unearthed a dark narrative involving market participants' intentional design and implementation of an array of manipulative schemes to create a market for worthless securities sold to the public.[60] According to Pecora, "[h]ad there been full disclosure of what was being done in furtherance of these schemes, they could not long have survived the fierce light of publicity and criticism. Legal chicanery and pitch darkness were the banker's stoutest allies."[61]

Juxtaposing the hearing transcripts of the 1932 Senate banking committee and the federal regulatory investigation reports prepared in the wake of the recent Flash Crash reveals hauntingly similar concerns. Each shock to the markets demonstrates the far-reaching effects of opacity. The absence of disclosure and transparency appear to create fertile ground for market disruption. Describing disclosure and transparency as a regulatory imperative, U.S. Supreme Court Justice Louis Brandeis explained that "[s]unlight is said to be the best of disinfectants; electric light the most efficient policeman."

The Senate banking committee's report informed Congress's decision to adopt federal statutes regulating securities and commodities markets,[62] securities exchanges and clearinghouses.[63] Federal regulation imposed a uniform body of laws and endowed the

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56. *See* Stephen C. Pirrong, *The Self-Regulation of Commodity Exchanges: The Case of Market Manipulation*, 38 J.L. & ECON. 141, 143 (arguing that "[s]elf-regulatory enforcement was virtually nonexistent during the period preceding the [Grain Futures Act]. Exchange members frequently voted down rules mandating penalties for manipulative conduct.").

57. *See* THOMAS LEE HAZEN, THE LAW OF SECURITIES REGULATION 305–08 (7th ed. 2017) [hereinafter HAZEN, SECURITIES REGULATION].

58. *See* U.S. Senate, *Subcommittee on Senate Resolutions 84 and 234*, https://www.senate.gov/artandhistory/history/common/investigations/Pecora.htm (last visited July 16, 2017).

59. *Id.*

60. *Id.*

61. Robert B. Thompson, *Market Makers and Vampire Squid: Regulating Securities Markets After the Financial Meltdown*, 89 WASH. U. L. REV. 323, 324–25 (2011) (citing MICHAEL PERINO, THE HELLHOUND OF WALL STREET: HOW FERDINAND PECORA'S INVESTIGATION OF THE GREAT CRASH FOREVER CHANGED AMERICAN FINANCE 52–59 (2010)).

62. *See generally* Roberta Romano, *The Sarbanes-Oxley Act and the Making of Quack Corporate Governance*, 114 YALE L.J. 1521, 1592 (2005).

63. Efforts in Europe to protect investors and regulate securities and commodities traders date back several centuries. HAZEN, PRINCIPLES, *supra* note 39, at 14.

SEC to execute rule-making and secondary regulatory authority.[64] Federal securities laws embraced the pre-existing and endemic self-regulatory character of market regulation.[65]

The statutory provisions reflect Congress's intent to preserve the vital role of exchanges and clearinghouses in the regulatory framework. Under Section 5 of the Securities Exchange Act of 1934 ("Exchange Act"), every "national securities exchange" must register with the SEC; Section 6 prohibits registration of a an exchange unless the exchange adopts rules designed to "prevent fraudulent and manipulative acts and practices, to promote just and equitable principles of trade" and to discipline members for violating the exchange's rules or federal securities laws.[66]

Section 15A of the Exchange Act empowers national securities associations with rule-making authority similar to the authority granted to exchanges. Under Sections 6 and 15A, national securities exchanges and national securities associations have the authority to expel, suspend or discipline members for conduct "inconsistent with just and equitable principles of trade."[67] Section 19 empowers the SEC to suspend or withdraw the registration of an exchange, to suspend or expel any member of an exchange, to suspend trading in listed securities and to impose rule changes on exchanges.[68]

Federal securities laws emphasize the importance of fair, orderly, and transparent trading in securities markets.[69] Because of their role in regulation, we describe exchanges and clearinghouse platforms as self-regulatory organizations ("SROs). Section 6(b) of the Exchange Act requires SROs to register with the SEC and endows the SEC with the authority to oversee SRO rulemaking and enforcement actions.[70] SRO rules and enforcement actions "prevent fraudulent and manipulative acts and practices" and "promote just and equitable principles of trade."[71] SROs may discipline members for violating SRO rules or federal securities laws.[72] In fact, the exchanges regulate the securities market by imposing rules on the issuers or companies that list their securities on the exchange platform for secondary market trading as well.[73] The members of exchanges

64. In the 1920s, Congress adopted the Grain Futures Act ("GFA") to regulate commodities. In 1936, Congress retitled the GFA the Commodity Exchange Act. In 1974, Congress amended the Commodity Exchange Act to authorize the Commodity Futures Trading Commission to oversee commodities markets.

65. *See* Donna Nagy, *Playing Peekaboo With Constitutional Law: The PCAOB and Its Public/Private Status*, 80 NOTRE DAME L. REV. 975, 1023 (2005).

66. *See* 15 U.S.C. § 78f(a) (2016).

67. *See* 15 U.S.C. § 78f(d)(3) (2016) (national securities exchanges); 15 U.S.C. § 78o–3(h)(3) (2016) (discussing securities dealers' associations).

68. The 1975 Amendments to the Exchange Act were a response to the Paperwork Crisis in the late 1960s and 1970s. The Amendments expanded the scope of the SEC's authority to reach all self-regulatory organizations. For a discussion of the Paperwork Crisis, see Part III.A.1.

69. *See SEC Strategic Plan: Fiscal Years 2014-2018*, SEC (2014), https://www.sec.gov/about/sec-strategic-plan-2014-2018.pdf ("The mission of the SEC is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation."); Janet Austin, *What Exactly Is Market Integrity? An Analysis of One of the Core Objectives of Securities Regulation*, 8 WM. & MARY BUS. L. REV. 215, 223–24 (2017).

70. 15 U.S.C. § 78f (a) (2016).

71. 15 U.S.C. §78f(b)(5) (2016).

72. Market participants who are members of the exchanges participate in the development of governance rules. Consequently, we describe securities markets as self-regulating, and securities exchanges, clearinghouse platforms and industry trade groups as self-regulatory organizations ("SROs"). SROs carefully craft rules that support and supplement existing federal statutory guidelines regarding transactions executed on exchange and clearinghouse platforms and the conduct of the firms and individuals that engage in securities market transactions.

73. HAZEN, PRINCIPLES, *supra* note 39, at 6–7.

and clearinghouses may act as brokers who merely execute transactions based on customer solicitations or dealers who transact with clients facilitating sales through their proprietary portfolios. Many brokerage houses offer both services, and consequently, markets describe these firms as broker-dealers.

Both the NYSE and the National Association of Securities Dealers (NASD) developed internal regulatory units to establish governing rules for issuers and broker-dealers trading on their platforms. In 2007, the regulatory units of the NYSE and the NASD merged and formed the Financial Industry Regulatory Authority, or FINRA.[74] In the evolving market ecosystem, FINRA, exercises quasi-governmental, monopolistic authority over broker-dealers.

Several general categories of rules govern the exchanges and clearinghouses and the members, or broker-dealers, who execute transactions on their platforms. Operational rules establish the criteria that permit exchanges to list securities, de-list securities or suspend trading in particular securities.[75] Other operational rules identify the disclosure and governance obligations of issuers of listed securities; regulate the submissions of bids on the exchange floor, the activities of "specialists"—that is, dealers who engage in market-making activities, transactions by members in listed securities for their own account, conditions under which transactions in listed securities may be executed off the exchange and clearing and settlement of exchange transactions.[76]

A second set of rules establish governance and eligibility rules that influence the internal organization and structure of broker-dealers, exchanges, and clearinghouses. These include rules that determine the qualifications for owners, partners, officers, and personnel, as well as rules that govern the handling of customers' accounts, advertising, and financial reports. These rules emphasize fair access and market integrity—aiming to mitigate fraud and market manipulation.[77]

Finally, a third category of rules govern the resolution process for trading platforms. These rules explain the relevant resolution proceedings if a large institutional client or several significant clients experience a solvency crisis and cannot perform their contractual obligations and commitments. Moreover, if an exchange or clearinghouse fails, this final category of rules offers some guidance for unwinding members' obligations.

While these rules and the process for implementing regulations have proven dynamic and responsive to changes in the structure of financial markets, a rising group of alternative trading strategies and alternative trading venues has introduced noteworthy challenges for the self-regulatory framework governing markets. Before turning to these emerging regulatory challenges, Parts III and IV describe these new classes of trading strategies and alternative venues.

## III. THE EVOLUTION OF FINANCIAL MARKET INTERMEDIATION

Functionally, exchanges and clearinghouses offer a marketplace where members purchase or sell listed securities for their own proprietary accounts or on behalf of their

74. *See* Roberta S. Karmel, *Should Securities Industry Self-Regulatory Organizations Be Considered Government Agencies?*, 14 STAN. J. L. BUS. & FIN. 151, 153–154 (2008).

75. HAZEN, SECURITIES REGULATIONS, *supra* note 57, at 13–17.

76. *Id.*

77. JAMES D. COX, ROBERT W. HILLMAN, & DONALD C. LANGEVOORT, SECURITIES REGULATION: CASES AND MATERIALS 7–8 (7th ed. 2013).

clients. In the early days, members (brokerage firms) staffed by humans (the employees of broker-dealer firms) matched the purchase and sale orders of customers seeking to trade securities. For many years, Hollywood films depicted the open outcry securities and commodities trading floors as "pits" where brokers and specialists gestured wildly using umpire-like hand signals and shouting buy/sell orders. These colorful images often fail to describe the diversity of entities that comprised the early trading market ecosystem—floor traders who cultivated private clubs, specialist firms that maintained books, brokers who posted limit orders to purchase and sell at designated prices, and dealers who served as market-makers.[78]

Prior to the adoption of the Exchange Act of 1934, private exchange rules and state law governed securities clearing and settlement processes for over a century.[79] For three decades after Congress adopted federal legislation federal regulators continued to demonstrate tremendous deference to private ordering in the form of SROs overseeing capital markets; self-regulating exchanges imposed administrative policies and procedures managing transaction trading, clearing, and settlement.[80] In the latter decades of the century, however, daily trading volumes began to increase, revealing the frailty of market infrastructure.

Beginning in the late 1960s and early 1970s, innovative developments in technology and the introduction of computer-based trading transformed financial markets. These changes challenged the operational infrastructure of trading markets. This Part explores the increasingly diverse strategies employed to execute, clear, and settle trades. While there are clearly benefits to the increased diversity in trading strategies, this Part contends that noteworthy costs accompany any gains.

The introduction of innovative trading strategies and the engineering of new financial products has threatened the stability of financial markets.[81] Three crises depict the types of concerns that arise in financial markets during periods of innovation and transition. Each crisis underscores the challenges that innovation and transitions create in financial markets and illustrates the limits of the existing self-regulatory framework.

### *A. The Paperwork Crisis of 1967*

By the end of the 1960s, financial markets faced the "greatest crisis since the Depression."[82] Simply stated, Wall Street had a paralyzing paper problem.[83] Share trading volume rose from 1.7 million shares traded daily to more than 12 million shares traded daily.[84] The inundation of transactions that marked the close of the decade caused an

78. HAZEN, PRINCIPLES, *supra* note 39, at 392–93.

79. HAZEN, SECURITIES REGULATIONS, *supra* note 57, at 11.

80. Markham & Harty, *supra* note 43, at 874.

81. HAZEN, SECURITIES REGULATIONS, *supra* note 57, at 11.

82. *See* Kurt Eichenwald, *Robert William Haack, 75, Dies; Led Stock Exchange During* Crisis, N.Y. TIMES, June 16, 1992, at B8, http://www.nytimes.com/1992/06/16/business/robert-william-haack-75-dies-led-stock-exchange-during-crises.html.

83. *When Paper Paralyzed Wall Street: Remembering the 1960s Paperwork Crisis*, FINRA (Aug. 19, 2015), https://www.finra.org/investors/when-paper-paralyzed-wall-street-remembering-1960s-paperwork-crisis [hereafter *When Paper Paralyzed Wall Street*].

84. *See* Eichenwald, *supra* note 82, at B8; SEC, STUDY OF UNSAFE AND UNSOUND PRACTICES OF BROKERS AND DEALERS, H.R. DOC. NO. 92-231, at 14–15, 34 (1971).

implosion in markets.[85] During the 1960s, however, daily trading volumes began to increase and underdeveloped market infrastructure and back-office administrative procedures captured federal regulators' attention.

Broker-dealers had long utilized a direct holding system that required brokers and dealers to execute transactions on behalf of investors and transfer the physical stock certificates evidencing ownership of the shares among a small group of custodians.[86] Broker-dealers relied on "back-office" trade processing departments as well as an army of administrators to facilitate the clearing of securities transactions and the physical delivery of stock certificates.[87]

As the volume of transactions multiplied exponentially, process deficiencies and delays became more disturbing. Relying on humans to process transactions created exceptional opportunities for shirking, error, corruption and theft.[88] Even well-intentioned back-office administrators struggled to keep pace with the rising tide of transactions.[89] The clearing and settlement process involved "a trackless forest,"[90] completing an inordinate number of documents and physically transferring certificates.[91] The NASD shortened the trading day by an hour and a half to enable clerical personnel to address the back-office build up.[92] According to one account "[c]lerical personnel at firms were working day and night to process transactions" and piles of paperwork stymied effective trade settlement.[93]

Consequently, an unprecedented number of high profile brokerage firms failed.[94] In the short period between 1967 and 1971, over a dozen NYSE member firms failed.[95] Among the surviving firms, more than seventy merged with or were acquired by other broker-dealer firms.[96] Many were liquidated,[97] and losses reached more than $130 million.[98] To safeguard the system from future crises, the SEC implemented a series of reforms including record-keeping standards, custody requirements for customer funds and securities, and heightened net capital requirements for broker-dealers.[99]

After careful review of the precipitating conditions of the Paperwork Crisis, Congress acknowledged that the U.S. clearing and settlement system had notable fundamental weaknesses.[100] The system lacked a single unifying vehicle designed to ensure clarity, a consolidating platform that would gather and disseminate information regarding securities trade processing market-wide.[101] In other words, the lack of interoperability of the several

85. H.R. DOC. NO. 92-231, at 14–15, 34.
86. *Id.*
87. *Id.*
88. *Id.*
89. *See When Paper Paralyzed Wall Street*, *supra* note 83 (discussing the paperwork crisis).
90. H.R. DOC. NO. 92-231, at 14–15, 34.
91. *Id.*
92. *See* Eichenwald, *supra* note 82, at B8.
93. Larry E. Bergmann, Senior Assoc. Dir., SEC, Speech at the International Securities Settlement Conference: The U.S. View of the Role of Regulation in Market Efficiency (Feb. 10, 2004), https://www.sec.gov/news/speech/spch021004leb.htm.
94. *Id.*
95. H.R. DOC. NO. 92-231, at 14–15, 34.
96. *Id.*
97. *See* Bergmann, *supra* note 93 (discussing how regulation affects market efficiency).
98. H.R. DOC. NO. 92-231, at 14–15, 34.
99. *See* Bergmann, *supra* note 93 (discussing how regulation affects market efficiency).
100. H.R. DOC. NO. 92-231, at 13.
101. *Id.*

independent entities that provided trade data inhibited transparency and posed noteworthy concerns for settlement.

Following the Paper Crisis, Congress amended the Securities Exchange Act, adding a number of provisions designed to enhance the operational connectivity and transparency among trading venues.[102] The 1975 Amendments to the Exchange Act aimed to develop a national market system (NMS) that unified and integrated trade clearing and settlement.[103]

Responding to the Paperwork Crisis and in effort to implement a NMS, the SEC proposed and finalized rules for collecting and disseminating information regarding securities pricing and share trading volume through Securities Information Processors (SIPs).[104] These reforms included the introduction of SIPs. The aggregation of market pricing information through SIPs facilitated display liquidity or real-time distribution to the public of current and available securities pricing information. The SIPs collected and disseminated securities pricing information including the share trading volume, bid price (price that a purchaser seeks to buy a security) and ask price (price for which a seller is willing to sell a security) for the nearly 6,000 companies whose shares are listed on the national securities exchanges.[105] SIPs connected trading venues and offered a central, consolidated live stream of every exchange's best quotes (bids and offers) in a single data feed.

By 1978, the Consolidated Quotation System ("CQS") aggregated NYSE-listed securities prices reported by the Boston, Midwest, New York, Philadelphia and Pacific Stock Exchanges; and, by 1979, the NASD began reporting price quotes.[106]

The legislative and regulatory response to the antiquated and outdated information and collection systems were insufficient, however, to address the financial product innovation that would mark the coming decade. By the 1980s, market participants creatively began to develop derivative contracts. Some of these arrangements would only

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102. *See supra* Part III.A and text accompanying footnotes 94–99.

103. *See supra* Part II.A.

104. Quotations in exchange-listed securities are collected and disseminated by the Consolidated Quote System ("CQS"), which is governed by the CQ Plan approved by the Commission under Rule 11Aa3-2. *See also* 15 U.S.C. § 78c(a)(22).

105. The term "bid" describes the current price that a buyer is willing to pay to purchase a security; "ask" describes the price that a seller at which a seller is willing to sell a security. Continuous display of the prices and quantities at which securities are trading enables market participants to confidently execute transactions and minimizes the costs of discovering the accurate price of a security.

