The Law and Ethics of High-Frequency Trading

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ABSTRACT

Michael Lewis's recent book Flash Boys has resurrected the controversy concerning "high-frequency trading" (HFT) in the stock markets. While HFT has been important in the stock markets for about a decade, and may have already peaked in terms of its economic significance, it touched a nerve with a public suspicious of financial institutions in the wake of the financial crisis of 2008-2009. In reality, HFT is not one thing, but a wide array of practices conducted by technologically adept electronic traders. Some of these practices are benign, and some even bring benefits such as liquidity and improved price discovery to financial markets. On the other hand, there are legitimate grounds for the commonly heard complaint that "HFT is not fair." Certain HFT practices such as co-location, flash orders, and enriched data feeds create a two-tiered financial marketplace, while other practices such as momentum ignition, spoofing, and layering are merely high-tech versions of traditional market manipulation. Finally, the creation of special order types such as "Hide Not Slide" shows the exchanges allowing their HFT clients to jump the queue of price-time priority embedded in Regulation NMS and stock market practice. While the commonly-used technique of a cost-benefit analysis leads to equivocal or indeterminate results when applied to HFT trading activity in complex and often opaque

markets, a more basic ethic of fairness grounded in commonly accepted rules of financial market behavior illustrates that certain HFT practices are indeed unfair. This Article draws on the legal, financial, and business ethics literatures to illustrate exactly how certain forms of HFT are unfair, and proposes four core principles to guide HFT activity and its regulation.

INTRODUCTION

Due mainly to the publication of Michael Lewis's *Flash Boys*,[1] the American public is once again concerned with the question of the fairness of the financial marketplace. Lewis's specific charge is that the stock market is a "rigged"[2] game, with high-frequency traders preying upon more traditional "Main Street" investors and the institutional investors that serve them. The allegation that the markets are rigged led to a

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    1.   MICHAEL LEWIS, FLASH BOYS: A WALL STREET REVOLT (2014).
    2.   *See, e.g.*, *id*. at 40 (when protagonist Brad Katsuyama realizes he cannot buy or sell stocks at the prices on the consolidated ticker feed, he "realized that the markets are rigged").

swift denial by Mary Jo White, the Securities and Exchange Commission (SEC) Chair concerned with policing them.[3] But in the wake of the financial crisis of 2008 and the slow recovery from the "Great Recession," the accusation that Wall Street insiders were profiting at the general public's expense quickly gained traction.[4]

SEC Chair White and other regulators have an important role to play in fostering trust in the financial system. However, a close look at a number of practices of the high frequency traders and the exchanges that cater to them suggests the markets are, if not "rigged," subject to unfair and deceptive practices carried out by some of the new high-frequency trading (HFT) market makers. While the total profits extracted by HFT are not great by Wall Street standards[5] and have been in

3. Mary Jo White, Chairwoman, Sec. & Exch. Comm'n, Enhancing Our Equity Market Structure, Address Before Sandler O'Neill & Partners, L.P. Global Exchange and Brokerage Conference (June 5, 2014), http://www.sec.gov/News/Speech/Detail/Speech/1370542004312#.U7ta8_ldWS q (stating that "[a]ll of these market quality metrics show that the current market structure is not fundamentally broken, let alone rigged" after citing data on the cost of executing large orders, market volatility, and bid-ask spreads).

4. *See, e.g.*, Harry Bruinius, *'Flash Boys' Reignites Debate: Is High-Frequency Trading a Digital Age Menace?*, CHRISTIAN SCIENCE MONITOR (Apr. 2, 2014), http://www.csmonitor.com/Business/2014/0402/Flash-Boys-reignites-debate-Is-high-frequency-trading-a-digital-age-menace; Stephen Gandel, *Is the SEC Protecting High-Frequency Traders?*, FORTUNE (Mar. 31, 2014), http://fortune.com/2014/03/31/is-the-sec-protecting-high-frequency-traders/; John Lanchester, *Scalpers, Inc.*, 36 LONDON REV. BOOKS 7–9 (June 5, 2014), http://www.lrb.co.uk/v36/n11/john-lanchester/scalpers-inc; Matthew O'Brien, *Everything You Need to Know About High-Frequency Trading*, ATLANTIC (Apr. 11, 2014), http://www.theatlantic.com/business/archive/2014/04/everything-you-need-to-know-about-high-frequency-trading/360411/. For a critical appraisal of Lewis's book, see Felix Salmon, *The Lewis Effect*, SLATE: BOOK REV., (Apr. 7, 2014), http://www.slate.com/articles/business /books/2014/04/michael_lewis_s_flash_boys_about_high_frequency_trading_re viewed.html (arguing that the stock market has never been fair, and transaction costs are far smaller than in the past). The controversy prompted Senator Carl Levin, Chair of the Senate Permanent Subcommittee on Investigations, to hold hearings on HFT. *See Conflicts of Interest, Investor Loss of Confidence, and High Speed Trading in U.S. Stock Markets: Hearing Before the Permanent Subcomm. on Investigations of the S. Comm. on Homeland Sec. & Governmental Affairs*, 113th Cong. (2014).

5. The Tabb Group estimates 2014 profits for HFT firms as approximately $1.3 billion, down from an estimated $7.2 billion in 2009. *See* Larry Tabb, *No, Michael Lewis, the U.S. Equities Market Is Not Rigged*, TABB F. (Mar. 31, 2014), http://tabbforum.com/opinions/no-michael-lewis-the-us-equities-market-is-not-rigged.

decline in recent years,[6] a number of characteristics of HFT suggest they constitute, to some degree at least, a rent extracted from long-term investors.[7] The most successful HFT firms experience little or no trading loss for years on end,[8] and the central plank used to justify their activities, that they provide liquidity to the current computerized marketplace, is subject to important qualifications.[9] That said, the argument that HFT is doing something wrong requires an ethics that rejects "caveat emptor" as a guiding principle for financial markets transactions. Since the most important structural elements that enable HFT activity—specialized order types, enriched data feeds, and "co-location" [10] —are, at least in principle, open for use by all, the exchanges and defenders of HFT can argue there is nothing intrinsically wrong with their conduct. The clash of perspectives results from the fact that, practically speaking, only highly specialized and

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6. *See* Matthew Philips, *How the Robots Lost: High-Frequency Trading's Rise and Fall*, BLOOMBERG: BUSINESS (June 6, 2013), http://www.bloomberg.com/bw/articles/2013-06-06/how-the-robots-lost-high-frequency-tradings-rise-and-fall (HFT peaked in share volume in 2008-2011); *see also* Donald MacKenzie, *A Sociology of Algorithms: High-Frequency Trading and the Shaping of Markets* 29–30 (June 2014) (unpublished manuscript), http://www.sps.ed.ac.uk/__data/assets/pdf_file/0004/156298/Algorithms25.pdf (noting that profits of HFT firms appear to have shrunk to approximately 1/20th of a cent per trade, although there are reasons to be skeptical of low estimates of profitability). For an early discussion of the limitations of HFT, see Richard Bookstaber, *The Arms Race in High Frequency Trading*, RICK BOOKSTABER BLOG (Apr. 21, 2009), http://rick.bookstaber.com/2009/04/arms-race-in-high-frequency-trading.html.

7. *See infra* note 219 and accompanying text.

8. Dave Cummings, owner of Kansas City-based Tradebot, reportedly told a group of business school students that his firm had not lost money on a single day over a four-year period. *See* Stephen Gandel, *Is KC Firm the New King of Wall Street?*, TIME (May 18, 2010), http://business.time.com/2010/05/18/is-kc-firm-new-king-of-wall-street/. Similarly, Virtu Financial disclosed that it had experienced only one day of trading losses over a five-year period. *See* Sam Mamudi & Leslie Picker, *Virtu Filing Shines Light on High-Frequency Trading*, BLOOMBERG: BUSINESS (Mar. 11, 2014), http://www.bloomberg.com/news/articles/2014-03-11/virtu-filing-shines-light-on-business-of-high-frequency-trading; *cf.* MacKenzie, *supra* note 6, at 30 (stating that one interviewee estimated that his firm profited on fifty-three percent of its trades, typically for a one cent profit).

9. Liquidity provision and price discovery are the two most frequently cited benefits HFT brings to the financial markets, and HFT firms appear to provide significant liquidity to the stock markets. For a discussion of various costs and benefits HFT brings to financial markets, see *infra* Section III.A.