106. National securities exchanges registered with the SEC distribute their trades and quotes to a central consolidator where the Consolidated Tape System ("CTS") and Consolidated Quote System ("CQS") data streams are produced and distributed worldwide. *See* Intercontinental Exchange, Inc., *Consolidated Tape Association*, (2017), https://www.ctaplan.com/index. The Consolidated Tape Authority ("CTA") administers the consolidated quotation system, disseminating real-time trade and quote information for listed companies' securities. According to CTS, the current exchanges that participate in the consolidated quotation system include Bats BZX Exchange, Inc., Bats BYX Exchange, Inc., Bats EDGX Exchange, Inc., Bats EDGA Exchange, Inc., Chicago Stock Exchange, Inc., Financial Industry Regulatory Authority, Inc., International Securities Exchange LLC, Investors Exchange LLC, NASDAQ OMX BX, Inc., NASDAQ OMX PHLX, Inc., Nasdaq Stock Market LLC, National Stock Exchange, New York Stock Exchange LLC, NYSE Arca, Inc., and NYSE MKT LLC. The CTA has governance provisions that regulate the collection, processing and dissemination of trade and quote data. *See Intercontinental Exchange, Inc.*, CONSOLIDATED TAPE ASSOCIATION, https://www.ctaplan.com/index (last visited Sept. 14, 2017).. The New York Stock Exchange LLC is the Administrator of Network A and NYSE MKT is the Administrator of Network B. The Plans were filed with and approved by the SEC in accordance with Section 11A of the Exchange Act of 1934. *See Consolidated Tape Association*, INTERCONTINENTAL EXCHANGE (2017), https://www.ctaplan.com/index (last visited Sept. 14, 2017). .

refer to a stock (or basket of stocks) listed on a national securities exchange (NMS listed stocks) as part of a more complicated contractual arrangement.

### *B. Stock Market Crash of 1987*

Two decades after the Paperwork Crisis, markets once again roiled in the wake of the introduction of innovative financial products and an inundation of new investors. During the period leading to October 19, 1987, the Stock Market Crash of 1987, equity markets celebrated an explosion of stock appreciation[107] and new investors—institutional investors, pension funds and retail investors flooded the markets.[108] Price increases outpaced earnings growth and boosted price earnings ratios.[109] The volume of securities transactions soared.[110] Between August 1982 and December 1986, the Dow rose from 777 to 1,896.[111] Favorable tax treatments permitting businesses to deduct the interest expenses on debt used to facilitate buyouts fueled corporate acquisitions.[112]

Capital markets trading strategies also witnessed monumental transformations. First, computer program trading enabled brokerage firms to utilize automated systems to execute large orders to buy or sell stock and futures based on instructions related to price changes in specified stocks or futures contracts.[113] Second, two innovative products gained significant following: portfolio insurance and index arbitrage.[114] Portfolio insurance aimed to limit the losses investors might face in a declining market.[115] Index arbitrage traders developed computer programs that executed transactions in futures markets based on expectations regarding anticipated movements in the cash market.[116] Coupling index arbitrage strategies and portfolio insurance, market participants assumed that they could

107. REPORT OF THE PRESIDENTIAL TASK FORCE ON MARKET MECHANISMS: SUBMITTED TO THE PRESIDENT OF THE UNITED STATES, THE SECRETARY OF THE TREASURY, AND THE CHAIRMAN OF THE FEDERAL RESERVE BOARD (1988), https://archive.org/stream/reportofpresiden01unit/reportofpresiden01unit_djvu.txt [hereinafter REPORT OF THE PRESIDENTIAL TASK FORCE].

108. *Id.*

109. *See* HAZEN, SECURITIES REGULATIONS, *supra* note 57, at 1218.

110. *See* HAZEN, SECURITIES REGULATIONS, *supra* note 57, at 1219.

111. *Id.*

112. *Id.*

113. Mark Carlson, *A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response* 4–5 (Fed. Reserve Bd., Fin. & Econs. Discussion Series, Working Paper No. 2007-13, 2006), https://www.federalreserve.gov/pubs/feds/2007/200713/200713pap.pdf (citing NICHOLAS KATZENBACH: AN OVERVIEW OF PROGRAM TRADING AND ITS IMPACT ON CURRENT MARKET PRACTICES. NEW YORK: THE NEW YORK STOCK EXCHANGE (1987)). "Under this strategy, computer models were used to compute optimal stock-to-cash ratios at various market prices. Broadly, the models would suggest that the investor decrease the weight on stocks during falling markets, thereby reducing exposure to the falling market, while during rising markets the models would suggest an increased weight on stocks. Buying portfolio insurance was similar to buying a put option in that it allowed investors to preserve upside gains but limit downside risk." *Id.* at 4.

114. *Id.* at 4–5. "The second program trading strategy was 'index arbitrage,' which was designed to produce profits by exploiting discrepancies between the value of stocks in an index and the value of the stock index futures contracts. If the value of the stocks was lower than the value of the futures contract, then index arbitragers would buy the stocks in the cash market and sell the futures contract knowing that the prices would have to converge at the time the futures contract expired. The reverse transactions could be executed if the value of stocks was above that of the futures contract; however, rules restricting short-sales made this trade more difficult to implement for arbitragers that did not own stocks." *Id.* at 5.

115. ROBERT E. WHALEY, DERIVATIVES: MARKETS, VALUATION, AND RISK MANAGEMENT 884 (1st ed. 2006); *see also* Carlson, *supra* note 113, at 4–5.

116. WHALEY, *supra* note 115, at 884.

capture gains and hedge against losses.[117] Traders acquired stock index futures during a rising market and sold them in a falling market, using portfolio insurance to hedge against losses if equity prices should fall.[118]

As markets roared, traders struggled to keep pace with the staggering volume of trading orders. Back office operations simply failed and exchanges and clearinghouses had to suspend trading on certain financial products. On Wednesday, October 14th, media outlets reported that Congress intended to revoke the favorable tax treatment that encouraged the wave of leveraged buy-outs (LBO) during the previous decade.[119] As a consequence, investors re-evaluated their assumptions regarding the likelihood that certain publicly-traded companies might be the target of an LBO.[120] In addition, news supporting concerns regarding macroeconomic indicators such as a decline in the value of the U.S. dollar, a higher than anticipated trade deficit and the Federal Reserve's intention to tighten monetary policy created "downward pressure on equity prices."[121] By Friday, October 16th, the uncertainty was palpable and a heavy sell-off ensued.

By October 19th, Black Monday, the value of all outstanding U.S. stocks decreased by almost $1.0 trillion.[122] Monday morning's opening market bell illustrates a critical juncture in the narrative of the crash and offers a focal point for analysis regarding innovation in financial markets. Traders on the NYSE delayed the start of trading, while traders in the derivatives market opened on time.[123] Index arbitrage traders seized upon this gap between equities trading and stock index trading.[124] When the stock market did reopen and stock prices were markedly lower than the index arbitrage traders had anticipated, there was a positive response to the confusion followed by disaster.[125]

Stock prices plummeted and volatility increased dramatically.[126] The Dow Jones Industrial Average fell by 508 or more than twenty-two percent.[127] Describing the stock market crash of 1987 in a report published the following year, the Report of the Presidential Task Force on Market Mechanisms explained the critical value of capital markets and the importance of financial markets infrastructure in our broader economy.[128]

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117. Carlson, *supra* note 113, at 4.
118. *Id.* at 4–5.
119. *Id.*
120. *Id.*
121. *Id.*
122. REPORT OF THE PRESIDENTIAL TASK FORCE, *supra* note 107 (discussing market mechanisms).
123. *Id.*
124. *Id.*
125. *Id.*
126. *Id.*
127. REPORT OF THE PRESIDENTIAL TASK FORCE, *supra* note 107 (discussing market mechanisms).
128. *Id.* at 1. ("The significance of this decline lies in the role that the stock market plays in a modern industrial economy, both as a harbinger and a facilitator of economic activity. Stock price levels can have an important effect on the confidence and, hence, the behavior of both businesses and households. Further, equity markets are a primary means by which businesses and industries raise capital to finance growth and provide jobs. However, the importance of stock sales is greater than simply the amount of funds raised. New equity capital and public equity markets are essential to financing innovative business ventures which are a primary engine of the nation's economic growth. . . .Moreover, publicly traded equities are a repository of a significant fraction of U.S. household wealth. . . Thus, in the early fall of 1987, the stock market accounted for approximately $3.2 trillion worth of household wealth. Equity markets are also inextricably tied to the wider financial system through the structure of banks and other financial institutions. Given the importance of equity markets to the economy and to the public, effectively structured and functioning equity markets are critical.").

The following morning, Tuesday, October 20th, the Federal Reserve issued a public statement affirming its intentions to "serve as a source of liquidity to support the economic and financial system."[129] As indicated by the report of the Presidential Task Force,

> [c]learing and credit system problems further exacerbated the difficulties of market participants. While no default occurred, the possibility that a clearinghouse or a major investment banking firm might default, or that the banking system would deny required liquidity to the market participants, resulted in certain market-makers curtailing their activities and increased investor uncertainty. Timely intervention by the Federal Reserve System provided confidence and liquidity to the markets and financial system.[130]

The Federal Reserve's actions in the period following the Stock Market crash created an impression that the federal government would intervene employing monetary tools to protect the stability and integrity of capital markets. Responses to subsequent crises have heightened questions regarding the appropriateness of government intervention generally and more specifically the willingness of the Federal Reserve to use monetary tools to address market disruptions.

### *C. Recent Financial Crisis of 2007*

From the late 1980s through the early 2000s, financial product engineers developed and refined a unique category of over-the-counter ("OTC") derivative instruments.[131] These financial products derive their value from an asset—stock, bond, or commodity—referenced in the contract. Unlike listed stocks, OTC derivatives do not trade on registered national securities exchanges such as the NYSE or the NASDAQ. Instead, these contracts are private, bilateral agreements typically executed by sophisticated market participants. To the extent that there is a secondary market, these instruments trade on private platforms or even more informally among industry participants.

Due to private ordering in OTC derivatives markets and the limited group of sophisticated market participants trading in these financial products, some posited that trading in OTC derivatives markets did not require federal regulatory oversight.[132] In response, Congress enacted a provision in the Gramm Leach Bliley Act that expressly exempted OTC derivatives from federal regulation.[133]

By the summer of 2007, OTC derivatives markets began to reveal an increasing level of distress.[134] The bilateral, off-exchange trading, clearing, and settling processes created a dark cloud of opacity that veiled risks in the OTC derivatives markets.[135] As distress

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129. *See* DONALD BERNHARDT & MARSHALL ECKBLAD, FEDERAL RESERVE, STOCK MARKET CRASH OF 1987, (Nov. 22, 2013), https://www.federalreservehistory.org/essays/stock_market_crash_of_1987 (describing the first contemporary global financial crisis).

130. REPORT OF THE PRESIDENTIAL TASK FORCE, *supra* note 107, at V.

131. Alan Greenspan, Chairman, Fed. Reserve Bd., Remarks on Financial Derivatives Before the Futures Industry Association in Boca Raton, *Florida* (Mar. 19, 1999), https://www.federalreserve.gov/boarddocs/speeches/1999/19990319.htm.

132. Johnson, *supra* note 38, at 196.

133. Gramm-Leach-Bliley Act, Pub. L. No. 106-102, 113 Stat. 1338 (2006) (codified at 15 U.S.C. §§ 6801-6809 (2006)).

134. Johnson, *supra* note 38, at 172–73.

135. *Id.*

intensified across the market for OTC derivatives, namely collateralized debt obligations ("CDOs") and credit default swaps ("CDSs"), legislators, regulators, and the public became increasingly aware of the potential threat to market stability.[136] Several storied financial institutions experienced solvency crises as the quality of the assets identified as collateral in these arrangements deteriorated.[137]

During the summer of 2007, OTC derivative market participants began to experience the significant distress.[138] Bear Stearns High Grade Structured Credit Strategies Enhanced Leverage Fund and a related fund (the "funds") held portfolios that were largely invested in CDO products.[139] The group of funds were highly leveraged, having borrowed up to 10 times their value to engage in speculation in the CDO market.[140] Bear Sterns' trading positions in credit derivatives markets had once generated sizable profits and was valued previously at $1.5 billion.[141] By the end, these investments threatened to thrust the firm into bankruptcy.

As the value of the firm's investments declined, trading counterparties demanded that Bear Sterns offer additional evidence that the bank could satisfy its contractual commitments.[142] Bear Sterns began to refuse investors' requests for the funds to redeem their shares.[143] As the value of the funds' assets continued to decline, counterparties such as Merrill Lynch and Deutsche Bank seized over $1 billion in assets.[144] The funds filed for bankruptcy in July of 2007 but the investment bank managed to survive another year. By the late spring 2008, Bear Sterns, an eighty-five-year-old storied investment bank with an office on Madison Avenue in New York City, found it increasingly difficult to manage its losses in the credit derivatives market.[145] On March 17, 2008, federal regulators intervened and orchestrated the sale of Bear Stearns to JP Morgan Chase Bank for $2 per share.[146] The crisis at Bear Sterns marked a tipping point.

In the wake of Bear Stearns' collapse, several storied financial institutions faced liquidity crises. Six months after the sale of Bear Sterns, on September 15, 2008, Lehman Brothers filed for bankruptcy. In the fall of 2008, the Lehman bankruptcy marked the largest bankruptcy in the history of the nation. Rumors that American International Group, Inc. (AIG) would follow Lehman Brothers and file for bankruptcy stoked the fires of trepidation in financial markets. AIG's swift decline was among the most significant events during the crisis.[147]

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136. *Id.* at 194–96.

137. *Id.* at 227–28.

138. Markus K. Brunnermeier, *Deciphering the Liquidity and Credit Crunch 2007–2008*, 23 J. ECON. PERSP. 77, 80 (2009).

139. *Id.* at 1307.

140. *Id.*

141. *Id.*

142. *Id.*

143. *See* Kristin N. Johnson, *From Diagnosing the Dilemma to Divining a Cure: Post-Crisis Regulation of Financial Markets*, 40 SETON HALL L. REV. 1299, 1307–08 (2010) (describing Bear Stearns' precarious position at the time) [hereinafter *Diagnosing the Dilemma*].

144. *Id.* at 1308.

145. *Diagnosing the Dilemma*, *supra* note 143, at 1307–08.

146. *Id.* at 1309–10.

147. *Id.* at 1311 ("On September 15, 2008, after a steep decline in the company's stock price and reductions in its credit ratings, Lehman Brothers Holdings, Inc. (Lehman Brothers) filed for Chapter 11 bankruptcy protection. Lehman Brothers' filing marked the largest bankruptcy in U.S. history and severely undermined consumer confidence in the stability of capital and credit markets. Lehman Brothers' bankruptcy illustrates the

AIG entered the OTC credit derivatives market at a crucial point and took an exceptionally large position as credit default swap protection seller. In the decade before the crisis, AIG created a Financial Products division (AIGFP).[148] As an insurer, AIG was familiar with the structural details of a wide range of insurance products.[149] It appears that AIG priced credit derivative products—specifically credit default swaps—as a kind of insurance product.[150] Based on this understanding and notwithstanding the fact that its net notional exposure to CDS agreements was over $550 billion, AIG's publicly filed annual reports, between 2003 and 2006 suggested the CDS arrangements created *de minimis* risk exposure for the firm.[151]

At the time of AIG's near collapse, the size of the OTC derivatives market had increased from a notional amount of $95.2 trillion in 2000 to approximately $673 trillion in 2007.[152] When markets began to decline, AIG faced a collateral call similar to the counterparty demands that Bear Stearns faced.[153] The sheer volume of AIG's exposure, however, created a cascade of losses.[154] In the context of the recent financial crisis, the Federal Reserved extended loans totaling over $185 billion to AIG to prevent the firm's insolvency.

These crises suggest that industry innovation may create conditions that may lead to a market disruption followed by prompt regulatory intervention. Careful evaluation of the regulatory intervention reveals three critical pathways of reform: economic protections, governance obligations, and the designation of regulatory authority to an SRO.

### *D. Learning from Crises*

The Paperwork Crisis, the Stock Market Crash of 1987 and the recent financial crisis illustrate the evolving nature of financial markets. Leading to each crisis the industry witnessed a marked increase in the volume of market transactions and notable innovations in financial products. The Paperwork Crisis offers the clearest example of an inundation of market transactions befalling an ill-prepared settlement and clearing system.

In the period before the Stock Market Crash of 1987, market participants introduced derivatives strategies involving index arbitrage.[155] During the period leading up to the financial crisis, markets witnessed the invention of CDSs and CDOs. Along with derivatives market innovations, hedging strategies appeared to be a linchpin in both the Stock Market Crash of 1987 and the recent financial crisis. Portfolio insurance provided a novel form of hedging during the period leading up to the Stock Market Crash of 1987.[156]

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tension that the government faced as concerns increased regarding liquidity in credit markets in 2008.").

148. Kristin N. Johnson, *Clearinghouse Governance: Moving Beyond Cosmetic Reform*, 77 BROOK. L. REV. 681, 687–88 (2012) [hereinafter *Clearinghouse Governance*].

149. *See* Andrew Ross Sorking, *JP Morgan Pays $2 a Share for Bear Sterns*, N.Y. TIMES, Mar. 17, 2008, http://www.nytimes.com/2008/03/17/business/17bear.html?mcubz=3.

150. Kristin N. Johnson, *Macroprudential Regulation: A Sustainable Approach to Regulating Financial Markets*, 2013 U. ILL. L. REV. 881, 911 (2013) [hereinafter *Macroprudential Regulation*].

151. *Clearinghouse Governance*, *supra* note 148, at 688.

152. *Id.* at 686.

153. *Id.* at 687–88.

154. *Id.* at 688–89.

155. *See supra* notes 114–117 and accompanying text (including technological innovations such as index arbitrage computer programs).

156. *See* Lewis D. Solomon & Howard B. Dicker, *The Crash of 1987: A Legal and Public Policy Analysis*, 57 FORDHAM L. REV. 191, 211 (1988) ("Portfolio insurance, also known as dynamic hedging, is an asset

Credit derivatives in the recent financial crisis concealed risk exposure by creating an illusion that each agreement reduced the concentration of risk.