10. See *infra* Part II for a detailed explanation of the varieties and specific structural elements of HFT activity.

technologically adept firms can take advantage of the opportunities offered by the exchanges, and the trading strategies they enable allow for, at least for some HFT firms, the nearly risk-free extraction of profits at the expense of slower traders. Furthermore, a number of the specialized order types used by traders appear to have been specifically created by the exchanges and HFT shops to allow technologically adept players to prey upon slower, unaware traders.[11]

This Article aims to provide a closer look at the features of HFT that have caused critics to complain that it is unfair.[12] In particular, it comes to the following conclusions:

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11. The allegation that HFT firms and the exchanges colluded to create techniques to enable HFT to profit at the expense of slower traders in the market is one of the most disturbing charges leveled against HFT. *See* Scott Patterson, Dark Pools: The Rise of the Machine Traders and the Rigging of the U.S. Stock Market 204–05 (2013) ("High-speed firms worked hand in hand with the trading networks to create exotic order types that would behave in very specific ways."); *accord* Lewis, *supra* note 1, at 163 ("By giving HFT what it wanted (speed, in relation to the rest of the market; complexity only HFT understood; and payment to brokers for their customers' orders, so that HFT had something to trade against), the new stock exchanges had stolen market share from the old stock exchanges."); *id.* at 171 (explaining that the purpose of the special order types was "to create an edge for HFT at the expense of investors"); *see also infra* notes 263–82 and accompanying text.

12. This Article aims to provide a detailed look at the potentially objectionable practices of HFT with particular attention paid to fairness issues. In doing so, it presents a considerably more negative overall evaluation of HFT than earlier commentators in the legal literature. *See, e.g.*, Charles Korsmo, *High Frequency Trading: A Regulatory Strategy*, 48 U. Rich. L. Rev. 523, 528, 562 (2014) (hedging against criticism of HFT by stating that it has generated an "appearance of unfairness"); Tom C.W. Lin, *The New Financial Industry*, 65 Ala. L. Rev. 567, 595 (2014) ("While actual and potential challenges presented by cy-fi [cyber finance] are many, serious, and real, so are its actual and potential benefits." (internal footnote omitted)); Mi Hyun Yoon, *Trading in a Flash: Implication of High-Frequency Trading for Securities Regulators Worldwide*, 24 Emory Int'l L. Rev. 913, 943 (2010) (arguing that the SEC should regulate only certain HFT strategies that create systemic risk); Michael J. McGowan, Note, *The Rise of Computerized High Frequency Trading: Use and Controversy*, 2010 Duke L. & Tech. Rev., ¶ 31 (2010) ("Despite these reservations, there is still evidence to suggest that HFT benefits the markets and curbing its use would be to the detriment of all investors."). More recent articles in the legal literature have cast a more critical eye on HFT. *See generally* Merritt B. Fox, Laurence R. Glosten & Gabriel V. Rauterberg, *The New Stock Market: Sense and Nonsense*, 65 Duke L.J. 191, 196 (2015) (proposing a tripartite framework of adverse selection, principal-agent problems, and multiple venue trading to analyze HFT); Frank Pasquale, *Law's Acceleration of Finance: Redefining the Problem of High-Frequency Trading*, 36 Cardozo L. Rev. 2085, 2087 (2015) (drawing on the "Legal Theory of Finance" to argue that benefits from ever-faster trading may be illusory); Gregory Scopino, *The (Questionable) Legality of High-Speed*

- HFT, like many other financial market activities, is complex, and the term encompasses an array of specific practices. Some HFT activity is morally objectionable, while other common HFT activities are morally neutral or even beneficial.
- While the dollars at stake in HFT may be declining, it is a symbolically important problem that resonates with equity concerns of ordinary Americans, particularly those who invest in the financial markets through 401(k) and other types of retirement plans. Regulators and financial markets participants therefore ought to treat it carefully.
- An accurate evaluation of the fairness of a marketplace activity cannot be understood from quantitative measures alone, but requires understanding the structural interaction of market participants in terms of their expectations and beliefs when entering into a transaction. This perspective highlights a role for deontological moral theory in financial regulation because a purely cost-benefit analysis will often miss the internal perspective of important stakeholders in the system.
- The invasion, and now dominance, of the financial markets by the information technology of the digital age appears to undermine the grounding assumptions of Regulation National Market System (Regulation NMS or Reg. NMS). Regulation NMS may come to be seen as an unstable and ultimately unworkable regime between the world of the 1934 Act and what comes next as information travels at the speed of light. In hindsight, warnings over the danger of fragmentation during the debates on the implementation of a "national market system" appear prescient.

"Pinging" and "Front-Running" in the Futures Markets, 47 CONN. L. REV. 607, 616–17 (2015) (arguing that high-speed pinging should be viewed as a deceptive trading practice under the CEA); Yesha Yadav, *How Algorithmic Trading Undermines Efficiency in Capital Markets*, 68 VAND. L. REV. 1607, 1644–57 (2015) (arguing that HFT's impact on prices harms the allocative efficiency of the stock market).

I. THE ECOSYSTEM OF THE EQUITY MARKETS

As with most other features of contemporary life, stock market transactions have been radically changed by the information technology revolution over the course of the past twenty or so years. Less than ten years ago, significant trading took place on the floor of the New York Stock Exchange (NYSE), but the implementation of Regulation NMS in 2007 quickly transformed the floor into little more than a backdrop for television stories relating to the economy.[13] The changes forced by regulators were intended to benefit the average investor, and the new rules succeeded in important ways.[14] At the same time, however, they created a significantly new financial ecosystem in which abusive activity has thrived. The interaction of Regulation NMS with a technological arms race has given rise to equity markets that run the risk of becoming a two-tiered system.

Over the course of the past twenty years, the stock exchanges have been transformed from institutions that primarily served their member-owners into for-profit corporations serving the interests of shareholders.[15] At the same time the corporate form they operated under changed, the economic effects of the new regulatory structure transformed their customer base.[16] Many broker-dealers went out of business, and only six "Designated Market Makers"[17] (DMMs)

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13. *See* 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, 866 (2008).

14. *See* Steve Wunsch, *HFT and the Computerization of Wall Street, Part 3: Eliminating the Middleman*, TABB F. (July 31, 2013), http://tabbforum.com/opinions/hft-and-the-computerization-of-wall-street-part-3-eliminating-the-middleman.

15. *See* Andreas M. Fleckner, *Stock Exchanges at the Crossroads*, 74 FORDHAM L. REV. 2541, 2593 (2006); Jonathan R. Macey & Maureen O'Hara, *From Markets to Venues: Securities Regulation in an Evolving World*, 58 STAN. L. REV. 563, 585 (2005) ("As exchanges convert to become profit-seeking firms . . . the gains of the few turn into profits of the corporation."). *See generally* JOHN C. COFFEE, JR. & HILLARY A. SALE, SECURITIES REGULATION 572–76 (13th ed. 2015).

16. *See* Macey & O'Hara, *supra* note 15, at 581, 593.

17. These are Barclays Capital Inc.; Brendan E. Cryan & Co., LLC; IMC Financial Markets; J. Streicher & Co., LLC; KCG; and Virtu Financial Capital Markets, LLC. *Market Model Overview*, N.Y. STOCK EXCH., www.nyse.com/market-model/overview (last visited Oct. 13, 2015). There are also seven firms designated as "Supplemental Liquidity Providers": Citadel Securities LLC; Goldman, Sachs & Company; HRT Financial LLC; KCG

serve the NYSE in the role formerly exercised by specialists on the exchange.[18] Instead of serving the interests of a relatively large group of members holding seats on the exchange, who were previously compensated for by large spreads, [19] the business model now followed by the exchanges is predicated on charging relatively small fees for numerous transactions and selling the information about such transactions.[20] In the new environment where exchanges compete for fees, any market participant bringing a large volume of trades to an exchange will be a valuable and favored client.

A. THE PRE-REGULATION NMS LANDSCAPE

The history of the stock markets in the United States stretches back to 1792, when stock trading was said to have been organized under a buttonwood tree on Wall Street.[21] The "Buttonwood Agreement" was signed by twenty-four brokers.[22] It specified that brokers would trade only amongst themselves, with a minimum commission rate of 0.25%. [23] These two features of trading on what became the New York Stock Exchange formed the cornerstone of the trading system that persisted until the twenty-first century.[24] The New York Stock Exchange grew in the twentieth century into the most

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Americas LLC; Latour Trading, LLC; Tradebot Systems, Inc.; and Virtu Financial BD LLC. *Id.*

18. *See* Ryan C. Fuhrmann, *Decline of the Independent Broker-Dealer*, INVESTOPEDIA (May 6, 2013), http://www.investopedia.com /articles/professionals/050613/decline-independent-brokerdealer.asp (discussing how the estimated "number of broker-dealers registered with FINRA fell by nearly 10% between 2005 and 2010, a trend that has continued over the past couple years").

19. *See generally* Markham & Harty, *supra* note 13 (describing the demise of traditional exchange trading floors).

20. *See* Bruinius, *supra* note 4.