Federal Reserve responses to the both the Stock Market Crash of 1987 and the recent financial crisis reflect the need for economic protections to stabilize markets during periods of disruption. The Federal Reserve supported market sentiment by issuing public statements and taking actions to reassure the investing community that the government would support credit and capital markets. The Federal Reserve increased liquidity in the financial system and mitigated volatility. Finally, through numerous public and private cooperative endeavors, the Federal Reserve encouraged cooperation and flexibility among market participants.[157] Similar to legislative and regulatory responses to previous crises, the Federal Reserve introduced additional liquidity to ensure the stability and integrity of credit and capital markets.

While these crises demonstrate market failures, the recent financial crisis reflects amplified risk exposure unseen in either the Paperwork Crisis or the Stock Market Crash of 1987. The opacity of trading in the OTC derivatives market prevented regulators from recognizing the growing risk in these shadows of conventional financial market activity. The sweeping effects of the recent financial crisis were largely the result of the additional risk exposure in off-exchange traded financial products.[158] Off-exchange traded financial products, such as CDSs, left institutional investors particularly vulnerable due to the unknown risks associated with these innovative financial products.[159]

Congressional and regulatory intervention following all three crises demonstrate a conventional reliance on the *ex ante* introduction of governance obligations and the delegation of authority to an SRO. Consistent with this approach, Congress adopted comprehensive regulatory reform, enacting the Dodd-Frank Act (DFA) in 2010. Title VII of the DFA imposes registration and clearing requirements in the OTC derivatives market.

Title VII creates greater transparency, economic and governance protocols. The obligation to register OTC derivatives lifted the shroud of opacity that characterized trading in bilateral markets. By requiring execution of eligible OTC derivatives trades on clearinghouse platforms, Title VII interposes central counterparties (CCPs) between the buyer and the seller in an OTC derivatives contract. The CCP introduces economic and governance obligations that militate against the perils that triggered AIG's near collapse.[160]

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allocation strategy that continually rebalances a portfolio between a risky investment and a riskless investment so that the portfolio's total return does not fall below some specified minimum over a given time period.").

157. *See* Carlson, *supra* note 113, at 4–5 (examining the varieties of tools and providing examples).

158. In the years leading to the recent financial crisis, financial market participants began to engineer new financial products and trade these innovative products in the OTC market. Initially, these OTC transactions were highly celebrated because they reduced trading costs and various risk exposures and enhanced liquidity in markets. Not very long after these products began trading in the "off-exchange" markets, the OTC derivatives market suffered severe distress and losses rippled across the OTC markets and conventional capital and credit markets creating a global financial crisis.

159. *See* Janis Sarra, *Financial Market Destabilization and the Role of Credit Default Swaps: An International Perspective on the SEC's Role Going Forward*, 78 U. CIN. L. REV. 629, 634 (2009).

160. Kristin Johnson, *Governing Financial Markets: Regulating Conflicts of Interest*, 88 WASH. L. REV. 185 (2013) (describing Title VII and the introduction of central counterparties(CCPs)). The CCPs theoretically reduce risk by shifting governance and risk management from individual financial market participants to central trading platforms. Notwithstanding the benefits of centralized trading, relying on market participants to determine CCP governance and risk management policies leaves CCPs vulnerable to systemic risk concerns. *See id* and Stephen Lubben, *Always Crashing in the Same Car—Clearinghouse Rescue in the United States under Dodd–Frank*, 3 J. FIN. REG. 133–158 (2017) (arguing that "clearinghouses themselves are apt to be quite fragile in times of extreme

Developments in the growth of alternative trading strategies, such as algorithmic and high frequency trading, and alternative trading venues, such as electronic trading platforms and other off-exchange venues, including dark pools, have raised similar additional regulatory concerns. These developments have inspired allegations that failure to carefully regulate these technology-inspired trading market transformations may undermine the integrity and stability of financial markets and serve to encourage discriminatory access to important trading markets.

Part IV establishes the increasing dominance algorithmic and HFT trading strategies. Contemporaneous with the rise of alternative trading strategies, the number of trading venues has multiplied, fragmenting the market share of trading volume across a broader landscape of trading platforms, exchanges, and clearinghouses. In the absence of a clear understanding of the interplay between innovative trading strategies and new (particularly dark) alternative trading venues continued reliance on these alternative venues to serve as conventional SROs may be shortsighted.

## IV. EMERGING TRADING STRATEGIES

In a quiet revolution, computer-based trading programs are rapidly replacing human traders. These changes mark the end of the era of specialists and physical execution of trades on legacy exchanges.[161] Moreover, computer-based trading programs have significantly impacted the volume and speed of securities market transactions. Section A describes the transformation of the collection of trade data, processing and settlement of trades, and the integration of technology in trading markets. This Section also argues that these changes inspired important transitions in the ownership structure and business models of legacy trading venues such as the New York Stock Exchange and the NASDAQ. Section B examines the integration of technology in financial markets trading and more specifically, the proliferation of computer-generated trading strategies. Section B outlines the newest frontier of algorithmic trading, high frequency trading.

### *A. Black Box Trading: Algorithms*

Algorithmic trading, one of the most popular forms of computer program-based trading, has seized an increasingly dominant role in securities markets. Algorithmic trading programs influence the trading decisions of as many as seventy percent of the securities transactions executed in the United States.[162] Relying on complex algorithms, these computer-based trading strategies disseminate instructions to broker-dealers to execute securities transactions.[163] Some programs execute trades without relying on traditional broker-dealers; using electronic communications networks and internet-based technology these programs directly interface with traditional and emerging securities exchanges, clearinghouses or alternative trading platforms.[164]

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financial stress, like that experienced in 2008").

161. See *supra* notes 36–51 and accompanying text.

162. *See* Michael Mackenzie, *High-frequency trading under scrutiny*, FIN. TIMES, (July 28, 2009), http://www.ft.com/intl/cms/s/0/d5fa0660-7b95-11de-9772-00144feabdc0.html#axzz3kPGSbBkJ.

163. Nathaniel Popper, *Searching for a Speed Limit in High-Frequency Trading*, N.Y. TIMES, Sept. 8, 2012, http://www.nytimes.com/2012/09/09/business/high-frequency-trading-of-stocks-is-two-critics-target.html.

164. *See* Yesha Yadav, *How Algorithmic Trading Undermines Efficiency in Capital Markets*, 68 VAND. L. REV. 1607, 1626–29 (2015) [hereinafter Yadav, *Algorithmic Trading*].

Algorithmic or computer-based trading programs digest and analyze vast volumes of data and manage sizable portfolios of securities. The programs evaluate a broad range of market indicators including changes in market prices, interest rates, news reports, publicly-traded company earnings and other disclosures, regulatory filings, corporate fines or penalties, and changes in corporate control.[165]

Once programming is complete, algorithmic trading strategies operate with limited human intervention. Programmed codes may control decision-making processes for executing orders to purchase or sell securities. The program decides when to buy or sell securities, the volume of securities to purchase or sell, the timing of trade execution, and where to route the transactions.

Programmers design algorithms to respond rapidly to new information, identify arbitrage opportunities, and discrepancies in pricing. Algorithmic trading enables market participants to calculate risks and costs of individual trades or large number of complex market trades that comprise a trading strategy.[166] The predictive features of algorithmic trading facilitate trade executions with greater accuracy and efficiency, lower margins of error, and reduced transaction costs.[167] Algorithmic programming integrates data analytics, employing models that evaluate the significance of data and analyze how the information impacts market trading decisions. Algorithms outpace antiquated approaches to reviewing and analyzing data.[168]

### *B. HFT: The New Trading Frontier*

While various types of market participants have adopted computer-based algorithmic programs, traders who couple algorithmic trading practices with strategies that entail rapidly submitting and canceling significant volumes of small trades—high frequency trading (HFT)[169]—have captured significant profits and popularity. Firms that adopt HFT strategies may submit significant numbers of orders for a small quantity of securities (100 or 200 shares) over a relatively short window of time. After submitting the orders, HFT strategists quickly cancel the orders and benefit from the small discrepancies in the price of the securities from the time of the submission of the order to the moment when the HFT

165. RISHI K. NARANG, INSIDE THE BLACK BOX: A SIMPLE GUIDE TO QUANTITATIVE AND HIGH-FREQUENCY TRADING 8–9, 24–62 (2d ed. 2013).

166. Popper, *supra* note 163.

167. *Id.*

168. Michael Kearns & Yuriy Nevmyvaka, *Machine Learning for Market Microstructure and High Frequency Trading, in* HIGH FREQUENCY TRADING 122–23 (David Easley, Marcos Lopez de Prado & Maureen O'Hara eds., 2013)).

169. There is no formal, universally adopted definition of high-frequency trading. Acknowledging the definitional ambiguity, the SEC describes HFT traders as "professional traders acting in a proprietary capacity that engage in strategies that generate a large number of trades on a daily basis." Concept Release on Equity Market Structure, Exchange Act Release No. 61358, 75 Fed. Reg. 3594, 3594 (Jan. 21, 2010) HFT firms may employ any of the following tactics: (1) The use of extraordinarily high speed and sophisticated computer programs for generating, routing, and executing orders; (2) use of co-location services and individual data feeds offered by exchanges and others to minimize network and other types of latencies; (3) very short time-frames for establishing and liquidating positions;(4) the submission of numerous orders that are cancelled shortly after submission; and (5) ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions overnight). Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3599 (Jan. 21, 2010) (to be codified at 17 C.F.R. pt. 242), https://www.sec.gov/rules/concept/2010/34-61358fr.pdf

firm cancels the order.[170] Estimates report that HFT transactions now account for two-thirds of trading activity in the U.S. financial market.[171]

While there are several different HFT strategies,[172] a common thread binds the approaches that HFT firms adopt. HFT firms seek to take advantage of short-term arbitrage opportunities in markets. HFT strategies abandon conventional investment approaches that emphasize long-term appreciation.[173] HFT strategies aim to ensure that their trading activity is neutral or flat—meaning the brokers-dealers executing HFT strategies do not maintain a portfolio of securities from one day to the next day. Instead, those employing HFT strategies close out any open positions before the end of each trading day; this approach enables broker-dealers adopting HFT strategies to embrace short-term price movements.[174] Entering into transactions and quickly exiting these positions has engendered outsized profits, seizing the opportunity to capture small price differences, and capitalizing on the low margins of each trade.[175]

Many HFT strategies aim to reduce latency or the timing required to process data and adapt one's trading strategy based on market conditions or price movements. Consequently, many describe efforts to achieve low latency as a technological arms race—traders sprinting to close trades faster than competitors, even if only by a millisecond.[176] HFT firms' success in achieving low latency often depend on the implementation of one of several strategies including the use of algorithmic trading programs, direct market access and co-location.[177]

HFT strategies that rely on algorithms submit and route trades at exponentially faster

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170. Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3599 (Jan. 21, 2010) (to be codified at 17 C.F.R. pt. 242), https://www.sec.gov/rules/concept/2010/34-61358fr.pdf.

171. Graham Bowley, *Clamping Down on Rapid Trades in Stock Market*, N.Y. TIMES, Oct. 8, 2011, http://www.nytimes.com/2011/10/09/business/clamping-down-on-rapid-trades-in-stock-market.html ("[High-frequency] trading . . . now accounts for two of every three stock market trades in America.").

172. HFT firms employ market making, arbitrage, structural and directional strategies. Market making strategies passively capitalize on liquidity rebates; arbitrage take advantage of discrepancies in rate, prices and other market conditions; structural strategies, like colocation, capture profits based on structural market vulnerabilities; and directional strategies rely on more traditional investment principles such as anticipating price movement based on the conclusion that the stock price for a security does not represent the fundamental value of the security. *See* PWC, *An Objective Look at High-Frequency Trading and Dark Pools*, PRICEWATERHOUSECOOPERS LLP, 4 (May 6, 2015), https://www.pwc.com/us/en/pwc-investor-resource-institute/publications/assets/pwc-high-frequency-trading-dark-pools.pdf.

173. Andrew J. Keller, *Note*, *Robocops: Regulating High Frequency Trading after the Flash Crash of 2010*, 73 OHIO ST. L.J. 1457, 1459 (2012).

174. Securities are sold on the same day that they are purchased; *See also* Michael J. McGowan, *The Rise of Computerized High Frequency Trading: Use and Controversy*, 2010 DUKE L. & TECH. REV. 16 (2010).

175. Keller, *supra* note 174, at 1459.

176. Charles Duhigg, *Stock Traders Find Speed Pays, in Milliseconds*, N.Y. TIMES, July 23, 2009, at A1, http:// www.nytimes.com/2009/07/24/business/24trading.html.

177. *Id.*; Charles R. Korsmo, *High-Frequency Trading: A Regulatory Strategy*, 48 U. RICH. L. REV. 523, 563–64 (2014) ("A second HFT-related market practice that has come under fire as 'unfair' is co-location. In seeking to reduce latency, HFTs will often seek to place their computers as physically close to an exchange's data center as possible. Doing so minimizes the distance data needs to travel between computers, and thus—due to the finite speed of electronic signals—the communications delay. Many trading centers rent 'rack space' on-site, so that HFTs and other proprietary traders can locate their computers at the exchange, right next to the exchange's own servers. Exchanges must receive SEC approval for offering co-location services, and the SEC requires that 'terms of co-location services must not be unfairly discriminatory, and the fees must be equitably allocated and reasonable.'").

speeds than human traders negotiating the purchase or sale of securities on an exchange trading floor. HFT strategies may execute hundreds of trades in the space of milliseconds or microseconds, earning these strategies the creative moniker—"lightning speed trading."[178] The HFT strategies that depend on algorithms analyze market data, organize trades based on pre-programmed instructions, access to trading center servers, and trade execution benefits.[179]

Early access to information reduces latency. HFT strategies aim to gain early access to information in order to benefit from executing transactions ahead of others in the market.[180] In the event of a rapid decline or a sharp surge in the price of a listed company's stock, HFT firms with early access to the details of price movement exploit their knowledge and adjust their market position. This approach disadvantages trading counterparties who lack access to the same early information.

HFT firms invest significant resources to gain early access to information. For example, HFT firms may pay national securities exchanges to gain direct access to market data feeds. Direct access enables HFT firms to intercept information regarding institutional and retail investors' indications of interest to buy or sell securities before these orders reach the legacy exchanges' servers.

HFT firms may also aim to gain early access to exchanges' servers by locating their servers closer to securities exchanges' servers. Co-location service arrangements enable HFT firms to rent space closer to the physical server of an exchange to take advantage of the proximity; closer proximity reduces the time required to match bids or asks, leading to lower latency.[181]

### *C. The Benefits of Innovation*

The use of algorithmic programs and other approaches to achieve lower latency engender several noteworthy benefits.[182] An increased number of trades leads to a higher turnover of equity securities, increased liquidity, narrowed bid-ask spreads, and improved market efficiency. Algorithmic trading coupled with the speed of HFT strategies facilitate a greater number of transactions in any period, improving the accuracy of securities pricing over smaller time intervals. The HFT strategies lower trading costs; firms adopting these

178. McGowan, *supra* note 174, at ¶ 22 ("Some of the most popular HFT strategies include automated market making, low latency arbitrage, and liquidity rebate trading. Additionally, the practice of issuing "flash orders" to high-frequency traders and the use of certain Alternative Trading Systems (ATSs) by those competing with HF traders have come under increasing scrutiny in recent months. These computerized "neural networks" and "genetic algorithms" permit computers to create new rules and automatically change underlying assumptions about the markets. They then evolve by letting different rules compete, and combining the most successful outcomes."). *See also* Keller, *supra* note 174, at 1464–71 (describing various HFT strategies).

179. Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3603 (Jan. 21, 2010) (to be codified at 17 C.F.R. pt. 242), https://www.sec.gov/rules/concept/2010/34-61358fr.pdf.

180. Peter Gomber et al., *High-Frequency Trading* 16 (2011), http://ssrn.com/abstract=1858626.

181. PWC, *An Objective Look at High-Frequency Trading and Dark Pools*, PRICEWATERHOUSECOOPERS LLP, 2, 4 (May 6, 2015), https://www.pwc.com/us/en/pwc-investor-resource-institute/publications/assets/pwc-high-frequency-trading-dark-pools.pdf; Concept Release on Equity Market Structure, 75 Fed. Reg. at 3608 ("Some proprietary firm strategies may exploit structural vulnerabilities in the market or in certain market participants. For example, by obtaining the fastest delivery of market data through colocation arrangements and individual trading center data feeds. . ., proprietary firms theoretically could profit by identifying market participants who are offering executions at stale prices.").

182. Inman, *supra* note 31.

strategies are able to pass these benefits to customers.

Yet, the strategies also threaten to disrupt markets. Rapid trading of shares held for only seconds creates increased short term price fluctuations. Consequently, price fluctuations increase volatility and undermine the integrity and stability of financial markets.

### *D. The Limitations of Innovation*

Notwithstanding the fanfare, computer-based algorithmic trading and HFT strategies have significant limitations.[183] Algorithmic and HFT strategies that rely on algorithms depend on human agents to create the programming codes that translate into instructions. While high-speed market analysis may fuel arbitrage, "computers . . . are not investors in the true sense of the word."[184] Computer-based trading models operate like trained robots, searching the market for discrepancies.[185]

Humans are unable to predict every variable that will influence market activity, and as a result, any analytical models or code will exclude these variables.[186] Human programmers lack perfect information and therefore, they lack the ability to create programming that examines issues outside a fixed universe of variables.