21. *See* CHARLES R. GEISST, WALL STREET: A HISTORY 13 (1997); Stuart Banner, *The Origin of the New York Stock Exchange, 1791-1860*, 27 J. LEGAL STUD. 113, 115 (1998). *See generally* Hans R. Stoll, *Electronic Trading in Stock Markets*, 20 J. ECON. PERSPS. 153, 153 (2006). For a history of the stock markets and the SEC since the 1930s, see JOEL SELIGMAN, THE TRANSFORMATION OF WALL STREET: A HISTORY OF THE SECURITIES AND EXCHANGE COMMISSION AND MODERN CORPORATE FINANCE (3d ed. 2003).

22. *See* Banner, *supra* note 21, at 115 n.3 (citing Peter Eisenstadt, *How the Buttonwood Tree Grew: The Making of a New York Stock Exchange Legend*, 19 PROSPECTS 75, 75 (1994)).

23. *See* Eisenstadt, *supra* note 22, at 77.

24. *Cf.* Banner, *supra* note 21, at 114 (chronicling the NYSE's growth from its Buttonwood beginnings to the center of the American economy).

important venue for stock trading in the United States.[25] While the exchange was open to often justified criticism that it benefitted its members at the expense of the public, it did present a predictable system for buying and selling equity in public companies, and regulations under the Securities Exchange Act of 1934 (the Exchange Act) were to a large degree effective in suppressing the worst abuses.[26]

Key aspects of trading stocks on an exchange in the pre-Regulation NMS landscape included both the fact that trading in a stock tended to gravitate to one venue and the relatively high cost of trading. Trading was limited to broker-dealers holding seats on the exchange, who traded in the context of the specialist system.[27] In addition to the members who were allowed to trade on behalf of their clients, specialists supported trading in NYSE-listed stocks, with "482 individual specialists at the New York Stock Exchange"[28] covering an average of three to six stocks each day in the early 2000s.[29] A specialist in a company's stock had the obligation to support trading when

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25. *See* Eisenstadt, *supra* note 22, at 75 ("[B]etween 1865 and 1920 . . . the exchange [NYSE] emerged as the dominant capital market in the world.").

26. *See, e.g.*, Frank B. Cross & Robert A. Prentice, *The Economic Value of Securities Regulation*, 28 CARDOZO L. REV. 333, 337 (2006) ("[E]mpirical evidence plainly demonstrates great economic value from our relatively stringent system of governmental securities regulation."); Steven A. Ramirez, *The Virtues of Private Securities Litigation: An Historic and Macroeconomic Perspective*, 45 LOY. U. CHI. L.J. 669, 684 (2014) ("[The] original conception of the federal securities laws ushered in an unprecedented era of financial stability."). For the view that it is enforcement of law that has beneficial effects for a market economy, see John C. Coffee, Jr., *Law and the Market: The Impact of Enforcement*, 156 U. PA. L. REV. 229, 230 (2007) ("[H]igher enforcement intensity gives the U.S. economy a lower cost of capital and higher securities valuations."). *See also* Howell E. Jackson & Mark J. Roe, *Public and Private Enforcement of Securities Laws: Resource-Based Evidence*, 93 J. FIN. ECON. 207, 227–30 (2009) (arguing that public enforcement of financial markets law is positively associated with deeper capital markets than private enforcement). For a skeptical counterargument, see George J. Benston, *Required Disclosure and the Stock Market: An Evaluation of the Securities Exchange Act of 1934*, 63 AM. ECON. REV. 132, 153 (1973).

27. *See generally* LARRY HARRIS, TRADING & EXCHANGES: MARKET MICROSTRUCTURE FOR PRACTITIONERS 494–513 (2003); SELIGMAN, *supra* note 21, at 335–44 (describing the function and history of specialists); Gideon Saar, *Specialist Markets*, *in* THE ENCYCLOPEDIA OF QUANTITATIVE FINANCE (Rama Cont ed. 2010); Nicholas Wolfson & Thomas A. Russo, *The Stock Exchange Specialist: An Economic and Legal Analysis*, 1970 DUKE L.J. 707, 707–08 (1970) (discussing specialists' roles and history).

28. HARRIS, *supra* note 27, at 496.

29. *Id.*

liquidity dried up;[30] about ten percent of trades were supported by specialists either purchasing or selling stock.[31] And while specialists could see the orders in the "order book," and thus had knowledge of where the market was headed,[32] "front-running" in stocks was forbidden.[33] In the "open outcry" auction system, trading occurred at the post on the floor of the exchange where a specialist was located, with brokers shouting bids or offers to one another.[34] In the classic twentieth century form of the exchange, trading gravitated to the exchange because brokers wanted access to the greatest trading volume.[35] In this way, stock exchanges held onto the vast bulk of the trading in stocks listed on their exchanges.[36]

The other central economic feature was the cost of trading. Since stocks were listed in 1/8th of a dollar increments, spreads

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30. *See generally* 17 C.F.R. § 240.11b-1(a)(2)(ii) (2015) (outlining the role of specialists in the stock market). Specialists, however, had a certain amount of discretion in meeting this obligation. *See* Wolfson & Russo, *supra* note 27, at 711–12.

31. *See* Nan S. Ellis, Lisa M. Fairchild & Harold D. Fletcher, *The NYSE Response to Specialist Misconduct: An Example of the Failure of Self-Regulation*, 7 BERKELEY BUS. L.J. 102, 107 n.20 (2010).

32. *See* Gerald T. Nowak, Note, *A Failure of Communication: An Argument for the Closing of the NYSE Floor*, 26 U. MICH. J.L. REFORM 485, 501–02 (1993) (presenting the economic benefits accorded to specialists).

33. Front-running by specialists was a common practice in the years before the Exchange Act. *See* GEISST, *supra* note 21, at 213 ("[S]pecialists were in a privileged position to see prices before executing for the public and would often act for themselves before filling an order from the public being executed through a floor broker."). Although front-running is not explicitly prohibited by the federal securities laws, the rules of the various exchanges and the Financial Industry Regulatory Authority (FINRA) forbid it and it is prosecuted as a violation of Section 10(b) of the Exchange Act. *See* Fox et al., *supra* note 12, at 227 n.87; David M. Bovi, *Rule 10b-5 Liability for Front Running: Adding a New Dimension to the "Money Game,"* 7 ST. THOMAS L. REV. 103, 111–14 (1994). For discussion of front-running and other misconduct by specialists, see Ellis et al., *supra* note 31, at 115–17 (describing front-running as well as other forms of specialist misconduct). For an analysis of the specialist system, see Jonathan Macey & Hideki Kanda, *The Stock Exchange as a Firm: The Emergence of Close Substitutes for the New York and Tokyo Stock Exchanges*, 75 CORNELL L. REV. 1007, 1025–34 (1990).

34. *See* Leo Melamed, *The Mechanics of a Commodity Futures Exchange: A Critique of Automation of the Transaction Process*, 6 HOFSTRA L. REV. 149 (1977) (presenting an overview and defense of open outcry trading).

35. *See* Craig Pirrong, *Competition and Vertical Integration in Financial Exchanges*, 7 COMPETITION POL'Y INT'L 90, 93 (2011) [hereinafter Pirrong, *Competition and Vertical Integration*] (explaining the liquidity network effect for exchanges).

36. *See id.* at 94 (reporting that the NYSE's market share plunged from 85% to approximately 30% after the introduction of Reg. NMS in 2007).

on stock trades were a minimum of 12.5 cents, with 25 cents being most common and 50 cents or more also possible.[37] The fixed prices in 1/8th increments preserved fat profits for market makers, as their compensation for making a trade was the spread between the bid and the ask, or the prices a broker would pay and sell for a stock, respectively.[38] While these high costs represented a significant rent extracted from the brokers' clients, they were also transparent,[39] in distinction to the present markets. In addition to spreads, stockbrokers traditionally charged high fixed commissions to clients, although fixed commissions were dealt a deathblow with the amendments made to the Exchange Act in 1975.[40] Despite this transparency, the cost of trading was a central motive for the implementation of a "National Market System" that began with the enabling legislation in 1975 and finally led to the promulgation of Regulation NMS in 2005.[41]

The gravitation of trading to exchanges on which stocks were listed and the high transaction costs charged to customers were two main features of the pre-Regulation NMS trading environment. In hindsight, it appears that for investors the

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37. *See* Stoll, *supra* note 21, at 160, 164.

38. *See* DIV. OF MKT. REG., U.S. SEC. & EXCH. COMM'N, MARKET 2000: AN EXAMINATION OF CURRENT EQUITY MARKET DEVELOPMENTS IV-9 (1994) [hereinafter MARKET 2000] ("[M]arket makers benefit because they can affect executions at wider spreads than if a smaller variation was used."); *see also infra* notes 54–55 and accompanying text.

39. *See id.* at 17, IV-1.

40. *See* Stanislav Dolgopolov, *Insider Trading, Chinese Walls, and Brokerage Commissions: The Origins of Modern Regulation of Information Flows in Securities Markets*, 4 J.L. ECON. & POL'Y 311, 324 n.62 (2008). The Securities Acts Amendments of 1975 prohibited fixed commissions on the stock exchanges. Securities Acts Amendments of 1975, Pub. L. No. 94-29, § 4, 89 Stat. 97, 107–09; *see also* SELIGMAN, *supra* note 21, at 473–86 ("The practical effect of the Commission['s] decision . . . was to add to the already considerable pressures to unfix commission rates totally.").

41. *See* Jonathan R. Macey & David D. Haddock, *Shirking at the SEC: The Failure of the National Market System*, 1985 U. ILL. L. REV. 315, 322 (1985) (noting the objectives behind the national market system legislation were "to assure economically efficient securities transactions; fair competition between brokers and dealers, and between exchanges and markets; the availability of information; the execution of investors' orders in the best market; and an opportunity to execute orders without the participation of dealers," which "reflect Exchange Act § 11A"); *see also* Regulation NMS, 70 Fed. Reg. 37,496, 37,497 (June 29, 2005) (codified at 17 C.F.R. pt. 242) ("[T]he NMS is designed to achieve the objectives of efficient, competitive, fair, and orderly markets that are in the public interest and protect investors."); SELIGMAN, *supra* note 21, at 511–14.

former aspect was on the whole beneficial[42] while the latter was largely detrimental.[43] (Of course, other parties within the system, such as stockbrokers, would have different views.[44]) While many market participants and scholars were concerned about the dangers of fragmentation as a result of the effort to introduce competition in the market system, whether or not such fragmentation would occur, and its effect if it did, was the subject of intense debate.[45] In retrospect, the push to "reform" the market system that began in the 1960s and 1970s, in conjunction with the rise of computer technology, led to the current, highly fragmented state of the markets with other, new dysfunctions.[46]

In the pre-Regulation NMS period, stock markets were for the most part auction markets run on an "open outcry system."[47] In this format, transactions were driven by orders conveyed to stockbrokers to either buy or sell.[48] The National

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42. Increased liquidity and price competition are the main benefits that economic theory would predict follow from the liquidity network effect. *See* Pirrong, *Competition and Vertical Integration*, *supra* note 35, at 93; Stephen Craig Pirrong, *The Self-Regulation of Commodity Exchanges: The Case of Market Manipulation*, 38 J.L. & ECON. 141, 154–55 (1995) [hereinafter Pirrong, *The Self-Regulation of Commodity Exchanges*] (discussing natural monopoly among commodities exchanges); *see also* Marco Pagano, *Trading Volume and Asset Liquidity*, 104 Q.J. ECON. 255, 255 (1989). *See generally* Anat R. Admati & Paul Pfleiderer, *A Theory of Intraday Patterns: Volume and Price Variability*, 1 REV. FIN. STUD. 3 (1988) (examining forces that lead to concentration of trades at certain periods of the day).

43. *See supra* note 40 and accompanying text.

44. Different players in the market will have different ideas concerning the ideal market structure. *See* COFFEE & SALE, *supra* note 15, at 577; *see also* Regulation NMS, 70 Fed. Reg. at 37,500 (noting that at points the interests of short-term traders and long-term investors may diverge). *See generally* Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3597 (Jan. 14, 2010) (noting that it can be difficult to reconcile the five objectives set forth by Congress in Exchange Act § 11A).

45. *See, e.g.*, MARKET 2000, *supra* note 38, at III-2 (arguing that U.S. equity markets as of 1994 were not "fragmented to the point that price discovery and liquidity have been affected adversely"); Roberta S. Karmel, *Turning Seats into Shares: Causes and Implications of Demutualization of Stock and Futures Exchanges*, 53 HASTINGS L.J. 367, 392–95 (2002); Mark Klock, *The SEC's New Regulation ATS: Placing the Myth of Market Fragmentation Ahead of Economic Theory and Evidence*, 51 FLA. L. REV. 753, 760–64 (1999); Arthur Levitt, *Dynamic Markets, Timeless Principles*, 2000 COLUM. BUS. L. REV. 1, 9–11 (2000); Macey & Haddock, *supra* note 41, at 341–42 (characterizing fears over fragmentation as "unwarranted").

46. *Cf.* Karmel, *supra* note 45, at 404–05 (examining discussions, proposals, and actual changes made through the 1960s and 1970s).

47. *See* Melamed, *supra* note 34, at 150.

48. *See id.*

Association of Securities Dealers Automated Quotations (NASDAQ) system stands as an exception, which through its influence on equity trading gave rise to the current stock market ecosystem. NASDAQ represented a fundamentally new mode of equity trading both in its use of technology and its format.[49] The National Association of Securities Dealers formed NASDAQ to provide its members with a way to trade stocks that would be difficult to list on the NYSE or other major exchanges.[50] These stocks were traditionally issued by smaller start-ups, often technology ventures, that would have difficulty meeting the NYSE listing requirements. [51] The NASDAQ trading system differed from the NYSE and other stock markets that used trading floors. It used a quote-driven system, where brokers put up quotes to buy or sell stocks on an electronic bulletin board, and waited for counterparties to accept them. [52] It also incorporated the use of computer technology, and so was the precursor to today's electronic trading systems.[53]

For many years NASDAQ was similar to the NYSE in that it preserved the ability of dealers to earn substantial commissions through large spreads, but a regulatory change in 1996 represented a break in the bulwark protecting dealers' easy profits. In 1994, finance professors William Christie and Paul Schultz published *Why Do NASDAQ Market Makers Avoid Odd Eighth Quotes?*[54] After surveying prices in heavily

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49.   *See* Korsmo, *supra* note 12, at 533 (noting that NASDAQ was first to use computers to trade in 1971); Markham & Harty, *supra* note 13, at 899; Peter Gomber, Björn Arndt, Marco Lutat & Tim Uhle, *High Frequency Trading* 8 (Mar. 2011) (unpublished manuscript), http://ssrn.com/abstract=1858626.

50.   *See* Markham & Harty, *supra* note 13, at 877.

51.   *See* Michael J. Simon & Robert L.D. Colby, *The National Market System for Over-the-Counter Stocks*, 55 GEO. WASH. L. REV. 17, 35 (1986) (characterizing the origins of the NASDAQ system as "real time pink sheets"). *See generally Overview of NYSE Quantitative Initial Listing Standards*, NYSE, https://www.nyse.com/publicdocs/nyse/listing/NYSE_Initial_Listing_Standards_Summary.pdf (last visited Nov. 18, 2015) (presenting general listing requirements for the NYSE).

52.   *See* Stoll, *supra* note 21, at 159–60.

53.   *Id.*

54.   William G. Christie & Paul H. Schultz, *Why Do NASDAQ Market Makers Avoid Odd-Eighth Quotes?*, 49 J. FIN. 1813 (1994) [hereinafter Christie & Schultz, *Why Do NASDAQ Market Makers*]; *see also* William G. Christie & Paul H. Schultz, *Did Nasdaq Market Makers Implicitly Collude?*, 9 J. ECON. PERSPS. 199 (1995); Stoll, *supra* note 21, at 159–60.

traded NASDAQ stocks, they suggested that brokers colluded to keep spreads wide through avoiding quotes in odd eighths, favoring even eighth quotes instead.[55] Their paper gave rise to significant controversy, [56] and as a result, then SEC Chair Arthur Levitt championed order handling rules, which required dealers to include in their own quotations customer limit orders improving on their own quotes.[57] While prices were still quoted in 1/8th increments, now a customer's bid or offer could improve on its broker's quote. [58] This investor-friendly regulation was a step in the direction of taking control away from the intermediaries in the system, the stockbrokers, and giving it to the end-users, the investors.

B. REGULATION NMS

Regulation National Market System, which became effective in 2007, has its genesis in Section 11A of the Exchange Act, entitled "National market system for securities; securities information processors."[59] Foreseeing the problems of fragmented securities markets and the ability of technology to help in overcoming them, Congress authorized the SEC "to use its authority under this chapter to facilitate the establishment of a national market system for securities." [60] Given the accelerating pace of change in the national securities markets, particularly in the 1990s and first decade of the 2000s, this regulatory project represented a difficult challenge for the SEC.[61] And given the developments since 2007 that came about

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55. Christie & Schultz, *Why Do NASDAQ Market Makers*, *supra* note 54, at 1838–39.

56. *See, e.g.*, Floyd Norris, *Market Place; U.S. Investigating Nasdaq's Pricing Practices*, N.Y. TIMES, Oct. 20, 1994, at D1; William Power, *Academics Fan Flames of Nasdaq Fairness Debate*, WALL ST. J., Nov. 7, 1995, at C1; *The Odd Couple Wins*, ECONOMIST, Jan. 13, 1996, at 70.