Computer-based trading models may only account for and respond to programmed conditions. If abnormal events occur or conditions arise, a computer-based program may respond in a manner that exacerbates the event or condition. For algorithmic trading strategies, "[i]f market conditions exceed the circumstances for which the algorithms were designed then they could exhibit unexpected behaviour."[187] Creating code that predicts the likelihood and magnitude of uncertain events is difficult and, in some instances, impossible.

Computers that are working within the parameters of programmed algorithms may be unable to deal with the uncertainty created by human traders motivated by irrational psychological factors such as fear and greed.[188] Algorithmic trading models must be flexible and "at their core, probabilistic rather than deterministic"[189] in order to recognize and react to market abnormalities. According to commentators, models must be

183. Popper, *supra* note 163 (discussing criticism of high-frequency trading).

184. Miles Johnson, *How Human Traders Will Beat the Machines*, FIN. TIMES (Jan. 25, 2016), https://www.ft.com/content/9c3a1b1a-c33f-11e5-b3b1-7b2481276e45 [hereinafter Miles Johnson].

185. *Id.*

186. Yadav, *Algorithmic Trading*, *supra* note 164, at 1618 ("[A]lgorithms have enabled markets to far exceed the cognitive bounds of humans in processing information. Rather than rely on human brains to perform the hard tasks of trading in real time, these may be delegated instead to algorithms. With proper programming set in advance, algorithms can harness complex financial models, computations, statistical analysis, and artificial intelligence to transact at speeds measured increasingly in microseconds.").

187. Terrence Hendershott, *High Frequency Trading and Price Efficiency*, UK GOV'T FORESIGHT PROJECT 14 (Aug. 3, 2011), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289019/11-1231-dr12-high-frequency-trading-and-price-efficiency.pdf.

188. *See* Joshua Holden, *Why Computers Can't—Yet—Beat The Market*, FORBES (June 22, 2009, 6:00 PM), https://www.forbes.com/2009/06/18/fina-financial-markets-opinions-contributors-artificial-intelligence-09-joshua-holden.html (discussing artificial intelligence and the market); *see also* Yadav, *Algorithmic Trading*, *supra* note 164, at 1654.

189. *See* Holden, *supra* note 253 (discussing artificial intelligence and the market); *see also* Yadav, *Algorithmic Trading*, *supra* note 164, at 1647–48

programmed to act "when results begin to drift relative to expectations[.]"[190] But it can be difficult to program a trading system to be human-like when it must rely on precise codes to function, especially when those codes have been based only on events and circumstances that humans have been able to predict.

Investors Sal Arnuk and Joseph Saluzzi (founders of Themis Trading) believe that human traders often navigate complex markets better than HFT firms.[191] A recent study comparing the performances of human traders versus algorithmic programs during periods of market stress found that human judgment prevailed.[192]

Humans can extract meaning from the enormous amount of data flooding the market at any given time; algorithms may not be able to evaluate the same data as efficiently or effectively because algorithms lack discernment or the ability to judge events not specified by programming. These innovative programs lack the ability to evaluate information outside of the parameters of programming. Program software may also be less adept than humans at detecting fraud, deception, or manipulative practices.

Firms employing HFT strategies have saturated the markets with trading strategies programmed to make similar assumptions regarding markets and similar mistakes. Notwithstanding the fact that algorithms and HFT strategies are expensive, well-guarded, proprietary programs, they tend to respond similarly to market conditions, resulting in similar investment decisions. Cognitive biases limit humans' ability to identify risks or effectively anticipate low-probability, large magnitude events.[193] Consequently, programs are often marked by a certain level of consensus.[194] In other words, because many HFT firms employ algorithmic trading with similar dispositions, there may be higher levels of correlation of risk-taking and trade concentration in specific areas of financial markets.[195]

Excessive correlation among financial market participants' investment strategies caused by firms relying on pre-programmed computer algorithms that invest in the same securities and other classes of assets pose threats to financial markets. The effect of losses if the market turns against these securities and classes of assets will be magnified as many firms seek to exit any positions, creating a fire sale or illiquidity in the market.

In addition, market participants' interconnectedness intensifies the perils of reliance on technology. As trading programs respond to the trades executed by other trading programs, a rogue algorithm may trigger a dramatic increase or decrease in the price of a

190. *Id.*

191. Popper, *supra* note 163 (discussing criticism of high-frequency trading). *See also* Henry Sender, *Human Traders Can Still Beat Computers*, FIN. TIMES (Sept. 14, 2015), https://www.ft.com/content/dc9e3dbc-57c9-11e5-a28b-50226830d644 ("At certain times, humans have the advantage, [Josh Brown of Ritholtz Wealth Management and The Reformed Broker blog] says. 'The new game for traders is not running away from rapacious algos. Instead, it's going to become about exploiting their failure to reason.'"). Anton Balint, *The High Frequency Trading vs. Human Reasoning Debate*, MKT. MOGUL (Mar. 23, 2016), http://themarketmogul.com/the-high-frequency-trading-vs-human-reasoning-debate/.

192. Yadav, *Algorithmic Trading*, *supra* note 164, at 1654.

193. *See* Joshua Holden, *Why Computers Can't—Yet—Beat The Market*, FORBES (June 22, 2009, 6:00 PM), https://www.forbes.com/2009/06/18/fina-financial-markets-opinions-contributors-artificial-intelligence-09-joshua-holden.html.

194. Miles Johnson, *supra* note 184 (discussing traders and technology).

195. *Id.* ("When everyone is using the same trading strategy, no one is left with an edge—the super computers will cancel out each other's advantage."). *See also* Balint, *supra* note 191 ("Human investors' experiences and decisions serve as an important basis for understanding how we make decisions when allocating capital, something that no machine or algorithmic trading strategy can teach us.").

security or the securities that represent a particular sector of the economy. Other firms relying on similarly designed algorithms will react to the rogue algorithm creating volatility in the market.

While there are many benefits to the use of analytics relying on algorithms, this may invite over-emphasis on data. Traders may under-emphasize the kinds of common-sense analysis that militates against volatility and mitigates market instability. Thus, some commentators propose introducing circuit breakers or kill switches that redirect trading to humans, enabling human traders to mitigate the effects of a trade or series of trades that threaten the stability of the market.[196]

HFT algorithms have also inspired latency arbitrage[197]—"trading in the sub-second time windows between when market process moves and when market makers update their quoted prices."[198] By using this low-latency strategy and HFT algorithms, traders process information much more quickly than slower, traditional traders and are able to profit at the slower traders' expense.[199]

Most significantly, many critics believe that HFT firms using algorithmic trading and other tactics disadvantage certain investors. As noted, HFT firms are successfully employing algorithmic trading and capitalizing on advantages such as co-location and direct data feeds, yet these services are typically inaccessible for smaller firms and individual investors. The disadvantages breed a form of discrimination that disproportionately disadvantages certain classes of investors.

The proliferation of algorithmic trading, particularly among HFT firms, poses a challenge for market regulators. Before turning to regulatory attempts to address these strategies, Part V introduces an emerging class of alternative trading systems and a parallel set of threats to financial markets. Part V contends that the developments in trading strategies and venues engender events that may lead to excessive volatility, disruption of the operational integrity of financial markets, or market failure.

## V. ALTERNATIVE TRADING VENUES

Similar to the evolution of trading strategies, technological developments have significantly influenced the organization and structure of securities market trading venues. Perhaps most importantly, in recent years, the number of trading venues has multiplied. The traditional oligarchy of trading venues with quasi-monopolistic powers has experienced a shock.

A precipitous decline in the volume of trades executed by brokers on conventional securities exchanges—a reduction in the exchanges' market share—signals the end of an era.[200] Competing trading venues have quickly captured an increasing percentage of market share in securities trading. These new platforms have fragmented the market. The new trading venues - private, exclusive clubs—determine their own governance rules and selectively admit participants, enabling new venues to discriminate in providing trading

196. Gomber, *supra* note 180, at 56.

197. Matt Prewitt, *High Frequency Trading: Should Regulators Do More?*, 19 MICH. TELECOMM. TECH. L. REV. 131, 134 (2012).

198. *Id.* at 136.

199. *Id.*

200. Yesha Yadav, *Dark Pools and the Decline of Market Governance* 7 (Vanderbilt Law & Econ. Research, Paper No. 16-5, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2754786.

services. New trading venues may decide to offer limited access to their trading platforms and delay or avoid disclosure of material trading terms, including trading price and the identify of trade counterparties.[201]

For the better part of the last century, the NYSE, the American Stock Exchange,[202] and NASDAQ have controlled a significant volume or market share of securities listed and traded on a national securities exchange (publicly-traded securities or NMS stocks). Alternative trading venues are quickly supplanting registered securities exchanges, capturing sizable fee streams, and challenging the hierarchy of authority among self-regulating trading financial intermediaries.

In 2008, alternative venues executed 4% of the total volume of U.S. publicly-traded equity securities "off-exchange."[203] By 2015, alternative venues handled approximately 33–34% of U.S. equity trading volume, rivaling the combined trading volume of the NYSE and NASDAQ.[204] In 2016, the NYSE executed only 20% of equity volume on U.S. exchanges, and the NASDAQ managed only 14.5% of trading volume.[205]

This Part explores the contours of the increasingly diverse body of entities that facilitate trade execution, clearing and settlement. While there are clearly benefits to the increased diversity, this Part contends that noteworthy costs accompany any gains. While algorithmic and HFT strategies pose risks for the financial system, as previously discussed, alternative trading venues also create risks that threaten to disrupt the stability of financial markets. Section A argues that trading volume has shifted away from conventional, nationally registered stock exchanges to alternative trading venues. Section B explains that innovation creates many benefits, but also raises a number of concerns regarding market integrity and stability of both lit and dark trading venues.

### *A. Early Fragmentation in Trading Markets*

Direct access to financial markets has historically been limited to registered broker-dealers and market makers trading on the stock exchanges. However, in the 1960s electronic communications networks (ECN) emerged that permitted market participants to trade directly with the exchanges' order book. ECNs offer anonymous computerized trading networks that connected financial institutions to third parties, eliminating conventional intermediaries and matching their buy/sell orders. Traders using ECNs enjoy lower transaction fees because ECNs eliminate certain costs associated with human intermediaries executing trades. ECNs clear and settle trades involving exchange-listed securities. When clearing and settling trades for exchange-listed securities, ECNs adopt the publicly displayed prices for these exchange-listed securities. ECNs may also facilitate trading of off-exchange traded or OTC securities that are not listed on a nationally registered securities exchange (unlisted securities).

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201. Jo Lynne Koehn & Daryl Koehn, *Ethical Issues with Dark Liquidity and the Ethics of Possible Remedies*, 3 MORAL CENTS: J. ETHICS IN FIN. 3, 5 (2014).

202. In 2008, the parent company of the New York Stock Exchange acquired the American Stock Exchange - third largest securities exchange in the United States. *NYSE to Acquire American Stock Exchange*, N.Y. TIMES, Jan.17, 2008 *available at* http://www.nytimes.com/2008/01/17/business/apee-nyse.html.

203. *Id.*

204. Yadav, *supra* note 200, at 7.

205. *Equity Market Share Statistics: April 2017*, NASDAQ, http://www.nasdaqtrader.com/trader.aspx?id=marketshare (last visited Aug. 15, 2017); Yadav, *supra* note 200, at 7.

The first ECN, Instinet, was created in 1969 and its success invited competitors to join the market. ECNs borrowed from the discriminatory model that national securities exchanges introduced and only allowed subscribers to trade on their networks. ECNs denied individual investors access to their trading platforms, creating an opportunity for subscribers to engage in arbitrage. Responding to the unequal access issues, the SEC intervened, requiring ECNs to register as broker-dealers, meaning they could no longer discriminate against customers on the basis of subjective eligibility criteria.

In 1971, the National Association of Securities Dealers (NASD) created the NASDAQ, an electronic automated quotation system for trading certain OTC or unlisted securities. The NASDAQ's faster and more transparent trade execution system attracted more than 3,000 listed companies including the largest technology and biotechnology firms. Innovation also ushered in system-wide implementation of computerized trading.

In 1976, the NYSE introduced the Designated Order Turnaround (DOT) system[206] which enabled routing trades electronically to a specialist on the trading floor to better compete with the ECNs. By the 1990s, however, the use of floor trading and reliance on the specialist auction system were quickly becoming vestiges of the past as new trading venues emerged and competition intensified for control over trading markets. Several decades passed before the specialist system yielded to alternatives.

### *B. Modern Developments in Trading Venues*

During recent years, financial intermediaries—broker-dealers,[207] exchanges,[208] and ECNs[209]—have created a class of private exchanges or alternative trading systems. In the late 1990s and 2000s, market participants organized several ECNs. The NASDAQ introduced an ECN known as SelectNet and the NYSE merged with an ECN known as Archipelago.[210]

In addition to creating alternative trading venues, conventional exchanges engaged in a period of consolidation. The last three decades have marked the end of an era as the nation's largest securities exchange—the NYSE—and the largest securities dealers' association—the NASD[211]—elected to demutualize and reorganize as for profit

206. Markham & Harty, *supra* note 43, at 897. In 1984, the NYSE released an enhanced iteration of the DOT—the Super-DOT. *Id.*

207. GARY SHORTER & RENA MILLER, CONG. RESEARCH SERV., R43739, DARK POOLS IN EQUITY TRADING: POLICY CONCERNS AND RECENT DEVELOPMENTS 3 (Sept. 26, 2014), https://fas.org/sgp/crs/misc/R43739.pdf ("Examples reportedly include Credit Suisse's CrossFinder, Goldman Sachs's Sigma X, and Morgan Stanley's MS Pool. Broker-dealers dominate the dark pool business: Domestically, Credit Suisse Group AG, UBS, Bank of America Corporation's Merrill Lynch, Deutsche Bank, and Morgan Stanley own the largest dark pools.").

208. *Id.* ("Examples of agency broker dark pools include Liquidnet and ITG Posit, while exchange-owned dark pools include those offered by BATS and the NYSE").

209. *Id.*

210. NASDAQ created Selectnet in 1990. *See* John M. Doyle, *Nasdaq Selectnet System Begins Early Trading Monday*, ASSOCIATED PRESS (Nov. 22, 1992), http://www.apnewsarchive.com/1992/Nasdaq-SelectNet-System-Begins-Early-Trading-Monday/id-561f404fb90cab04780f35a55a204e53. In 1994, Stuart Townsend and Gerald Putnam founded TerraNova Trading LLC and created Archipelago, an electronic securities exchange, and merged with Pacific Exchange. The resulting entity, Archipelago Holdings, merged with the NYSE in 2006.

211. From its founding in 1939 until 2007, the National Association of Securities Dealers ("NASD") served as an SRO regulating stock trading and stock brokers. The NASD was the regulatory arm of the NASDAQ immediately prior to its merger with the regulatory arm of the NYSE. As a consequence of the merger, the

corporations.

In 2005, as noted above, the NYSE merged with one of its largest competitors and became a publicly-traded company. Following the merger with Archipelago, the NYSE merged with Euronext, a multinational securities exchange created by consolidating the largest national securities and derivatives trading platforms in Belgium, France, the Netherlands, Portugal and the United Kingdom.[212] On October 1, 2008, the NYSE Euronext, the surviving entity of the earlier merger, acquired the American Stock Exchange. Most recently, in 2012, the Intercontinental Exchange—the parent company of several clearing and exchange platforms—successfully launched a bid to acquire the NYSE Euronext.[213]

The NASDAQ has similarly participated in the consolidation and demutualization wave. In 1992, the NASDAQ merged with the London Stock Exchange and the combined international securities trading network became a publicly traded company. In 2000, NASDAQ registered its common stock with the SEC and following its initial public offering, NASDAQ became a publicly traded company. In 2007, the parent company of the exchange acquired the Philadelphia Stock Exchange and the Swedish exchange operator OMX.

While acquisitions and business combinations among the largest securities exchanges seem to forecast consolidation, the introduction of diverse alternative trading venues has increased competition among trading venues and reduced the market share of the largest, oldest and most highly-regulated trading venues. The introduction of these alternative venues permanently altered the securities trading landscape. The burgeoning battle for market share prompted regulatory intervention

### *1. The Rise of Dark Pools*

Among the ATSs, a group colloquially described as "dark pools" has captured an increasingly significant share of securities trading transactions. Dark pool operators permit trading of securities listed on national securities exchanges (NMS listed securities) as well as securities that trade "off-exchange" or unlisted securities without disclosure of trading information required on nationally regulated exchanges ("lit" venues).

Less than a decade ago, there were few ATSs; by the third quarter of 2009, approximately thirty-two dark pools were actively trading NMS stocks and executing approximately 7.9% of share volume in listed securities.[214] In the first quarter of 2016,

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regulatory units of the two largest national securities exchanges now comprise the Financial Industry Regulatory Authority.

212. In 2013, NYSE Euronext merged with the Intercontinental Exchange ("ICE"). *NYSE Euronext merger with Deutsche Boerse blocked by EU*, BBC (Feb. 1, 2012), http://www.bbc.com/news/business-16838793.

213. *See* John McCrank & Luke Jeffs, *ICE To Buy NYSE Euronext For $8.2 Billion*, REUTERS (Dec. 20, 2012), http://www.reuters.com/article/us-ice-nyse-idUSBRE8BJ0LK20121220 (discussing the acquisition of NYSE Euronext).

214. Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3599 (Jan. 21, 2010) (to be codified at 17 C.F.R. pt. 242). This was a rise from approximately ten active dark pools in 2002, and even from twenty-nine active dark pools in the second quarter of 2009. *See* Regulation of Non-Public Trading Interest, 74 Fed. Reg. 61,208, 61,209 (Nov. 23, 2009) (to be codified at 17 C.F.R. pt. 242). However, the actual number of dark pools in operation at any given time is sometimes hard to ascertain. *See, e.g.*, Rob Curran, *Trading in a Dark Pool? Watch for Sharks,* WALL ST. J.: MARKETBEAT BLOG (Aug. 18, 2008, 1:06 PM), http://blogs.wsj.com/marketbeat/2008/08/18/trading-in-a-dark-pool-watch-for-sharks/ (estimating that forty dark pools were operating in 2008).

trading in these dark pools rose to 42.5% of U.S. equity trading volume.[215] Today, there are more than forty dark pools in operation. The following sections compare trading on "lit" and dark pool venues and discuss the benefits and perils of dark pools.

*a. "Lit" vs. Dark Venues*

Historically, market participants executed transactions involving listed securities on registered national securities exchanges.[216] When broker-dealers place an order to purchase or sell securities on national securities exchanges, the exchange requires the broker-dealer to show their hand, so to speak. The bid or ask price is displayed to the market in an attempt to fill customers' orders. This process reveals the customers' expectations regarding the future value of shares of listed companies' stock. On registered national securities exchanges, transactions are highly-visible as brokers and dealers signal efforts to purchase or sell identified securities at specific prices. Consistent with principles of transparency long embraced in trading markets, trading in "lit" exchanges requires disclosing counterparties,[217] reporting transaction pricing and identifying the intermediary-securities clearing platform or exchange where market participants execute a transaction.[218]

Dark pools offer a source of "dark liquidity" because they do not display post-execution trade data.[219] Even when dark pools report trade data after a trade is completed, dark pools may not reveal the identity of trade counterparties nor signal the trading intermediary that executed the relevant trade.[220] This "pre-trade opacity" enables institutional and retail investors to trade large numbers of shares anonymously; they may trade the preferred volume of shares in dark pools without publicly signaling their interest to buy or sell the securities—an act that invites predators to purchase or sell ahead of their large order and ensures price fluctuations that disadvantage large block trades.[221] By publicizing price information after the completion of a trade, dark pools minimize information leakage, hindering the ability of predatory traders to detect large orders immediately prior to their submission.[222]

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215. Mostowfi & Bogard, *supra* note 30 (discussing industry volume numbers). In the third quarter of 2014, the average daily volume of shares trading in alternative venues rose to 45% of the total average daily share volume in the U.S. *See also* Anna Bernasek, *The Rise of Trading in the Dark*, N.Y. TIMES, Jan. 9, 2015, https://www.nytimes.com/2015/01/11/business/mutfund/the-rise-of-trading-in-the-dark.html?_r=0.

216. SHORTER & MILLER, *supra* note 207, at 2.

217. *See* Peter Gomber et al., *High-Frequency Trading* 8 (2011), http://ssrn.com/abstract=1858626 ("The majority of market models of those fully automated equities exchanges are implemented as electronic central limit order books (CLOB), which store market participants' trading interests visible to and executable for all other connected traders.").

218. Regulation of Non-Public Trading Interest, 74 Fed. Reg. at 61209.

219. Commentators often describe "dark liquidity" as "undisplayed liquidity." *See* Concept Release on Equity Market Structure, 75 Fed. Reg. at 3612; Robert Hatch, *Reforming the Murky Depths of Wall Street: Putting the Spotlight on the Security and Exchange Commission's Regulatory Proposal Concerning Dark Pools of Liquidity*, 78 GEO. WASH. L. REV. 1032, 1034 (2010).

220. Regulation of Non-Public Trading Interest, 74 Fed. Reg. at 61209.

221. SHORTER & MILLER, *supra* note 207, at 2. *See also* Maria Zyskind, *Student Note*, *Fighting for Market Share: How a Trade-at Rule Can Improve Market Efficiency*, 91 CHI.-KENT L. REV. 411, 422–23 (2016).

222. SHORTER & MILLER, *supra* note 207, at 3 ("Front-running refers to the practice of trading ahead of a large order to benefit from the anticipated price movement that the large order will create.").

### *b. The Allure of Dark Pools*

Market participants posit that the popularity of dark pools may be attributed to the economic benefits these alternative trading venues engender. Dark pools are believed to counter problems in "lit" trading venues. When institutional investors trade large block orders on "lit" exchanges, information related to submitted orders becomes publicly available; the revelation of large, whale-sized, block orders to buy or sell securities (information leakage) invites predatory, opportunistic practices. Trading securities in a "lit" venue enables competitors to mimic trading strategies and possibly exploit access to information regarding the standing large block orders.[223] Thus, dark pools offer the advantage of un-displayed or dark liquidity. Market participants may execute large block transactions without leaking information to the market regarding their trading strategies or intentions.[224] Dark pools enable institutional or retail investors to shield their transactions from the transparency of lit markets, preventing others from mimicking their trading strategies or employing predatory, arbitrage-style tactics. Consequently, dark liquidity reduces transaction costs.[225] As discussed later in this Article, however, the predatory HFT tactics may also arise in dark pools.

Investment banks and privately organized trading entities were all too eager to respond to the demand for discrete off-exchange trading venues. Exchanges, investment banks, and groups of broker-dealers launched their own dark pool trading platforms. These private clubs—the newest form of financial market intermediation—began to quickly capture notable market share. As trading volume migrates from conventional exchanges, the rising number and increasing prominence of dark pools presents pernicious problems. The next Section explains that several disconcerting threats may follow from the increased migration of securities trading to dark pools.

### *2. The Perils in Dark Pools*

Dark pools raise several regulatory concerns. The introduction of dark pools heightened market fragmentation, exacerbated existing debates regarding fairness and access, invited new questions regarding price manipulation, improper trades, and price discovery. The abundance of dark pools also poses economic and logistical challenges. In addition to these challenges, the competition among trading venues has created mounting conflicts of interest for broker-dealers. With favors and fees promised to broker-dealers who direct trades to dark or lit venues, broker-dealers must decide whether to route trades to lit or dark venues. If routing trades to a particular venue serves broker-dealers' needs but creates additional costs for the broker-dealers' customers, how might broker-dealers

223. *See, e.g.*, *SEC Proposes Regulation of Dark Pools,* MORRISON & FOERSTER LLP (Nov. 16, 2009), http://www.mofo.com/files/uploads/Images/091116DarkPools.pdf [hereinafter *MoFo News Bulletin*]; Tom C.W. Lin, *The New Financial Industry*, 65 ALA. L. REV. 567 (2014) [hereinafter Lin, *New Financial Industry*] (discussing the changes in the financial industry).

224. *See* Linette Lopez, *What the Heck Is a Dark Pool and Why Are People Trading in Them?*, BUS. INSIDER (Oct. 17, 2012), http://www.businessinsider.com/what-is-a-dark-pool-2012-10.

225. *Id.*; Ajay Makan & Philip Stafford, *Liquidnet Attracts Corporate Share Buy Backs*, FIN. TIMES (Oct. 17, 2011), https://www.ft.com/content/9a498fb2-f692-11e0-9381-00144feab49a ("[V]enues, [] known as 'dark pools', allow institutional investors anonymously to trade shares in blocks and have drawn trading away from exchanges in recent years."). For a more detailed discussion of the trading strategies employed by high frequency traders that increased transaction costs, *see infra* Part IV.C.

resolve these conflicts of interest and determine where to execute trades? This subsection explores these issues.

Growing in prominence, dark pools have experienced a metamorphosis. Initially, institutional and retail investors celebrated dark pools for offering block trading with the benefit of publicly displayed pricing data without the threat of information leakage. Early benefits for retail and institutional investors have, however, dissipated.

Dark pools do not have to disclose certain fair access requirements. Therefore, dark pools may disclose their liquidity to the investing public on terms of their own. As a result, many fear that dark pools will expose customers to unfair or discriminatory terms or pricing. Additionally, concerns regarding manipulation have grown; some posit that HFT firms place orders in the "lit" markets to intentionally manipulate securities prices in dark pools. Confidentiality in dark pools facilitates trade execution processes that are obscured from oversight; thus, broker-dealers manage trade execution processes with limited.

Governance decisions regarding access and trading priority created a fertile ground for abuse. Financial intermediaries who operate dark pools have autonomy to establish the terms for trading on their platforms, set trading fees, establish access to order flow (a practice sometimes referred to as "indirect internalization"),[226] and determine other material conditions influencing trading on their platforms.

Scholars describe dark pool trade pricing as derivative because dark pool participants borrow from the pricing data publicly available on lit exchanges to determine trade pricing. These venues, however, initially refused requests to provide pre-trade pricing data in the consolidated price quotation system that facilitates the discovery of pricing data distributed to the public.[227] Because of the opacity in dark pools, some characterize dark pools as "parasitic," referring to their proclivity to extract pricing from registered exchanges and their unwillingness to share information regarding pricing information.[228] Consequently, some argue that such practices interfere with efficient price discovery, a goal of securities regulation.

As the market share of dark pool transactions have increased, predators who employed opportunistic trading strategies on lit exchanges, replicate their strategies in dark pools. The dark cloak that obscures these trading venues shields these behaviors from regulatory

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226. *Id.*; *see also* Rhodri Preece, *The Pros and Cons of the Rise of Dark Pools of Liquidity*, FIN. TIMES (Jan. 7, 2013), https://www.ft.com/content/b594f978-54dd-11e2-a628-00144feab49a ("Internalisation involves broker/dealers internally executing client order flow against their own accounts on a systematic basis. It represents a form of dark liquidity because broker/dealers acting as over-the-counter (OTC) market makers typically do not have to publicly display quotes, although there are some limited quoting obligations for systematic internalisers in the European Union.").

227. Regulation of Non-Public Trading Interest, 74 Fed. Reg. 61,208, 61,209 (Nov. 23, 2009) (to be codified at 17 C.F.R. pt. 242). *See also* Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3599 (Jan. 21, 2010) (to be codified at 17 C.F.R. pt. 242) ("Dark pools are ATSs that, in contrast to ECNs, do not provide their best-priced orders for inclusion in the consolidated quotation data.").

228. Trading interests are 'dark' because they are not included in the consolidated quotation data for National Market System ('NMS') stocks that are disseminated to the public. *See* Regulation of Non-Public Trading Interest, 74 Fed. Reg. at 61,208; Concept Release on Equity Market Structure, 75 Fed. Reg. at 3612; Tom C.W. Lin, *Reasonable Investor(s)*, 95 B.U. L. REV. 461, 491–92 (2015); Charles R. Korsmo, *High-Frequency Trading: A Regulatory Strategy*, 48 U. RICH. L. REV. 523, 536 (2014) (citations omitted); McGowan, *supra* note 174, at ¶ 38 (citation omitted); Regulation of Non-Public Trading Interest, 74 Fed. Reg. at 61,208 ("[T]rading interest is considered non-public, or 'dark,' primarily because it is not included in the consolidated quotation data for NMS stocks that is widely disseminated to the public."); Inman, *supra* note 31 (discussing allegations of bank's misrepresentation of its dark pool safety).

oversight and, more disturbingly, from other dark pool trading counterparties. Abuses in dark pools has become rampant and, in the absence of regulatory oversight or effective internal governance, flourished.

Dark pools have begun to allow traders to use hidden orders that do not require public display of pricing prior to trade execution.[229] While there is a general presumption that display pricing is a public good, market participants' have individual incentives to capture the benefits of display liquidity and externalize the costs. In other words, market participants encouraged others to comply with transparency expectations and display liquidity while embracing dark pool trading or transacting with limited or no transparency. Moreover, dark pools are not obligated to guarantee the execution of trades. Consequently, orders placed with dark pools may not be completed.[230]

Finally, conflicts of interest abound in dark pools. To entice broker-dealers to route customer orders to dark venues, dark pool operators began to offer rebates to market-makers and high frequency traders for providing liquidity.[231] Some exchanges countered, offering taker rebates. Broker-dealers with liquidity maker/taker fee arrangements are tempted to maximize fees collecting rebates even if trading costs at other venues may benefit their customers.

In addition to the conflicts created by competing trade venues, when a customer places an order, a broker-dealer may attempt to satisfy the order by selling the customer securities from the broker-dealer's existing inventory. In this manner, the broker-dealer internalizes the trades. When the brokerage firm is unable to match trades, the firm may send the orders to a national securities exchanges that must publicly display the order or an ATSs that may not display order details. There may be significant profits for the broker-dealer who internalizes trades or route trades to preferred trading venues. Often customers will not know their broker-dealers' motivations for selecting a particular venue. Increasingly regulators and market participants have expressed concerns that broker-dealers will select trading venues based on arrangements that benefit the broker-dealers at the expense of the customer.

In summary, it is clear that dark pools may not be the safe haven that dark pool operators suggest.[232] The problems with dark pools discussed above raise questions regarding whether it is likely that the incentives and conflicts in dark pools may lead to market instability.[233] In response to increasing evidence of asymmetries of information in dark pools, federal and state regulatory authorities are carefully examining broker-dealer

229. *See infra* Part IV.C.

230. SHORTER & MILLER, *supra* note 207, at 2.

231. Sviatoslav Rosov, *Investors Beware: New Dark Pools Report Issues Warning*, CFA INST.: MKT. INTEGRITY INSIGHTS (Sept. 30, 2015), https://blogs.cfainstitute.org/marketintegrity/2015/09/30/investors-beware-new-dark-pools-report-issues-warning/; *The Dark Side of the Pools: What Investors Should Learn From Regulators' Actions*, HEALTHY MKTS. (Sept. 15, 2015), https://www.healthymarkets.org/dark-side-of-the-pools/ [hereinafter *Dark Side of the Pools*].

232. Inman, *supra* note 31 (discussing allegations of bank's misrepresentation of its dark pool safety); Press Release, N.Y. Attorney Gen., A.G. Schneiderman Announces Landmark Resolutions With Barclays And Credit Suisse For Fraudulent Operation Of Dark Pools; Combined Penalties And Disgorgement To State Of New York And Sec Of Over $154 Million (Feb. 1, 2016), https://ag.ny.gov/press-release/ag-schneiderman-announces-landmark-resolutions-barclays-and-credit-suisse-fraudulent.

233. *Dark Side of the Pools*, *supra* note 231 (discussing what investors can learn from regulators); Press Release, SEC, Barclays, Credit Suisse Charged With Dark Pool Violations (Jan. 31, 2016), https://www.sec.gov/news/pressrelease/2016-16.html.

and dark pool operator incentives, as discussed in the next Section.

## VI. REGULATION AND PERSISTENT CHALLENGES

The controversy surrounding HFT trading has increased exponentially upon the use of these strategies in dark venues. This Part explores early regulatory and market-based responses to concerns regarding discriminatory trading and volatility. This Part focuses on the intersection of concerns that complex computer-based algorithmic trading strategies (HFT strategies) are increasingly prominent in dark pools. Section A explores early regulatory responses to concerns regarding discrimination and unfair trading strategies. Recent regulatory investigations and litigation involving dark pools and HFT customers reveals that the unequal access and discriminatory practices persist in dark pools. Section B argues that certain HFT tactics foster the abuses in dark pools that early intervention aimed to mitigate.

### *A. Early Regulatory Responses*

Following the stock market crash at the turn of the century, the value of the NYSE listed securities declined from a high in 1929 of $89 billion to $15 billion in 1932.[234] As a result of a market disruption, investor confidence and liquidity may evaporate overnight; trading may be suspended and lenders may refuse to offer credit.[235] Similar market conditions and an economic shock followed the Stock Market Crash of 1987 and the recent financial crisis in 2007. The rise of algorithmic trading and the wide-spread adoption of HFT trading in lit markets and dark pools prompt questions about competition or the fragmentation of trading across venues and its impact on market stability. The fragmentation of markets created by the rise of alternative trading venues may destabilize capital markets. The rampant of HFT strategies in lit and dark markets exacerbate these concerns.

In their earliest years, these private exchanges operated beyond the ambit of regulation and, therefore, dark pool governance was subject only to private operators' oversight. On December 8, 1998, in response to the growing competition among financial intermediaries, the SEC adopted a regulation to govern alternative trading systems ("Reg ATS").[236]

Regulation ATS introduced requirements for alternative trading venues to register as broker-dealers, bringing them within the purview of the securities regulation framework. Notwithstanding the Commission's intentions, Regulation ATS created conditions that have facilitated arbitrage and certain opportunistic behaviors.

Regulators intended Reg ATS to compliment a series of legislative and regulatory efforts that began in the 1970s. In 1975, Congress amended the Exchange Act adding Section 11A to introduce its vision for a national market system ("NMS"). The statute directed the SEC to implement regulations that link all markets for qualified securities in a manner that would enhance efficiency, foster competition, increase transparency, and facilitate the best execution of investors' orders. The new regulatory outlook responded to

234. JAMES D. COX, ROBERT W. HILLMAN, & DONALD C. LANGEVOORT, SECURITIES REGULATION: CASES AND MATERIALS 7–8 (7th ed. 2013).

235. *Id.*

236. Regulation of Exchanges and Alternative Trading Systems, 63 Fed. Reg. 70,844 (Dec. 22, 1998) (to be codified at 17 C.F.R. pts. 202, 240, 242, 249).

an industry-wide order processing crisis[237] and acknowledged shifts in technology. The new statutory provisions empowered the SEC to impose data processing and communications obligations across capital markets.[238]

In 2005, to enhance uniformity among regulations applied to different trading venues while promoting free competition, greater order interaction and transparency, the SEC adopted Regulation National Market System (Reg NMS).[239] Reg NMS implemented a series of rules aimed at ensuring that both buyers and sellers received the best price on their trades, enhancing the links between trading venues and reducing trading access fees. The rules obligated broker-dealers to route trade orders to the trading venue that offered the best price.[240] Known as the "order protection" or "trade-through" rule, broker-dealers were tasked with executing transactions only on exchange platforms offering customers the best price for their trades.