57. *See* Order Execution Obligations, 62 Fed. Reg. 40,732 (July 30, 1997) (codified at 17 C.F.R. pt. 240) (promulgating the "order handling rules"); Robert L.D. Colby & Erik R. Sirri, *Consolidation and Competition in the US Equity Markets*, 5 CAP. MKT. L.J. 169, 183–85 (2010); *see also Collusion in the Stockmarket*, ECONOMIST, Jan. 17, 1998, at 89.

58. *See* Order Execution Obligations, 62 Fed. Reg. 40,732 (July 30, 1997) (codified at 17 C.F.R. pt. 240) (requiring "market makers and exchange specialists to publicly display certain customer limit orders").

59. 15 U.S.C. § 78k-1 (2012).

60. *Id.* § 78k-1(a)(2).

61. Regulation NMS, 70 Fed. Reg. 37,496 (June 29, 2005) (codified at 17 C.F.R. pt. 242), represents the culmination of this process. The final release was preceded by two proposed releases, Regulation NMS, 69 Fed. Reg. 77,424 (Dec. 27, 2004) and Regulation NMS, 69 Fed. Reg. 11,126 (Mar. 9, 2004). For a

largely in response to the new regulatory landscape, it is tempting to see Regulation NMS as a failure. While the new system certainly created opportunities for private actors to game it, these problems, with which this Article is largely concerned, should be understood as unintended consequences of an attempt to foster competition among disparate securities markets across the United States.[62]

Regulation NMS consists of Exchange Act Rules 600–612.[63] The key provisions were promulgated in 2005. They are Rule 611 (the Order Protection Rule),[64] Rule 610 (the Access Rule),[65] Rule 612 (the Sub-Penny Rule),[66] and amendments to Rules 601 and 603 (the Market Data Rules).[67] These rules knit together the many exchanges and trading venues in the United States through the mechanism of a single price, the National Best Bid and Offer[68] (NBBO). They also set up a complicated system of rules mandating the provision of quotes to the market at large, and how brokers and others can interact in this ecosystem.[69] While largely successful in its aims of reducing spreads and fostering competition amongst exchanges, the new regime also led to the creation of a highly fragmented system—contrary to its intentions—in which a subset of traders can prey upon slower traders.[70]

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critical history of the development of Regulation NMS, see Dale A. Oesterle, *Regulation NMS: Has the SEC Exceeded Its Congressional Mandate to Facilitate a "National Market System" in Securities Trading?*, 1 N.Y.U. J.L. & BUS. 613 (2005). *See also* SELIGMAN, supra note 21, at 495–534.

62.   *See* Regulation NMS, 70 Fed. Reg. at 37,498 ("The NMS is premised on promoting fair competition among individual markets, while at the same time assuring that all of these markets are linked together, through facilities and rules, in a unified system that promotes interaction among the orders of buyers and sellers in a particular NMS stock.").

63.   17 C.F.R. §§ 242.600–.612 (2014); *see* Regulation NMS, 70 Fed. Reg. at 37,496.

64.   Regulation NMS, 70 Fed. Reg. at 37,501.

65.   *Id.* at 37,502.

66.   *Id.* at 37,503.

67.   *Id.*

68.   17 C.F.R. § 242.600(b)(42) ("National best bid and national best offer means, 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 . . . .").

69.   *See id.* § 242.600(b)(11), (26)–(29) for NMS Regulation definitions relating to quotes.

70.   *See* Craig Pirrong, *Pick Your Poison—Fragmentation or Market Power? An Analysis of RegNMS, High Frequency Trading, and Securities Market Structure*, 26 J. APPLIED CORP. FIN. 8, 8 (2014) [hereinafter Pirrong,

The cornerstone of Regulation NMS is the Order Protection Rule.[71] This rule prevents "trade-throughs,"[72] or trades on one market at a price inferior to one available on another market.[73] The rule requires that each trading center establish "policies and procedures that are reasonably designed to prevent trade-throughs on that trading center of protected quotations in NMS stocks," other than in the case of a specified exception.[74] In this way, orders are protected from being executed at a price inferior to the NBBO. While there was concern that the Order Protection Rule could conflict with the duty of "best execution" by brokers, as large "block orders" could face difficulty in being executed quickly,[75] execution at the best price was given priority in constructing the national market system.[76] The Order Protection Rule, therefore, is commensurate with the general principle of price-time priority prevailing in the markets.[77] Price is the primary factor in determining whether a trade will be made. When there is more than one quote at a particular price, the time of submission is generally used as a secondary factor.[78] The "Intermarket Sweep Order" (ISO) exception to the prohibition against trade-throughs[79] allows brokers to execute large trades quickly in the markets at the request of clients, where the desire for speed in executing the transaction outweighs the desire to search for the best possible price among different market centers.[80] As explored further

Pick Your Poison] (characterizing Reg. NMS as leading to the current fragmented market system).

71. 17 C.F.R. § 242.611.

72. *Id.* § 242.600(b)(77) ("Trade-through means the purchase or sale of an NMS stock during regular trading hours, either as principle or agent, at a price that is lower than a protected bid or higher than a protected offer.").

73. *See id.* § 242.611.

74. *Id.* § 242.611(a).

75. *See* Regulation NMS, 70 Fed. Reg. 37,496, 37,523 (June 29, 2005) (codified at 17 C.F.R. pt. 242).

76. *Id.* at 37,497.

77. *Id. See generally* HARRIS, *supra* note 27, at 116–20 ("Rule-Based Order-Matching Systems").

78. HARRIS, *supra* note 27, at 117 ("All order-matching markets use *price priority* as their *primary order precedence rule.* . . . Markets use various secondary precedence rules to rank orders based on their time of submission, on their display status, and on their size.").

79. 17 C.F.R. § 242.611(b)(5). The "Intermarket Sweep Order" is defined at 17 C.F.R. § 242.600(b)(30).

80. *See* Regulation NMS, 70 Fed. Reg. at 37,523 ("The Commission . . . provided exceptions for intermarket sweep orders that respond[ed] to the need

below, the ISO became an essential item in the toolkit of high-frequency traders, but its origin lay in the desire of the SEC to allow broker-dealers flexibility in meeting their "best execution" obligations.[81]

The Access Rule[82] provides for uniform access to quotes on the various trading venues by restricting the price charged for a quote to $0.003 per share[83] and by forbidding market centers from discriminating in access to quotes.[84] These rules were necessary because without equal access to quotes, requiring brokers to execute at the NBBO would be "futile if broker-dealers and trading centers were unable to access those prices fairly and efficiently."[85] The Access Rule is important to HFT for two very different reasons. First, it may play a supporting role to other regulations that are implicated in the question of whether the exchanges have in fact acted in a "discriminatory" fashion in providing "enriched" data feeds and "flash orders."[86] While offering enriched data feeds and flash orders does not appear to violate the provisions of the Access Rule, they may be at odds with the general intention behind the rule, which was to "further the goal of fair and efficient access to quotations primarily by prohibiting trading centers from unfairly discriminating against non-members or non-subscribers" who access quotations through an exchange member or subscriber.[87]

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of market participants to access multiple price levels simultaneously at different trading centers.").

81. *See infra* Section II.F.

82. 17 C.F.R. § 242.610 ("Access to quotations").

83. *Id.* § 242.610(c)(1). Where the "price of a protected quotation or other quotation is less than $1.00, the fee or fees cannot exceed or accumulate to more than 0.3% of the quotation price per share." *Id.* § 242.610(c)(2).

84. *Id.* § 242.610(a).

85. Regulation NMS, 70 Fed. Reg. 37,502.

86. The anti-discrimination principle of Rule 610(a) may be a supplement to Rule 603(a)(2), which mandates that an exchange "that distributes information with respect to quotations for or transactions in an NMS stock to a securities information processor . . . shall do so on terms that are not unreasonably discriminatory." 17 C.F.R. § 242.603(a)(2). On the other hand, "the unfair discrimination standard of Rule 610(a) will apply only to access to quotations, not to the full panoply of services that markets generally provide only to their members." Regulation NMS, 70 Fed. Reg. at 37,540. For discussion of the application of Regulation NMS to enriched data feeds and other HFT practices, see John C. Coffee, Jr., *High Frequency Trading Reform: The Short Term and the Longer Term*, COLUM. L. SCH. BLUE SKY BLOG (July 21, 2014), http:// clsbluesky.law.columbia.edu/2014/07/21/high-frequency-trading-reform-the-short-term-and-the-longer-term/. *See also infra* notes 240–41 and accompanying text.

87. Regulation NMS, 70 Fed. Reg. at 37,539.

Second, the Access Rule's prohibition on locked and crossed quotations creates an environment in which a number of abusive practices of HFT thrive.[88] Ironically, the prohibition only arose because of the disorderly consequences of traders attempting to capture liquidity rebates in the "maker/taker" payment model used by the early electronic exchanges.[89] A "locked" market occurs when bids and offers are posted at the same price, whereas a "crossed" market is when a bid is posted at a higher price than the current offer (or an offer at a lower price than the current bid).[90] Locked and crossed markets represent fundamentally irrational conditions, and markets react by seizing up.[91] As a result, Regulation NMS bans displaying quotes that lock or cross previously displayed quotes in the interest of promoting "fair and orderly markets" and "market efficiency."[92]

Why do locks and crosses occur? The motive for posting locking or crossing quotations in a "maker/taker" system is to avoid being a "taker" of liquidity, and to instead be a "maker" of liquidity. This is because liquidity takers are charged an access fee for hitting a pre-existing order, while liquidity makers are paid a rebate, typically two-thirds of the fee paid by the liquidity taker.[93] Unfortunately, banning locking and crossing quotes only leads to a further problem: the development of abusive order types such as "Hide Not Slide" which provide traders with a means to overcome the ban on locking and crossing quotes while simultaneously jumping the queue of price-time priority embedded in market practice.[94]

Next, the Sub-Penny Rule prohibits quotes in prices less than $0.01 for national market securities valued at more than $1.00, and in prices less than $0.0001 for stocks valued at less than $1.00.[95] The main purpose of this rule was to protect the

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88. *See generally id.* at 37,546–48 (discussing locking and crossing quotations).

89. For a discussion of "maker/taker" payment model, see *infra* notes 148–51 and accompanying text. For a discussion of the problem of locked and crossed markets prior to the passage of Regulation NMS, see Ivy Schmerken, *Nasdaq's Battle over Locked Crossed Markets*, WALL ST. & TECH., May 2003, at 12, 12–18.

90. *See* Schmerken, *supra* note 89, at 14.

91. *Id.*

92. Regulation NMS, 70 Fed. Reg. at 37,547.

93. *See* Schmerken, *supra* note 89, at 16–18.

94. *See infra* Section II.F, which discusses the "Hide Not Slide" order in detail.

95. 17 C.F.R. § 242.612 (2014); Regulation NMS, 70 Fed. Reg. at 37,503.

use of limit orders in the securities markets.[96] A limit order is a standing order to purchase or sell a certain amount of a given security at a given price;[97] the list of standing limit orders forms the central limit order book of a market and constitutes the available liquidity for a stock.[98] In the wake of the conversion of quotes from 1/8ths to decimals, or "decimalization," which occurred in 2000, there was pressure on the exchanges to allow quotes in fractions of a penny.[99] This inevitably led to the use of minute increments to jump ahead of standing limit orders in a given market; a trader could jump ahead of a bid for a given stock at $20.55, for example, by bidding $20.551.[100] Allowing such minute "improvements" on prices would jeopardize the use of limit orders, threatening the main mechanism for building deep liquidity in the markets.[101] The Sub-Penny Rule therefore "was designed to limit the ability of a market participant to gain execution priority over a competing limit order by stepping ahead by an economically insignificant amount."[102]

Finally, Regulation NMS instituted Market Data Rules in Rule 601[103] and Rule 603[104] that form the regulatory backdrop for the information systems that disseminate the NBBO and other information to market participants.[105] (Rules 602 and 604–606 were left mostly unmodified by the final implementing release.[106]) These rules provide for the contemporary version of the "consolidated tape"[107] and serve the crucial function of

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96. *See* Regulation NMS, 70 Fed. Reg. at 37,503.

97. *See* HARRIS, *supra* note 27, at 73 ("A *limit order* is an instruction to trade at the best price available, but only if it is no worse than the *limit price* specified by the trader.").

98. *See id*. at 75–78 (discussing the liquidity benefits of standing limit orders).

99. *See* Regulation NMS, 70 Fed. Reg. at 37,550–51.

100. *See generally id.* at 37,551–52 (listing "a variety of additional problems caused by sub-penny quoting").

101. *Id.*

102. *See id.* at 37,551.

103. 17 C.F.R. § 242.601 (2014) (governing the "[d]issemination of transaction reports and last sale data with respect to transactions in NMS stocks").

104. *Id.* § 242.603 (governing the "[d]istribution, consolidation, and display of information with respect to quotations for and transactions in NMS stocks").

105. Regulation NMS, 70 Fed. Reg. at 37,503.

106. *Id.* at 37,570.

107. *Consolidated Tape*, SEC. & EXCH. COMM'N, https://www.sec.gov/answers/consolt.htm (last updated Oct. 15, 2012) ("The

disseminating a single NBBO for all exchange-listed stocks. They are also crucial for any questions of fairness surrounding dissemination of various types of information concerning quotes, as Rule 603 specifies that any "exclusive processor[108] . . . distribut[ing] information with respect to quotations . . . in an NMS stock to a securities information processor[(SIP) 109] shall do so on terms that are fair and reasonable." 110 Furthermore, "[a]ny national securities exchange, national securities association, broker, or dealer that distributes information with respect to quotations for or transactions in an NMS stock . . . shall do so on terms that are not unreasonably discriminatory."111 The invocation of equity in these rules is especially important to debates concerning the provision of information by the exchanges and other venues to HFT firms outside the mechanism of a SIP.112

There are currently four consolidated information dissemination systems inheriting the role of the consolidated tape: The Consolidated Quotation System, the Consolidated Tape System, the NASDAQ System, and the OPRA System.113 These four entities qualify as SIPs under Regulation NMS, and each must disseminate data to the market in accordance with its Transaction Reporting Plan.114 The SIPs are crucial nodes in the National Market System because they are meant to be the entities that disseminate the NBBO to market participants at large.115 The SIPs are responsible for providing each NMS

'consolidated tape' is a high-speed, electronic system that reports the latest price and volume data on sales of exchange-listed stocks.").

108.   15 U.S.C. § 78c(a)(22)(B) (2014) (defining "exclusive processor").

109.   *Id.* § 78c(a)(22)(A) (defining "securities information processor").

110.   17 C.F.R. § 242.603(a)(1) (2015).

111.   *Id.* § 242.603(a)(2).

112.   *See, e.g.*, Coffee, *supra* note 86; Fox et al., *supra* note 12, at 270–71; *see also infra* notes 238–40 and accompanying text.

113.   Regulation NMS, 70 Fed. Reg. 37,496, at 37,503 n.40, 37,571 (June 29, 2005) (codified at 17 C.F.R. pt. 242); *see* Oesterle, *supra* note 61, at 621, 630; *see also* Collection and Dissemination of Transaction Reports and Last Sale Data, 45 Fed. Reg. 12,377 (Feb. 26, 1980).

114.   Regulation NMS, 70 Fed. Reg. at 37,571; *see also* 17 C.F.R. § 242.600(82) (2015) ("*Transaction reporting plan* means any plan for collecting, processing, making available or disseminating transaction reports with respect to transactions in securities filed with the Commission pursuant to, and meeting the requirements of, § 242.601.").

115.   *See* Regulation NMS, 70 Fed. Reg. at 37,503–04. For a discussion of Congress's intent in providing for one or more SIPs in the 1975 Amendments, see Oesterle, *supra* note 61, at 624–26.

security with "core data"[116] consisting of "(1) last sale reports
. . . ; (2) the current highest bid and lowest offer for the security
. . . ; and (3) the . . . NBBO."[117]

Rule 603(a)(1) requires that "[a]ny exclusive processor, or
any broker or dealer with respect to information for which it is
the exclusive source, that distributes information with respect
to quotations for or transactions in an NMS stock to a
securities information processor shall do so on terms that are
fair and reasonable."[118] This requirement is meant to allow a
SIP to gather the relevant data it requires. Rule 603(a)(2),
however, allows for exchanges and others to disseminate
information concerning quotes and transactions to other
market participants "on terms that are not unreasonably
discriminatory."[119] This implies a less stringent standard than
the one applicable to the requirement in 603(a)(1) that an
"exclusive processor" shall provide such information to a SIP.[120]
The dissemination of data by the exchanges through enriched
data feeds and other arrangements outside of dissemination to
the SIP falls under 603(a)(2), not under 603(a)(1). [121] The
question of the timing of the release of such data came up
during the promulgation of Regulation NMS. [122] The SEC
determined that an exchange could release data to market
participants simultaneously with its release of data to the SIP,
and was not required to do so in such a way as "to synchronize
the delivery of its data to end-users with delivery of data by a
Network processor to end-users."[123] This stance has obviously