The "order protection" or "trade through" rule reinforces the fundamental principle that investors should obtain the best price represented by automated quotations that are immediately accessible by trading venues. The "trade-through" rule permits investors to conduct trade executions efficiently and at the best price.[241] Under the "trade-through" rule, the SEC requires trading centers to establish policies and procedures to ensure trades are not executed at prices inferior to protected quotations.[242] Reg NMS's equal access rule prohibits market centers from giving preferential treatment to members or subscribers for protected orders and capping access fees.[243] In the absence of rules ensuring equal access, market participants justly complain that unfair and discriminatory access creates a two-tier market in which some investors become second class citizens paying higher transaction fees or prices; or, the in worst cases, both. The SEC intended the rule to discourage discriminatory access to the best prices for a particular security, regardless of where the markets displayed the prices.[244]

Reg NMS's "sub-penny" rule prevents market participants from "displaying, ranking or accepting an order in a listed security or NMS stock that is priced in an increment of less

237. *See infra* Part IV.B.

238. *See* 15 U.S.C. § 78k-1(a)(3)(B) (2017).

239. Regulation NMS, 70 Fed. Reg. 37496 (June 29, 2005) (to be codified at 17 CFR pts. 200, 201, 230, 240, 242, 249, 270). *See also* Daniel Beunza et al., *Impersonal Efficiency and the Dangers of a Fully Automated Securities Exchange*, UK GOV'T FORESIGHT PROJECT 8 (June 7, 2011), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289015/11-1230-dr11-impersonal-efficiency-and-dangers-of-a-fully-automated-securities-exchange.pdf (stating Reg NMS "sought to introduce competition by improving the interconnectedness among American exchanges").

240. SHORTER & MILLER, *supra* note 207, at 6; *see also* Steven McNamara, *The Law and Ethics of High-Frequency Trading*, 17 MINN. J.L. SCI. & TECH. 71, 85–90 (2016) (describing the key rules of Reg NMS); Jennifer Victoria Christine Dean, *Paradigm Shifts & Unintended Consequences: The Death of the Specialist, the Rise of High Frequency Trading, & the Problem of Duty-Free Liquidity in Equity Markets*, 8 FIU L. REV. 217, 245–46 (2012).

241. *Regulation NMS and Developments in Market Structures: Hearing Before the Comm. on Banking, Housing, and Urban Affairs*, 108th Cong. (July 21–22, 2004), *available at* https://www.gpo.gov/fdsys/pkg/CHRG-108shrg26057/html/CHRG-108shrg26057.htm (statement of William H. Donaldson, Chairman, SEC).

242. Securities Exchange Act Release No. 53829 (May 18, 2006); *see also* THOMAS P. LEMKE & GERALD T. LINS, SOFT DOLLARS AND OTHER TRADING ACTIVITIES § 2:42 (2016).

243. Securities Exchange Act Release No. 53829; *see also* LEMKE & LINS, *supra* note 242, § 2:42.

244. Regulation NMS, 70 Fed. Reg. at 37496.

than $0.01 (unless the price of the stock is itself less than $1 per share)."[245] Reg NMS's "Sub-Penny Rule" promotes greater price transparency and consistency. Finally, market data rules created a formula for "allocating revenues to exchanges for disseminating market information that are based on trades and quotations, rather than solely on trades."[246]

Through Reg NMS, the Commission aimed to enhance investor access to market data and improve price quote and trade execution on domestic exchanges.[247] Reg NMS expanded the depth of public price discovery and increased direct interaction opportunities for investors buying and selling interest.[248] The SEC endeavored to bring various trading venues together through an extensive set of detailed regulations.[249]

Operating under the structure created by Reg NMS, one of two SIPS calculates and disseminates bids and offers[250] and the National Best Bid and Best Offer (NBBO) requirement obligates brokers to execute customers' orders at the best available ask or bid price.[251] Reg ATS and NMS aimed to require trading venues to "publicly display their best priced orders for securities in which they represent five percent or more of the trading volume, [so] the best priced orders for certain securities will also be available through the markets."[252] To this end, the computer networks of brokers, dealers, and market makers display and continuously update the NBBO for listed securities.[253] Unfortunately, each of the systems processed trade data slowly, creating a lag in the distribution of information regarding the NBBO and fueling opportunities for arbitrage.

NMS promised to foster competition and interoperability among market centers comprised of various trading models.[254] In addition, the Commission predicted that Reg NMS would promote efficient and fair price formation across markets.[255] In the end, many questioned the NMS model and lamented that the rules did not promote efficient interaction of all buyers and sellers interested in a particular security.[256]

While many praised the Commission's effort to mitigate manipulation of customers' orders—routing orders to preferred exchanges to capture fees or maximize trade execution

245. LEMKE & LINS, *supra* note 242, § 2:42 (2016); *see also* Securities Exchange Act Release No. 53829 (May 18, 2006).

246. LEMKE & LINS, *supra* note 242, § 2:42; *see also* Securities Exchange Act Release No. 53829.

247. *See* SHORTER & MILLER, *supra* note 207, at 6.

248. Regulation NMS, 70 Fed. Reg. at 37496.

249. *See* McNamara, *supra* note 240, at 92 (describing the key rules of Reg NMS).

250. Jonathan Macey & David Swensen, *Recovering the Promise of the Orderly and Fair Stock Exchange*, 42 J. CORP. L. 777 (2017).

251. The Code of Federal Regulations defines NBBO as "with respect to quotations for an NMS Security, the best bid and best offer for such security that are calculated and disseminated on a current and continuing basis by a plan processor pursuant to an effective national market system plan." 17 C.F.R. § 242.600(b)(42) (2005). Best bid and best offer means "the highest priced bid and the lowest priced offer." 17 C.F.R. § 242.600(b)(7).

252. Regulation of Exchanges and Alternative Trading Systems, 63 Fed. Reg. 70,844 (Dec. 22, 1998) (to be codified at 17 C.F.R. pts. 202, 240, 242, 249).

253. *Id.*

254. Regulation NMS, 70 Fed. Reg. at 37496.

255. SHORTER & MILLER, *supra* note 207, at 2 (citing Press Release, SEC, SEC Adopts Regulation NMS and Provisions Regarding Investment Advisers Act of 1940 (Apr. 7, 2005), http://www.sec.gov/news/press/2005-48.htm).

256. Regulation NMS, 70 Fed. Reg. at 37496 ("The seriousness of this weakness has been voiced frequently in recent years by institutional investors. For large institutional orders (generally greater than 10,000 shares and often substantially greater), price impact costs are a more significant component of execution quality than spread costs.").

as best suited their interests, controversy quickly ensconced the "trade-through" rule. Under the strictest interpretation of the rule, broker-dealers' were frustrated; they could not execute orders in many instances where investors might agree to a price that did not constitute the best price, leading to sub-optimal trading outcomes. Determining the best price for a security that could be traded on multiple trading venues created a noteworthy challenge for traders attempting to abide by the rule. Determining the best price required aggregating the data regarding recent trades among the venues. In the absence of interoperability among trading venues, how would the exchanges communicate this information across their networks?

The combination of a growing body of ATSs not subject to the same rules as registered exchanges and broker-dealers did not enhance competition; rather, the introduction of new lightly regulated ATSs fostered discrepancies that created inequities between conventional registered trading venues and off-exchange ATS venues. Market participants who initially praised Reg ATS's innovativeness, elimination of barriers to entry and reduced transaction costs began to question the impact of Reg ATS and NMS. Not only were ATSs enjoying the benefits of operating as clearinghouse platforms without the expensive and onerous regulatory burdens that had long plagued registered exchanges, market participants and regulators began to inquire about the lack of transparency regarding trade execution practices, the increasing migration of trading volumes and conflicts of interests that characterized ATSs.

Registration and disclosure requirements for financial intermediaries have long offered a pathway to transparency. In 2010, the SEC announced its intentions to address a broad range of emerging issues in financial markets including more careful regulation of dark pools and HFT. In 2014, SEC Chair Mary Jo White offered further details regarding the Commission's plans in a response to a Congressional inquiry. In her response, Commissioner White described several measures that focus on transparency and one nascent effort to reach beyond transparency and regulate risk.

Among the proposed measures, exchanges must add a timestamp in consolidated data feeds to indicate when a trading venue processed the display of an order or execution of a trade. Creating the timestamp markedly improves regulators and market participants' access to information about latency. The SEC is now requiring exchanges to disclose how they are using consolidated and direct data feeds to enable market participants to better assess conflicts of interest and HFT firms' ability to capitalize on early information. Requiring disclosure regarding data feeds and careful examination of use of data feeds also facilitates conversations regarding misuse of early information. Finally, FINRA began collecting information regarding the aggregate trading volume of ATSs.

In 2015, the SEC proposed an amendment to Regulation NMS which would require greater oversight of ATSs.[257] The proposed rule sought to provide greater transparency. The proposal only applied to ATSs trading NMS stock and did not apply to trading of non-NMS stock.[258] The proposed rule would introduce disclosure on Form ATS-N – a detailed description of ATSs transactions involving NMS stock. The required disclosure would include information about the broker-dealer operating the ATS and the manner in which the ATS operates; the types of orders and market data used on the ATS; and ATS procedures. Pursuant to the proposed rule, this information would be publicly available to

257. Regulation of NMS Stock Alternative Trading Systems, 80 Fed. Reg. 80997 (proposed Dec. 31, 2015).
258. *Id.*

enable investors to make informed decisions regarding their instructions to broker-dealers regarding trade execution.

While the SEC failed to adopt its proposed amendment to Regulation NMS, FINRA has introduced requirements enhancing ATS transparency and disclosure. Under FINRA's Rule 6110, FINRA will publish ATS Trading Information on its website for ATSs subject to reporting rules 6282(b), 6380A(b), and 6380B(b).[259]

While the disclosure-oriented measures merit some discussion, risk-oriented regulatory measures offer a more valuable tool for ensuring the stability and integrity of financial markets. In addition to these disclosure-oriented rules, the SEC adopted a pilot rule, the "trade at" rule that prevents trades in listed equity securities when an individual stock price moves beyond a specified price band. To calculate the band, we look to the average price of the stock over a five-minute trading period. If a stock price moves outside the price band and trading remains outside of the limited range of the band for more than fifteen seconds, then trading in the stock would be suspended for five minutes.

Critics of the trade-at rule include brokerage firms, some of whom own dark pools. Congress has examined regulatory concerns over dark pools.[260] While all of these measures address needed transparency and structural reform in capital markets, systemic risk oversight requires a more careful examination of burgeoning threats and perils that may impact the operational systems of the largest "lit" exchanges or alternative trading venues.

Filling the regulatory void and responding to claims that dark pool operators were shielding market participants' use of predatory tactics, New York state's Attorney General and the SEC began to investigate dark pools. In February 2016, New York Attorney General (NYAG), Eric Schneiderman and the SEC announced that Barclays Capital Inc. and Credit Suisse Securities LLC would pay landmark settlements totaling $154.3 million to settle the respective investigations "false statements and omissions made in connection to the marketing of their respective dark pools and other high-speed electronic equities trading services."[261] The next part briefly examines these claims as evidence of persistent challenges and gaps in the federal regulation of dark liquidity.

### *B. Prosecution of Predatory Tactics*

Employing the Martin Act, the New York state financial fraud statute, the New York Attorney General Schneiderman has launched investigations into claims regarding

259. These rules only apply to ATSs trading NMS stocks listed on the national exchanges. FINRA Rule 6282(b) requires a FINRA member trading on an ATS that trades NMS stocks to report the transaction to the Alternative Display Facility (ADF) which is a display for FINRA members that gives information on trades. Rule 6282(b) applies to transactions between either two FINRA members or a FINRA member and a person who is not a member of FINRA. In the case of two members, the executing party shall report. In the case of a member and a non-member, the member shall report the transaction to FINRA ADF. FINRA Rule 6380A requires members to report transactions to FINRA/Nasdaq Trade Reporting Facility after the transaction is completed. FINRA Rule 6380A outlines the same standards regarding reporting between two members of FINRA and between a member and a non-member as does Rule 6282(b). FINRA Rule 6380B requires members to report transactions to FINRA/NYSE Trade Reporting Facility after the transaction is completed. Reporting standards for this rule are the same as Rule 6380A and Rule 6282(b). Finally, FINRA Rule 6610(c) applies to trading information for OTC Transactions in OTC Equity Securities Executed on Alternative Trading Systems. This rule states that FINRA will publish this information that was required to be filed pursuant to FINRA Rule 6622.

260. SHORTER & MILLER, *supra* note 207, at 5.

261. Press Release, Schneiderman, *supra* note 232.

manipulation and misrepresentation in ATSs.[262] Based on investors' claims that Barclays issued false and misleading statements regarding the operation of its dark pool—Barclays LX—Schneiderman and the SEC began an investigation into Barclay's representations to dark pool customers. [263]

From December 2011 through 2015, Barclays marketed a "Liquidity Profiling" service that allowed traditional investors to opt-out of trading with aggressive high-speed traders in Barclays' dark pool in order to protect the investors from predatory trading.[264] Instead, Barclays utilized a system that enabled clients utilizing HFT strategies to trade within the same pool as traditional institutional and retail investors. As of May 2014, Barclays was the second largest dark pool in the market.[265]

Barclays used a system of overrides in the "Liquidity Profiling" rating of its internal high-frequency trading desk, moving some LX subscribers from the more aggressive categories to less aggressive categories.[266] Thus, clients who thought they were trading only against the safest counterparties were instead trading with some of the most aggressive and predatory high-speed traders in Barclays' dark pool.[267] For several years, Barclays intentionally deleted the largest, most aggressive trader to create the impression of a safer trading pool.[268]

According to Schneiderman and the SEC, Barclays misrepresented HFT trading firms' participation in transactions in Barclays LX dark pool. Barclays misrepresented the HFT traders' participation in order to capture the fees that HFT firms paid to gain access the trading platform. According to the allegations, Barclays provided other unfair advantages to HFT firms, including the use of co-location services and proprietary feeds. Barclays permitted HFT firms to access these services and opportunities while recognizing that the services and opportunities were prohibitively expensive for other investors.[269]

Barclays not only failed to disclose the participation of HFT firms in the dark pool and HFT firms' ability to take advantage of such tactics, but "misrepresented its efforts to police its dark pool, overrode its surveillance tool, and misled its subscribers about data feeds at the very time that data feeds were an intense topic of interest."[270] Barclays suggested that the firm was monitoring the dark pool for HFT predatory trading. Barclays repeatedly told its clients that it used sophisticated tools to monitor for "latency arbitrage," and ran weekly surveillance reports—Barclays did neither.[271] Barclays agreed to settle the claims regarding misrepresentations related to its dark pool by paying a fine of $35 million to each regulator—the SEC and the NYAG.[272]

Following a similar investigation, Credit Suisse agreed to pay $60 million (a penalty

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262. New York General Business Law Art. 23-A, § 352 *et seq*.

263. People v. Barclays Capital Inc., No. 14-45139, 2015 NY Slip Op. 25043, at *1 (N.Y. Sup. Ct. Feb. 13, 2015).

264. *Id.*

265. NYAG, *In re the Matter of Barclays PLC and Barclays Capital LLC,* Settlement Agreement, https://ag.ny.gov/pdfs/2016.2.1_Final_Signed_Barclays_Settlement_Agreement.pdf.

266. *Id* at 3.

267. *Id* at 4.

268. *Id* at 5–6.

269. In re Barclays Liquidity Cross & High Frequency Trading Litig., 126 F. Supp. 3d 342, 352 (S.D.N.Y. 2015).

270. Press Release, SEC, Barclays, *supra* note 233.

271. *Id* at 6.

272. *Id.*

imposed jointly by the NYAG and SEC) and an additional $24.3 million to the SEC in disgorgement and prejudgment interest for other violations.[273] According to the investigations, Credit Suisse made misrepresentations regarding its dark pool, Crossfinder and its electronic communications network, Lightpool.[274]

Since 2008 Crossfinder claimed the status of being either the largest or second-largest dark pool in the United States.[275] From 2010 through 2014, Credit Suisse made statements that aimed to differentiate its dark pool from other competitors by marketing its methodology, called "alpha scoring;" according to Credit Suisse this methodology placed dark pool participants into various categories in accordance to the quality or toxicity of their order flow.[276] The approach presumably addressed investors' demand for transparency regarding interactions with dark pool orders executed by HFT firms utilizing high speed and low latency tactics.[277] Credit Suisse marketed the alpha scoring methodology to investors, claiming that Crossfinder would categorize participants objectively and in a transparent manner, and allow investors the ability to avoid trading with pool participants that utilized certain trading strategies, such as those categorized as "High Alpha" or "Opportunistic", with these categorizations being done monthly.[278] In fact, alpha scoring did not categorize participants monthly and instead of using purely objective elements in its categorization, used subjective elements.[279]

As a result some HFT firms gained the moniker "non-opportunistic" yet, these firms are objectively "opportunistic."[280] Moreover, because some clients had multiple client identifiers, they could selectively execute trades through one of their aliases or alternative identities. For example, if Crossfinder categorized a direct participant's client as "Opportunistic," the direct participant could simply continue to execute HFT trades through one of its alternative identities that had been categorized as "Non-Opportunistic."[281] Further, Credit Suisse failed to disclose to most of its clients that it was transmitting confidential order information from Crossfinder to selected market participants using a smart order router (SOR).[282]

These misrepresentations have been criticized as "rigging" trading in dark venues in favor of HFT firms. Concerns regarding this type of discriminatory activity first motivated institutional and retail investors to seek refuge in dark venues. The institutional and retail investors chose to execute transactions in dark venues to escape the interference of HFT firms.[283] Several specific, highly questionable

273. *See supra* note 5 (discussing he dangers of high speed trading).