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116. While the term "core data" is not defined as such in Reg. NMS, it is
the data required by Reg. NMS to be submitted by a national securities
exchange or a national securities association to a SIP. *See* NetCoalition v.
SEC, 615 F.3d 525, 529 (D.C. Cir. 2010); Regulation NMS, 70 Fed. Reg. at
37,567. It is a crucial concept for the functioning of Reg. NMS. *NetCoalition*
concerns the SEC's approval of fees for non-core data charged to securities
traders by NYSE Arca. *NetCoalition*, 615 F.3d at 525–29. The Reg. NMS
Release allows prices charged for non-core data to be determined by market
forces, unlike the Reg. NMS regime that governs distribution of revenues from
market data. *See* Regulation NMS, 70 Fed. Reg. at 37,569.
   117.   *See NetCoalition*, 615 F.3d at 529.
   118.   17 C.F.R. § 242.603(a)(1) (2015).
   119.   *Id.* § 242.603(a)(2).
   120.   *See* Regulation NMS, 70 Fed. Reg. at 37,566–67.
   121.   *See* 17 C.F.R. § 242.603(a).
   122.   *See* Regulation NMS, 70 Fed. Reg. at 37,566–67.
   123.   *Id.* at 37,567.

acquired far more relevance with the advent of HFT and the marketing of private and enriched data feeds to HFT firms.[124]

Regulation NMS is an extensive set of very detailed regulations meant to knit together the various trading venues in the United States. While it has accomplished its goal of forcing traders to compete in a national market through the mechanism of the NBBO and the prohibition against trade-throughs, it has been less successful in countering the centrifugal forces at work among the growing field of trading venues since its implementation in 2007. While all the blame for the current problems in the equity trading environment cannot be laid at the door of Regulation NMS, it is at the center of the constellation of factors leading to the current situation, which is characterized above all by a race for speed between multiple trading venues.

C. OVERVIEW OF THE CURRENT EQUITY MARKETS

In the nine years since Regulation NMS came into force, the pace of technological change rapidly advanced, transforming the markets.[125] While seven years earlier, at the turn of the century, the markets looked in many respects similar to the markets of the 1960s or 1970s, just nine years later they are radically different. Almost no stock is traded on a trading floor any longer, and an estimated forty to sixty percent of the volume on the exchanges is due to HFT.[126] Algorithmic-assisted trading makes up much of the rest.[127] In addition to the IT revolution, the exchanges have converted from mutually-owned associations into for-profit companies, transforming their policy-making and ability to make quick changes.[128] The business model of the exchanges has likewise changed, with their role as information providers supplementing their role as

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124. *See generally infra* Section II.D.
125. S*ee* Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3594–96 (Jan. 14, 2010); *see generally* Andrei A. Kirilenko & Andrew W. Lo, *Moore's Law Versus Murphy's Law: Algorithmic Trading and Its Discontents*, 27 J. ECON. PERSPS. 51, 51–53 (2013).
126. Kirilenko & Lo, *supra* note 125, at 59; *see also* GARY SHORTER & RENA S. MILLER, CONG. RESEARCH SERV., R43608, HIGH FREQUENCY TRADING: BACKGROUND, CONCERNS, AND REGULATORY DEVELOPMENTS 13–14 (2014) (describing market share held by HFT in recent years).
127. *Cf.* SHORTER & MILLER, *supra* note 126, at 5.
128. *See id.* at 15.

venues for trading.[129] And trading venues have proliferated, particularly among the "unlit" fora of dark pools, with thirteen exchanges and over forty dark pools and other alternative trading systems (ATS).[130] Along with the fragmentation of trading venues has come a rise in technologically-induced flash crashes and other market disruptions. Finally, the growing complexity of the marketplace, combined with questions about the quality of liquidity and availability of many quotes posted, caused observers to ask whether the old exchanges have merely been replaced by electronic markets of questionable reliability and numerous hidden costs.[131]

The demutualization of the exchanges began in 1993 with the Stockholm Stock Exchange.[132] After that point, a wave of demutualizations occurred, including that of the London Stock Exchange in 2000.[133] The most important American demutualization, however, did not take place until 2006 when the NYSE converted from a member-owned corporation to a corporation.[134] In the conversion, "owners of the 1,366 seats on the NYSE received 80,177 shares of NYSE Group stock plus $300,000 in cash and another $70,571 in dividends . . . . [T]he deal valued each seat at approximately $5.5 million."[135] Proponents of demutualization argued that a corporate structure would prove far more effective in dealing with the

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129.   *See id.* (noting for-profit trading centers responding to market demand by offering "direct connections to their trade data transmissions").

130.   *See id.* at 8.

131.   *See, e.g.*, SAL ARNUK & JOSEPH SALUZZI, BROKEN MARKETS: HOW HIGH FREQUENCY TRADING AND PREDATORY PRACTICES ON WALL STREET ARE DESTROYING INVESTOR CONFIDENCE AND YOUR PORTFOLIO 47 (2012); LEWIS, *supra* note 1, at 23–55 ("Brad's Problem"); PATTERSON, *supra* note 11, at 281–96 ("A Rigged Game"); MacKenzie, *supra* note 6, at 6–7; Alice K. Ross et al., *Robot Wars: How High Frequency Trading Changed Global Markets*, BUREAU OF INVESTIGATIVE JOURNALISM (Sept. 16, 2012), http://www.thebureauinvestigates.com/2012/09/16/robot-wars-how-high-frequency-trading-changed-global-markets.

132.   *See* Reena Aggarwal, *Demutualization and Corporate Governance of Stock Exchanges*, 15 J. APPLIED CORP. FIN. 105 (2002).

133.   *See id.* at 106 tbl.1.

134.   The NYSE was a member-owned, non-profit corporation from 1971 until 2006. *See* Roberta S. Karmel, *The Once and Future New York Stock Exchange: The Regulation of Global Exchanges*, 1 BROOK. J. CORP. FIN. & COM. L. 355, 385 (2007).

135.   Associated Press, *NYSE Stock Surges in First Day of Trading*, NBC NEWS (Mar. 8, 2006), http://www.nbcnews.com/id/11725095/38189133#.VkyT-N-rR0s. *See generally* Aaron Lucchetti, *A Big Exchange: NYSE Members Approve Deal; Vote Overwhelmingly Endorses Archipelago Plan, Public Listing; Closing In on 'End of an Era,'* WALL ST. J., Dec. 7, 2005, at C1.

challenges of running a complex financial services business than a cumbersome member-owned cooperative.[136] In particular, a chief executive officer with a board of directors presented a far more efficient decision-making body than a member-owned cooperative, where groups of members had effective veto power over proposed changes.[137]

In the years before and after demutualization, there was significant academic controversy surrounding the changes in the legal structure of the exchanges. While some, such as Professor Paul Mahoney, argued that as self-regulatory organizations the exchanges could effectively serve the investing public's interests,[138] others, such as Professors Macey and O'Hara, pointed out that under a Coasian analysis for-profit corporate exchanges were an uneasy fit with the prevailing regulatory structure governing the exchanges.[139] Macey and O'Hara's argument that exchanges as corporations in the current regulatory context would likely fail to self-regulate, as regulation was a public good subject to significant

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136. *See* Onnig H. Dombalagian, *Demythologizing the Stock Exchange: Reconciling Self-Regulation and the National Market System*, 39 U. RICH. L. REV. 1069, 1132 (2005); Fleckner, *supra* note 15, at 2576–77; Benn Steil, *Changes in the Ownership and Governance of Securities Exchanges: Causes and Consequences*, 2002 BROOKINGS-WHARTON PAPERS ON FIN. SERVS. 61, 68– 71; *cf.* Ruben Lee, *Corporatisation of Exchanges and Central Counterparties: The Dark Side Will Come*, *in* COMPAQ HANDBOOK OF WORLD STOCK, DERIVATIVE & COMMODITY EXCHANGES xxxix, xl (2002) (arguing that "[e]xchange managements are . . . likely to take excessive risks").

137. *See generally* Steil, *supra* note 136, at 69, 81 (presenting various options for the organizational structure of exchanges).

138. Paul G. Mahoney, *The Exchange As Regulator*, 83 VA. L. REV. 1453, 1453–56 (1997); *see also* Jake Keaveny, *In Defense of Market Self-Regulation*, 70 BROOK. L. REV. 1419, 1420 (2005); Karmel, *supra* note 45, at 409 ("Current Governance Structures and the Future of Self-Regulation."). Intellectual support for Mahoney's self-regulation argument is found in Stephen J. Choi & Andrew T. Guzman, *National Laws, International Money: Regulation in a Global Capital Market*, 65 FORDHAM L. REV. 1855 (1997) and Daniel R. Fischel, *Organized Exchanges and the Regulation of Dual Class Common Stock*, 54 U. CHI. L. REV. 119 (1987).