274. *Id.*

275. N.Y. ATTORNEY GEN., *In re the Matter of Credit Suisse Securities, LLC,* Settlement Agreement, No 15-183, 1, 3 (2015), https://ag.ny.gov/pdfs/20160201_Fully_Executed_Settlement_Agreement_AES.PDF [hereinafter, *Credit Suisse Settlement*].

276. *Id* at 4.

277. *Id* at 1.

278. *Id.* at 1–2.

279. *Id* at 5.

280. *Credit Suisse Settlement*, *supra* note 275.

281. *Id.* at 6.

282. *Id* at 2.

283. Jared Bernstein, *The Importance of Shedding Some Light on Dark Pools*, N.Y. TIMES (July 22, 2014), http://www.nytimes.com/2014/07/23/upshot/the-importance-of-shedding-some-light-on-dark-pools.html [https://perma.cc/R9VD-52F5] ("[T]he dark pools are private clubs, initially used by large institutional investors that wanted to execute a large sale in a darkplace. One reason for such a move is that sales

practices in HFT have gained additional attention and heighten concerns that dark pool operators who permit HFT (particularly without disclosing the same to other dark pool participants) may be paving the road to the next crisis.

### *C. Speeding to The Next Crisis: HFT Strategies in Dark Pools*

Institutional investors flocked to dark pools to escape the predatory nature of HFT firms.[284] Various techniques allow HFT firms to use data acquired earlier than other market participants.[285] Over the last several years, employing algorithmic trading strategies and physical ploys such as co-locating servers closer to the exchange server, HFT firms have successfully "gamed" markets.[286] Mobilizing these strategies in dark pools has fueled complaints alleging that these trading tactics may destabilize financial markets. This Section explores four controversial HFT tactics and the reasons that these tactics exacerbate concerns regarding HFT trading in dark venues.

#### *1. Front-Running*

Capitalizing on the proximity of servers and accelerated trade execution technologies, broker-dealers using HFT strategies may prey on customer orders in dark pools by jumping ahead of institutional investor or retail investor orders. By hopping ahead of others in the order queue and purchasing or selling the same shares that the institutional and retail investors intend to trade, HFT firms may acquire the shares and sell them to slower market participants at better market prices. By the time the institutional investors could successfully execute their trades, the price movement that results from HFT firms' trades makes the transaction more expensive. Front-running guarantees HFT firms profit.[287]

Dark pools often see front-running in the form of small, rapid increases in stock price, caused by a trader buying shares of stock just before a large institutional buy.[288] Front-running[289] tactics by HFT firms in lit markets drove institutional and retail investors to migrate to dark pools. Front-running has significantly limited the institutional and retail investors' ability to maintain a level playing field in the market and created an increasingly

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on the more transparent public exchanges risk falling prey to 'front-running' by high-frequency traders."); *See also,* Moyer, Liz, *Barclays and Credit Suisse to Settle 'Dark Pool' Inquiries,* Jan. 31, 2016, https://www.nytimes.com/2016/02/01/business/dealbook/barclays-and-credit-suisse-to-settle-dark-pool-inquiries.html?action=click&contentCollection=DealBook&module=RelatedCoverage&region=EndOfArticle&pgtype=article.

284. *See generally* Gregory Scopino, *The (Questionable) Legality of High-Speed "Pinging" and "Front Running" in the Futures Markets*, 47 CONN. L. REV. 607 (2015) (discussing legalities in the futures markets).

285. *Id.* at 625–26.

286. *Id.* at 610. ("Proprietary trading firms that use automated trading systems (ATSs) to employ high-frequency trading (HFT) strategies are said to engage in a category of tactics in the financial markets that have been variously called (among other things) high-speed 'pinging,' 'HFT front running,' 'abusive liquidity detection,' and even 'exploratory trading.'").

287. Inman, *supra* note 31 (discussing allegations of bank's misrepresentation of its dark pool safety). *See also* Hester Peirce, Dir., Fin. Mkts. Working Grp., Keynote Address at the Journal of Corporation Law Symposium: What Happens in the Dark: An Exploration of Dark Pools and High Frequency Trading (Mar. 30–31, 2017).

288. *Id.*

289. SHORTER & MILLER, *supra* note 207, at 3. *See also* Edwin Batista, *A Shot in the Dark: An Analysis of the SEC's Response to the Rise of Dark Pools*, 14 J. HIGH TECH. L. 83 (2014) (discussing SEC reaction to dark pools).

widening gap in profitability between HFT firms and other investors.[290]

As described in the previous part, regulatory measures and investigations are obligating dark pool operators to acknowledge that HFT firms are engaged in front-running in alternative trading venues. Perhaps more distressingly, HFT firms are paying for access to dark pools to enable the HFT firms to prey on the retail order flow[291] and to enable HFT firms to execute transactions in dark pools employing an order-jumping strategy in an even less transparent market.[292]

### *2. Hide Not Slide*

To implement the 1975 Congressional amendments to the Securities Exchange Act, the SEC implemented a series of rules to enhance fairness in financial markets. The SEC adopted Rule 611—the Order Protection Rule—which requires trading venues to establish, maintain, and enforce written policies and procedures reasonably designed to prevent "trade-throughs"—the execution of trades at prices inferior to protected quotations displayed by other trading centers. Rule 610—the Market Access Rule—compliments Rule 611 by requiring fair and non-discriminatory access to quotations, establishing a limit on access fees to harmonize the pricing of quotations across different trading centers, and requiring each national securities exchange and national securities association to adopt, maintain, and enforce written rules that, among other things, prohibit their members from engaging in a pattern or practice of displaying quotations that lock or cross protected quotations.[293]

Rules 610 and 611 serve to prevent trading in locked markets.[294] Markets become locked when the best bid price and the best offer price for a security are identical across all exchanges. In order for trading to occur, locked markets must be avoided.[295] A market becomes unlocked "when the bid 'slides' back into the previous lower bid price."[296] Unfortunately, the locked market ban only applies to display orders.

High frequency traders using a strategy referred to as "Hide Not Slide" enter orders that are hidden from display. Taking advantage of the opportunity to execute a transaction at a lower price before the display market is unlocked creates an opportunity to gain fees. The hidden bid will be displayed later if the higher offer is executed because the market is no longer locked and the hidden bid is now the "first in line to be executed—even ahead

290. *See generally* Scopino, *supra* note 284 (discussing legalities in the futures markets).

291. SHORTER & MILLER, *supra* note 207, at 3.

292. *Id.*

293. *See Division of Market Regulation: Responses to Frequently Asked Questions Concerning Rule 611 and Rule 610 of Regulation NMS*, SEC, https://www.sec.gov/divisions/marketreg/rule611faq.pdf (last visited Aug. 5, 2017).

294. Scott Patterson & Jenny Strasburg, *How 'Hide Not Slide' Orders Work*, WALL ST. J. (Sept. 18, 2012), https://www.wsj.com/articles/SB10000872396390444812704577605840263150860 (offering the following example of a locked market: "Say an order to buy Microsoft Corp. for up to $30.01 a share is sent to electronic stock exchange Direct Edge Holdings LLC, with instructions to be filled only there and not routed elsewhere. Meanwhile, though there is no matching sell order on Direct Edge, another market, such as Nasdaq, has an order to sell Microsoft at $30.01. It is also an order to be filled only on that exchange. The fear is it could encourage manipulation such as buying and selling a stock merely to generate fees. The ban means an order to buy for $30.01 can't be displayed on Direct Edge. The order will 'slide' to a lower price, $30.").

295. *Id.*

296. *Id.*

of the previous higher bid that slid down to a slightly lower price."[297] This technique allows high frequency traders to skip the line ahead of conventional investors.

Surprisingly, the SEC endorsed the "Hide Not Slide" technique.[298] While the SEC has posited that locked and crossed markets are "inconsistent with fair and orderly markets and detract from market efficiency," others argue that by allowing HFTs to continue using this technique, the SEC is not promoting long-term investors' interests.[299]

Scholars Jonathan Macey and David Swensen argue that the SEC's implementation of national best bid and offer ("NBBO"), a requirement that brokers execute customer trades at the best available bid and ask prices, creates arbitrage opportunities for high frequency traders.[300] Macey and Swensen contend that market fragmentation harms traditional long-term investors and erodes market transparency, which disadvantages such investors.[301] According to Macey and Swensen, "[m]arket fragmentation degrades market quality as investors lose opportunities to interact directly with one another, as trades are scattered across multiple venues" and "create arbitrage opportunities, like those exploited by HTFs, that did not exist when trading markets were unified."[302] According to Macey and Swensen, "the SEC appears to be entirely indifferent to the consequences of the increasing complexity of order types that it has been approving."[303]

Macey and Swensen assert that a locked market[304] ban is "irrational from a public policy perspective," because "[w]hen a market is locked, HFTs can leapfrog over existing orders and resell the securities at better prices (better for the HFT, worse for the investor) almost instantaneously to the original investor facing the locked market."[305] They opine that if all trades occurred on a single market, then locked markets would not even occur.[306] Ultimately, they conclude that Reg NMS was a "disastrous implementation" and they propose a new market structure where "competitive forces serve as a check on monopolistic excess."[307]

### *3. Spoofing*

"Spoofing" refers to a bluffing tactic whereby traders submit and cancel a series of bids for the purpose of gaining an advantage in the market price.[308] For example, a trader

297. Macey & Swensen, *supra* note 250.

298. *Id.*

299. *Id.* at 18.

300. *Id.* at 2.

301. *Id.* at 5–6.

302. Macey & Swensen, *supra* note 250.

303. *Id.* ("It is not remotely possible for disclosure of the type envisioned by the SEC to place long-term investors, who trade relatively infrequently, on a level playing field with HFTs. This is why the SEC's settlement in the Direct Edge/Hide Not Slide enforcement proceeding is simply silly from a public policy point of view.").

304. *See id.* at 15 ("When the best bid price and the best offer price for a security are identical across all exchanges, the market is locked, which must be avoided for trading to occur.").

305. *Id.* at 9–10.

306. *Id.* at 9.

307. Macey & Swensen, *supra* note 250.

308. *See* Whipp & Scannell, *supra* note 17 (discussing a futures trader's part in the Flash Crash). *See also* Yun-Yi Wang, *Strategic Spoofing Order Trading by Different Types of Investors in the Futures Markets*, EUR. FIN. MGMT. ASS'N CONF. PAPER 2 (2016), http://www.efmaefm.org/0EFMAMEETINGS/EFMA%20ANNUAL%20MEETINGS/2016-Switzerland/papers/EFMA2016_0171_fullpaper.pdf ("'Spoofing orders' are orders that are submitted into the

engages in spoofing if she places thousands of buy or sell orders and then cancels many or all of those orders within milliseconds after placing them in an effort to "trick other investors into buying and selling at artificially high or low prices."[309] The Dodd-Frank Act prohibits certain acts that involve "spoofing"[310] and imposes harsh penalties for violating the regulation.[311]

Some have "raised concerns that HFT firms may be placing orders in lit markets for the purpose of manipulating securities prices in dark pools."[312] Commentators have argued that high-frequency traders are engaged in intentionally manipulating the market by "firing off fake orders thousands of times a second to slow down exchanges and mislead others."[313] FINRA's former chief executive Richard Ketchum suggested that FINRA expand its oversight of dark pools to focus on whether orders placed on public exchanges were "trying to move prices or encourage sellers that may advance their trading in the dark market."[314] As described in the previous Part, FINRA has increased oversight of dark pools to mitigate systemic risk and arbitrage between markets.[315]

There is a growing concern that abuses in the HFT area involving methods such as spoofing will cause the public to fall victim to misrepresentation.[316] When a trader engages in spoofing, they do so with the "intent of causing it to change the prices prevailing in the markets, and then another quote is acted on to the detriment of others responding to the change."[317] As a result, regulators have targeted such activities with laws that restrict and prohibit market manipulation.[318]

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market, with no intention of the order being executed, as a means of injecting misleading information with regard to the demand or supply of an asset, with the ultimate aim of coercing other traders to trade in a particular way. 'Spoofers', that is, those submitting spoofing trading orders, will subsequently submit their real orders, in order to take advantage of the price changes resulting from trading by other market participants in response to their earlier spoofing orders."); Richard Satran, *Spoofing or Just Fast Trading? Chicago Case Helps Unwrap Mystery*, REUTERS (Nov. 19, 2015), http://blogs.reuters.com/financial-regulatory-forum/2015/11/19/spoofing-or-just-fast-trading-chicago-case-helps-unwrap-mystery/ ("Spoofing involves traders entering and quickly canceling large orders in an attempt to manipulate prices."); Larry Schneider, *"Spoofing" and Disruptive Futures Trading Practices*, N.Y. INST. FIN., https://www.nyif.com/articles/disruptive-futures-trading-practices-spoofing (last visited Aug. 5, 2017).

309. Bradley Hope, *As 'Spoof' Trading Persists, Regulators Clamp Down*, WALL ST. J. (Feb. 22, 2015), https://www.wsj.com/articles/how-spoofing-traders-dupe-markets-1424662202; *see also* McNamara, *supra* note 240, at 114–15 (""Spoofing" would involve making an offer to buy (a bid) at $ 15.12, then executing the opposite transaction, selling the security at this price, after other players in the market have raised their bids in responseto the higher offer. Finally, the original offer to buy at $ 15.12 will be cancelled before other parties can act on it.").

310. Commodity Exchange Act, 7 U.S.C. § 6c(a)(5)(C) (as amended in 2010).

311. Hope, *supra* note 309 (discussing the regulation of spoof trading); Satran, *supra* note 306 (discussing spoofing and fast trading).

312. SHORTER & MILLER, *supra* note 207, at 7. *See also* Hatch, *supra* note 219, at 1041–42.

313. Kelly S. Kibbie, *Maleficent or Mindblind: Questioning the Role of Asperger's in Quant Hedge Fund Malfeasance and Modeling Disasters*, 49 AM. CRIM. L. REV. 367, 394 (2012) (citing Graham Bowley, *The New Speed of Money, Reshaping Markets*, N.Y. TIMES, Jan. 1, 2011, at BU1).

314. Scott Patterson, *Vow of New Light For 'Dark' Trades*, WALL ST. J. (Jan. 8, 2013), https://www.wsj.com/articles/SB10001424127887324391104578229610038363372 [hereinafter Patterson, *Vow of New Light*].

315. William A. Birdthistle & M. Todd Henderson, *Becoming a Fifth Branch*, 99 CORNELL L. REV. 1, 68 (2013) (citing Scott Patterson, *Vow of New Light For 'Dark' Trades*, WALL ST. J. (Jan. 8, 2013), https://www.wsj.com/articles/SB10001424127887324391104578229610038363372).

316. McNamara, *supra* note 240, at 142.

317. *Id.*

318. *Id.* (citations omitted).

### *4. Pinging*

Another technique used by HFT firms, "pinging," involves placing small test orders in the market at a number of different price levels, and then quickly cancelling orders that are not filled.[319] At first, the trader may suffer a small loss, but will then adjust their position and earn a larger profit.[320] Some scholars refer to pinging as a form of "high-speed front running," and liken it to use of a radar or sonar system—hence the term "pinging."[321] While some see pinging as a legitimate tactic in modern trading, many complain that it takes advantage of the market and those who do not have access to such techniques. For example, a primary issue is that computer programs, effectively algorithms and artificial platforms, bait institutional and traditional investors into placing large numbers of orders, then cancel the vast majority of them quickly.[322]

Pinging is highly controversial. Some commentators have described the technique as deceptive.[323] Others have posited that the tactic violates federal law.[324] Commodity Exchange Act § 4c(a)(2)(B) prohibits the use of non-bona fide prices in the market, and pinging potentially violates the statutory provision when traders employ pinging with the intent to cancel the majority of the orders that they place in the market.[325]

Regulators are concerned that dark pools can be used to enable insider trading or other improper trading because of the anonymity of such trades.[326] There are also concerns that lit venue stock prices do not reflect the actual market price because of the dark pools that do not publicize pre-trade data, which inhibits the price discovery process.[327] Because algorithmic trades tend to be correlated, "shocks that hit a small number of very active HFT traders could detrimentally affect the entire market."[328]There are also concerns that dark pools could lead to another "flash crash," or worse, a prolonged market crash.[329]

## VII. A MODEST PROPOSAL: FOCUSING ON SYSTEMS INTEGRITY

The SEC has exercised oversight of the technology infrastructure of the U.S. securities markets for almost a century. Notwithstanding resource and other limitations the

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319. Scopino, *supra* note 284, at 613 (citing Letter from Dennis M. Keller, President & CEO, Better Markets, Inc., to Melissa Jurgens, Sec'y, CFTC (Dec. 11, 2013), http://comments.cftc.gov/PublicComments/ViewComment.aspx?id=59446&SearchText= [hereinafter Better Markets Comment Letter]).

320. *Id.*

321. *Id.* at 614.

322. *See generally id.* at 623–24.

323. *Id.* at 686.

324. Commodity Exchange Act §§ 4c(a)(2)(B), (5)(C), and 9(a)(2)).

325. *Id.*

326. *See House Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies Holds Hearing on President Obama's Proposed Fiscal 2015 Budget Request for the Justice Department*, CQ CONGRESSIONAL TRANSCRIPTS (Apr. 4, 2014), http://www.cq.com/doc/congressionaltranscripts-4453431?wr=RDlYTlRja3lSajZKMHByWlZQS3dzZw (statement of Eric Holder, Jr., U.S. Attorney Gen.); SHORTER & MILLER, *supra* note 207, at 7.

327. SHORTER & MILLER, *supra* note 207, at 8.

328. GARY SHORTER & RENA MILLER, CONG. RESEARCH SERV., R43608, HIGH-FREQUENCY TRADING: BACKGROUND, CONCERNS, AND REGULATORY DEVELOPMENTS 27 (June 19, 2014), https://fas.org/sgp/crs/misc/R43608.pdf.

329. Matt Egan, *Flash Crash: Could It Happen Again?*, CNNMONEY (May 6, 2014), http://money.cnn.com/2014/05/06/investing/flash-crash-anniversary/.

SEC will likely play an important role in monitoring markets and mitigating systemic risk and volatility for decades to come.[330] The broad scope of the SEC's early regulatory intervention in trading markets rendered the blunt rules adopted too imprecise to address and effectively combat unfair access and discrimination created by innovative alternative trading strategies and alternative trading venues.

This Part proposes the use of one existing and perhaps a more refined tool to mitigate the volatility created by emerging trading strategies and their use in dark venues. In addition, this Part suggests that two underexplored resources may yield great benefits in the effort to illuminate dark markets.

### *A. Regulation SCI*

The SEC's Automation Review Policy ("ARP") Inspection Program has offered a voluntary information technology review program for over twenty years.[331] In the late 1980s and 1990s, SEC staff members developed the ARP Inspection Program to conduct reviews of significant concerns regarding automated systems. Under the ARP Inspection Program "participation in and compliance with the ARP Inspection Program by ARP entities [was] voluntary" and thus limited in application.[332] The ARP Inspection Program largely succeeded in working with SROs to improve their automated systems, but because it was voluntary, the SEC was constrained in being able to ensure compliance with ARP standards.

In November of 2014, the SEC adopted Regulation Systems Compliance and Integrity or Regulation SCI (Reg SCI) to enhance the technology infrastructure of U.S. securities markets.[333] The regulation aims to reduce the occurrence of systems issues, improve resiliency when systems problems occur and empower the SEC and FINRA to better oversee the intersection of technology in securities markets. Reg SCI applies to registered exchanges and clearing agencies as well as any ATS that trades NMS and unlisted stocks exceeding a specified volume and organizations that disseminate consolidated market data. Reg SCI imposes a series of comprehensive compliance and risk management measures that provides the best path toward mitigating systemic risk in capital markets.

Several factors contributed to the SEC's Reg SCI proposal and the SEC's decision to address technological vulnerabilities and improve its oversight of the core technology of crucial U.S. securities market entities.[334] The Commission acknowledged the need to examine and better understand market evolution resulting in significant dependence upon "sophisticated, complex and interconnected technology;" moreover, the Commission acknowledged the limitations of existing technology evaluation and recovery programs. Specifically, the Commission recognized the increasing concerns regarding the fragmentation of trading across registered exchanges, alternative trading venues and off-

330. Hilary J. Allen, *The SEC as Financial Stability Regulator*, 43 J. CORP. L. (forthcoming 2018) (encouraging the SEC to adopt a proactive perspective on financial stability regulation); Cary Martin Shelby, *Closing the Hedge Fund Loophole: The SEC as the Primary Regulator of Systemic Risk*, 58 B.C. L. REV. 639 (2017) (arguing in favor of the SEC as a potentially effective regulator of systemic risk in the hedge fund industry).

331. *Id.*

332. Regulation Systems Compliance and Integrity, 79 Fed. Reg. 72,252, 72,254 (Dec. 5, 2014) (to be codified at 17 C.F.R. pts. 240, 242, 249)

333. *Id.* at 72,254.

334. *Id.* at 72,253. Such securities markets entities include "national securities exchanges and associations, significant alternative trading systems, clearing agencies, and plan processors." *Id.*

exchange platforms increased the threat that "single points of failure" in the securities markets may undermine the integrity of U.S. capital markets and threaten the global economy.[335]

Under Reg SCI, critical trading market participants must implement comprehensive policies and procedures to help ensure the robustness and resiliency of their technological systems; moreover, the rule requires significant market participants to provide notices and reports to the Commission regarding their use of technology and its impact on securities market infrastructure.[336] The SEC proposed Reg SCI to expand and formalize the SEC's ARP Inspection Program, and with respect to SCI entities specifically, to supersede and replace its "ARP Policy Statements and rules regarding systems capacity, integrity and security in Rule 301(b)(6) of Regulation ATS."[337]

A debate regarding the scope of Reg SCI erupted as ATSs angled to escape the reach of the regulation; others advocated for an expansive application of the regulation.[338] After carefully considering the comment letters, the SEC decided that including ATSs that trade NMS stocks and non-NMS stocks in Reg SCI was appropriate because "certain of those ATSs play an important role in today's securities markets, and thus should be subject to the safeguards and obligations of Regulation SCI."[339] The SEC "believe[d] that ATSs meeting certain volume thresholds can play a significant role in the securities markets and, given their heavy reliance on automated systems, have the potential to significantly impact investors, the overall market, and the trading of individual securities should an SCI event occur."[340]

For eighteen weeks during 2014, the SEC gathered trading data from ATSs and concluded that twelve ATSs trading NMS stocks trade at volumes that would exceed proposed thresholds and bring them within the regulation. The SEC recognized that fundamental differences between ATSs and exchanges exist, but the SEC disagreed that Reg SCI should exclude all ATSs because certain significant-volume ATSs "have the

335. *Id.*

336. Regulation Systems Compliance and Integrity, 79 Fed. Reg. 72,252, 72,253 (Dec. 5, 2014) (to be codified at 17 C.F.R. pts. 240, 242, 249).

337. *Id. See also id.* at 72,264 ("Regulation SCI seeks to expand upon, update, and modernize the requirements of the ARP Policy Statements and Rule 301(b)(6), by, for example, expanding the requirements to a broader set of systems, imposing new requirements for information dissemination regarding SCI events, and requiring Commission notification for additional types of events, among others. Accordingly, the Commission believes that, for SCI ATSs, the existing broker-dealer rules and regulations identified by commenters are complemented by the requirements of Regulation SCI (other than Rule 301(b)(6), which will no longer apply to ATSs that trade NMS stocks and non-NMS stocks), and do not serve as substitutes for the regulatory framework being adopted today.").

338. *Id.* at 72,258. ("Some commenters discussed the definition of SCI entity generally and advocated for an expansion of the proposed definition, asserting that additional categories of market participants may have the potential to impact the market in the event of a systems issue. For example, one commenter suggested that the definition of 'SCI entity' be extended to include the ATS and broker-dealer entities covered by the Regulation NMS definition of a 'trading center.' Another commenter stated that the Commission should potentially expand the definition of SCI entity to also include dark pools if they met the volume thresholds of ATSs. Other commenters believed that the scope of the definition should be more limited. For example, one commenter suggested that the definition should only include those entities that are systemically important to the functioning of the U.S. securities markets and should utilize volume thresholds for exchanges and ATSs to make this determination.").

339. *Id.* at 72,262.

340. Regulation Systems Compliance and Integrity, 79 Fed. Reg. 72,252, 72, 262, 72,263 (Dec. 5, 2014) (to be codified at 17 C.F.R. pts. 240, 242, 249).

potential to significantly impact investors, the overall market, or the trading of individual securities should an SCI event occur."[341]

Critics argued that the SEC had already imposed a rule designed to mitigate systemic risks and encourage enhanced risk management. In November of 2010, the SEC adopted Rule 15c3-5, which requires broker-dealers with or providing market access to establish, document, and maintain a system of risk management controls and supervisory procedures reasonably designed to manage the financial, regulatory, and other risks of this business activity. Market access is defined in the Rule as access to trading in securities on a national securities exchange or ATS as a result of being a member of the exchange or a subscriber to the ATS. Consequently, critics argued that Reg SCI addressed problems resolved by an existing rule.

These arguments are flawed. While noting that Reg SCI and Rule 15c-3 shared similar goals—enhancing the capacity, integrity and/or security of a broker-dealer's systems—Reg SCI aims to consider the national market system more broadly and to ensure the capacity, integrity, resiliency, availability, and security of the automated systems of entities important to the functioning of the U.S. securities markets.[342] Collectively, these measures signal significant steps toward protecting markets.

The introduction of Reg SCI offers a useful pathway for collecting information regarding transactions in dark pools in real-time. Many of the significant issues that relate to alternative trading strategies and venues center on the opacity that surround these trading tactics and the venues where trades are executed. Broker-dealers who develop propriety trading technology or algorithms expend tremendous resources to maintain secrecy and avoid revealing the same in public disclosures. Their activities in dark pools, however, are a matter of concern for regulators tasked with promoting fairness and equal access and maintaining stability in financial markets.

Reg SCI may offer the Commission an opportunity to review more carefully and with greater information how market transactions are unfolding and the impact of market transactions- particularly those involving high speed strategies in dark venues—on the general integrity of markets. We will likely identify few solutions to questions that resolve normative concerns regarding fairness and equal access, but regulators will be more informed and armed with the ability to better distinguish the genuine influence that evolving trading strategies and emerging venues have on financial markets.

Market participants who have invested significant financial resources in technology raise an alarm regarding disclosure—even disclosure to the Commission that will not be publicly reported. Some participants complain that information disclosed to the Commission may be subject to disclosure based on public inquiries under the Freedom of Information Act. Others quibble that they are not reassured by programs that require limited disclosure simply offered to study the health of markets and investigate issues related to market integrity. Still others fear that proprietary information delivered to the Commission may be the subject of a cyberattack, mistakenly released or shared with other government agencies.

These concerns are valid. On balance, however, the threat posed by a sizable volume of highly accelerated transactions executed in dark venues cannot easily be set aside. Even if promoting fairness and equal access in financial markets does not motivate action to

341. *Id.* at 72,263.
342. *Id.* at 72,263.

evaluate and redress concerns regarding high frequency trading in obscure, off exchange alternative venues, the potential volatility that these activities may engender and the threat to systemic stability create a reasonable basis for continuing to explore the possible benefits of regulatory oversight.

### *B. Responding to Innovation in Lit and Dark Markets*

In today's market, exchanges and clearinghouse platforms facilitate the transfer of capital among investors and firms by creating a forum for transactions among buyers and sellers of securities, commodities, derivatives, and other financial products. Trading in these centralized platforms produces critical economic benefits such as price discovery, price accuracy, and liquidity which in turn reduces transaction costs and enhances efficiency in financial markets.

Reg SCI alters our understanding of the operational rules of these entities whether they are lit or dark venues. The operational rules have historically established eligibility criteria for questions such as listing, de-listing, or trade suspension of securities. These rules have also served to identify market participants and ensure disclosure of governance standards.

Employing Reg SCI, the SEC will gain a better, but still imperfect, view of the operational and technological limitations of lit and dark trading venues as well as the contours of certain aspects of the HFT strategies employed by broker-dealers. All of this information should enable the agency to better address concerns regarding the impact of technology and innovation. Reg SCI may also offer additional clarity regarding trading counterparties that will incentivize dark pool operators who allow HFT firms to trade on their platforms to become more transparent. All of these insights inure to greater equity and militate against the tendency to discriminate.

Beyond fair access, shining a light on HFT trading practices specifically and dark pools generally will mitigate the conflicts of interests that plague dark pool operators' decision-making. Critics may fear that the imposition of Reg SCI will have a chilling effect on innovation. Coupling Reg SCI with macroprudential oversight, however, may overcome this concern.

To enhance the value of regulatory intervention, information collected under Reg SCI should be managed at the macroeconomic level and evaluated across financial markets. The Dodd-Frank Act introduces several mechanisms that may enable regulators to better monitor risk in financial markets.

The Financial Stability Oversight Council (FSOC) creates an opportunity to carefully consider how markets and market participants operating in various sectors are interacting.[343] Without a macroprudential approach, it will be difficult to identify and

343. *See* Dodd-Frank Wall Street Reform and Consumer Protection Act, Pub. L. No. 111-203, §111(a), 124 Stat. 1376, 1392 (2010) (codified as amended in scattered sections of 7, 12, 15, 18, 22, 31, 42 U.S.C.) (establishing the Financial Stability Oversight Council); Hilary Allen, *Putting the 'Financial Stability' in Financial Stability Oversight Council*, 76 Ohio S. L. J. 1087,1147 (2015) (describing the history, regulatory mandate, leadership structure, and limitations of FSOC and offering suggestions for better incorporation of OFR in US financial markets regulatory framework); Brett McDonnell & Daniel Schwarcz, Regulatory Contrarians, 89 N.C. L. REV. 1629, 1674–75 (2011); Heidi M. Schooner, *Private Enforcement of Systemic Risk Regulation*, 43 CREIGHTON L. REV. 993, 998–99 ("Among many duties enumerated under Section 112(a)(2) of the Dodd-Frank Act, the Council shall require Federal Reserve supervision of systemically significant nonbank financial companies . . . and make recommendations to the Federal Reserve regarding the imposition of heightened prudential standards on systemic

address systemic risk concerns. In addition to introducing FSOC, the Dodd-Frank Act creates an Office of Financial Research ("OFR"). In connection with its annual comprehensive evaluation of market integrity and stability, the OFR should be employed to carefully map and analyze systemic risks, particularly the risks that arise in off-exchange clearing and trading venues.

Both FSOC and the OFR face similar limits; funding will depend largely on political will and commitment. As per the previously proposed revisions, these will be independent clauses. Moreover, FSOC's humiliating and widely criticized loss in recent litigation involving the designation of MetLife as a systemically important financial institution suggests that the regulator is a toothless tiger.[344]

Setting aside the strengths or limitations of FSOC, the challenges of macroprudential oversight of risk management suggests that U.S. financial markets will require a regulatory body that harmonizes regulation across regulatory agencies. An important element in this process will involve identifying emerging systemic risk concerns. The OFR may offer a unit for the study of these risks.

Few would dispute the necessity of addressing the interoperability of trading systems, enhancing resiliency, or buttressing regulators and market participants understanding of and protections related to nascent and evolving technologies. The OFR may also have the ability to coordinate the development of a macroprudential regulatory framework.

Alternative trading strategies and venues create risks that threaten to disrupt the stability of financial markets. Successful risk management requires a formal commitment to monitoring financial products and trading across markets. The OFR may serve as a repository for our best learning regarding systemic risk management and a valuable resource for addressing systemic risks that arise in dark pools and similar markets that will most certainly emerge in the years and decades to come.

Although algorithmic programs engender several benefits, Part IV signaled several significant limitations. For example, computer-based trading models may lack judgment and the ability to process information not specifically captured in programming. While the technology is generally valuable, there may be cause for the OFR to monitor proprietary programs to identify deficiencies that may be replicated across markets. While the SEC may use its authority under Reg SCI to implement a systems integrity analysis, the agency lacks the resources and expertise to evaluate the limitations of algorithms. OFR's expertise and resources, however, may fill this gap, creating a double-hull styled protection against the risks that algorithmic trading or the use of HFT strategies might undermine lit or dark markets.

Similar to the impact on trading strategies, combining the SEC's use of its authority under Reg SCI and the OFR's expertise in macroprudential oversight, may offer valuable insights for managing the fragmented market structure that alternative trading venues create. The combined resources of these regulatory entities may effectively address concerns regarding the impact of fragmentation on price accuracy and price discovery.

Admittedly, this approach has notable shortcomings. First, notwithstanding the creation of FSOC, it is aspirational to presume that financial market regulators will collaborate. While Congress has determined that successful coordination among regulators will enhance market efficiency and improve regulatory oversight, the balkanization of

nonbank financial companies and large, interconnected bank holding companies.").

344. MetLife, Inc. v. Fin. Stability Oversight Council, 177 F. Supp. 3d 219 (D.D.C. 2016).

financial market regulation across a diverse group of regulatory agencies with differing priorities and subject to regulatory capture stymies progress.

Perhaps equally challenging are the regulated entities who have invested billions of dollars in proprietary technology. These entities justifiably distrust government agencies' capacity to protect the confidentiality of their proprietary technology. Regulated entities argue that their private, exclusive self-regulating clubs, governed by their internal industry regulations can overcome both threats to the integrity of markets as well as concerns that they selectively admit participants, offer limited access to their trading platforms, and delay or avoid disclosure of material trading terms.[345]

Neither the limitations of regulators nor the objections of industry participants should, however, alleviate the growing concerns regarding innovation in trading strategies and venues. Following the recent financial crisis, regulators demonstrated the ability to coordinate rule-making processes. The SEC and CFTC collaboration on the development of Title VII regulations in the swaps market illustrates the potential and benefit of such collaboration. As noted in Parts IV and V, the SEC has initiated a number of measures that compliment Reg SCI's goal of systems integrity. The OFR's systemic risk initiatives fit well within the ambit of these regulatory initiatives. Most notably, the conflicts of interests that industry participants face impede delegation of significant regulatory authority to private trading venues generally and dark pools in particular.

## VIII. CONCLUSION

During the Flash Crash of 2010, major equity indices in both futures and securities markets plummeted in a matter of minutes. Notwithstanding the fact that markets rebounded almost as quickly, the event illustrated the potential for innovations in financial markets to trigger unanticipated events. The consequences of these events may quickly spill over beyond financial market participants and impact economies and communities around the world. While an emerging body of scholarship explores the benefits and costs of diversity, this Article raises questions regarding the systemic risks that innovation, competition and fragmentation create in markets.

The opacity of dark pools, the lack of interoperability linking these institutions to the broader market ecosystem, the systemically important financial institutions operating and participating in these venues and the difficult-to-predict influence of computerized, algorithmic trading strategies suggest that dark pools may provide a fertile corner for a new class of systemic risk concerns in financial markets. Conventional solutions are insufficient to address the pernicious and perilous threats that systemic risks pose. Consequently, shining a light in dark markets requires a more aggressive regulatory approach. The threat of systemic risks in dark pools is magnified by the absence of a pre-determined framework for unwinding a dark venue that experiences a solvency crisis.

345. *See supra* Part V.