139. Macey & O'Hara, *supra* note 15, at 563–66. Macey & O'Hara's argument relies on Coase's distinction between transaction costs and agency costs to argue that the reduction in transaction costs of trading securities increases the level of competition between trading venues, which in turn reduces the efficacy of self-regulation on the part of the exchanges. *See id.* at 565; *see also* Coffee, *supra* note 86 ("With the privatization of securities markets, markets are no longer self regulators in any meaningful sense, but instead are aggressive profit maximizers."). For an economic analysis of problems with self-regulation at the commodity exchanges, see Pirrong, *The Self-Regulation of Commodity Exchanges*, *supra* note 42.

free rider problems, was prescient. [140] Nevertheless, demutualization proceeded and was complete among the world's major stock trading venues by 2006.[141]

In addition to the introduction of Regulation NMS and demutualization, technological developments also had a transformational effect on the exchanges. Scott Patterson's *Dark Pools: The Rise of the Machine Traders and the Rigging of the U.S. Stock Market* tells the story of the rise of HFT.[142] Computerized trading was pioneered in the 1990s by Josh Levine at Datek Securities,[143] who wrote computer programs that would trade on NASDAQ quotes posted on the small-order entry system (SOES) by NASDAQ market makers.[144] These quotes were posted on the electronic bulletin board operated by NASDAQ and left overnight, or simply became stale in light of information emerging from other venues.[145] Levine's programs traded on the discrepancy between SOES quotes and other prices, enabling the "SOES bandits" at Datek Securities to profit handsomely.[146] Datek's operations gave rise to the Island trading network, an electronic communication network (ECN) that competed with Instinet for market share in NASDAQ stocks.[147] Island also revolutionized how both traders and exchanges profited from their activities. In order to attract

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140.   *See* Macey & O'Hara, *supra* note 15, at 576.
141.   *See* Aggarwal, *supra* note 132, at 106.
142.   PATTERSON, *supra* note 11.
143.   *See generally id*. at 67–230.
144.   While the NASDAQ was formed to provide for electronic, screen-based dissemination of quotes, trades were still conducted over the phone. *See* Meeta Kothare & Paul A. Laux, *Trading Costs and the Trading Systems for Nasdaq Stocks*, 51 FIN. ANALYSTS J. 42, 43 (1995). NASDAQ introduced the SOES in 1984 in order to allow for automatic execution of small orders of up to 500 shares of certain NASDAQ-listed stocks. *Id*. In response to criticism that NASDAQ dealers failed to execute trades at posted prices during the stock market crash of October 19, 1987, NASDAQ expanded the share limit for small orders to 1,000 shares. *Id*. at 44. The SOES was subject to vociferous criticism by dealers because it exposed them to more nimble traders who could pick off its "stale quotes." *See id*. These nimble traders became known as the "SOES bandits." *See* Chuck Epstein, *SOES Storefronts*, WALL ST. & TECH., Sept. 1997, at 48, 48–49.
145.   *See generally* Kothare & Laux, *supra* note 144, at 45–46.
146.   *See* PATTERSON, *supra* note 11, at 89–99; Jeffrey H. Harris & Paul H. Schultz, *The Trading Profits of SOES Bandits*, 50 J. FIN. ECON. 39, 39–40 (1997).
147.   PATTERSON, *supra* note 11, at 116–24; Rebecca Buckman, *Island ECN Raises Capital to Become a Stock Exchange*, WALL ST. J., May 11, 1999, at C1; *see also* MacKenzie, *supra* note 6, at 35–37 (discussing Island and its relationship with the SOES bandits).

order flow, Island was the first to institute what became known as the "maker/taker" payment system.[148] Instead of earning commissions through spreads, which had collapsed in the wake of decimalization,[149] Island paid traders who supplied a quote that was acted upon (i.e., the "makers") and charged those who took such a position (i.e., the "takers").[150] Island itself earned money from this arrangement by keeping one-third of the fees collected from the takers, while paying out two-thirds of the fees as rebates to the makers.[151]

The current fragmented and unsettled state of the markets is signaled by a handful of recent events connected with the rise of computerized trading. In addition to Michael Lewis's *Flash Boys*, the "flash crash" of May 6, 2010 and the failed IPOs of BATS Global Markets and Virtu Financial Inc. brought the current problems of the markets to widespread public attention.[152] The flash crash involved the loss of over $1 trillion in market capitalization in less than an hour and then its subsequent recovery by the ending of the trading day. [153]

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148. *See* PATTERSON, *supra* note 11, at 157–60; Maureen O'Hara, *High Frequency Market Microstructure*, 116 J. FIN. ECON. 257, 262 (2015) (arguing that the maker/taker fee structure is particularly attractive to HFT). Because anyone "hitting" a quote has to pay a fee, and anyone posting a quote that is hit receives a rebate, the maker/taker system creates a mismatch between the quoted bid and ask spread and the actual, economic bid/ask spread. *See* Lawrence Harris & Ethan Namvar, *The Economics of Flash Orders and Trading* 3 (Jan. 15, 2011) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1953524.

149. "Decimalization" is the conversion of prices on an exchange from 1/8ths (typically) to dollars and cents. The exchanges voluntarily introduced decimalization in April 2001 after Congress threatened to pass legislation requiring prices in dollars and cents. *See* HARRIS, *supra* note 27, at 115. While decimalization greatly reduced spreads on stocks, and therefore reduced the transaction costs for investors, it also reduced the ability of retail stockbrokers to earn profits, and is widely suspected of contributing to the reduction in IPOs and the lack of liquidity for small and mid-cap stocks. Staff, U.S. Sec. & Exch. Comm'n, *Report to Congress on Decimalization* (July 2012). For an overview of the regulatory history of the move to pricing in decimals as well as current concerns, see *id*.

150. *See* PATTERSON, *supra* note 11, at 157–60.

151. *See id.*

152. *See generally* Kirilenko & Lo, *supra* note 125, at 60–67 (detailing five incidents related to "new vulnerabilities created or facilitated by algorithmic trading").

153. *See* COMMODITY FUTURES TRADING COMM'N & SEC. & EXCH. COMM'N, FINDINGS REGARDING THE MARKET EVENTS OF 6 MAY 2010 (Sept. 30, 2010) [hereinafter CFTC & SEC]; Edgar Ortega Barrales, *Lessons from the Flash Crash for the Regulation of High-Frequency Traders*, 17 FORDHAM J. CORP. & FIN. L. 1195, 1195 (2012); Ananth Madhavan, *Exchange-Traded Funds,*

During this episode, believed to have been triggered by the sale of 75,000 E-mini S&P 500 June 2010 stock index futures (worth $4.1 billion), the algorithmic trading programs of a number of firms went haywire and started a cascade of sell orders for firms including Accenture and 3M, as well as certain stock index exchange-traded funds. [154] While ultimately non-consequential to the majority of market participants, some retail and institutional investors did suffer serious losses.[155] More generally, this episode alarmed observers as it presented the specter of markets careening out of control due to computer malfunctions.[156] These and other incidents, such as the "mini-flash crashes" of September 27, 2010,[157] October 15, 2014,[158] and many others, gave rise to calls for improved circuit breakers to algorithmic trading in the event of a malfunction.[159] Other incidents that highlighted the dangers of automated trading include the delayed IPO of Facebook and the failed IPO of BATS Global Exchange; [160] the latter, ironically, a major player in the HFT world.[161] The Facebook IPO stumbled due to delays in the processing of trades,[162] and

Market Structure and the Flash Crash, FIN. ANALYSTS J., July–Aug. 2012, at 20, 20; Andrei A. Kirilenko, Albert S. Kyle, Mehrdad Samadi & Tugkan Tuzun, *The Flash Crash: The Impact of High Frequency Trading on an Electronic Market* 1 (Nov. 7, 2015) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1686004.

154.   *See* CFTC & SEC, *supra* note 153, at 83–86 (describing the impact of the Flash Crash on Accenture and 3M stock); Kirilenko et al., *supra* note 153, at 5.

155.   *See* Kirilenko et al., *supra* note 153, at 1 ("Broad stock market indices – the S&P 500, the Nasdaq 100, and the Russell 2000, collapsed and rebounded with extraordinary velocity."); Madhavan, *supra* note 153, at 20 ("Despite its short duration, the flash crash affected many market participants.").

156.   *See* Kirilenko et al., *id.*

157.   *See* Graham Bowley, *The Flash Crash, in Miniature*, N.Y. TIMES, Nov. 9, 2010, at B1.

158.   Matt Egan, *Market 'Freak Out': Stocks Rebound from Scary Plunge*, CNN MONEY (Oct. 15, 2014), http://money.cnn.com/2014/10/15 /investing/stocks-markets-wall-street-correction/.

159.   *See* Jacob Bunge & Brendan Conway, *Regulators Hone Circuit-Breaker Proposals*, WALL ST. J., Sept. 28, 2011, http://www.wsj.com/articles/SB10001424052970204831304576597023437684818; Demos Telis & Michael Mackenzie, *US Exchanges Eye Harmonized Pause Rules*, FIN. TIMES, May 6, 2011, at 2. For the discussion of the circuit breaker programs implemented after the May 6, 2010 crash, see CFTC & SEC, *supra* note 153, at 7.

160.   *See* Kirilenko & Lo, *supra* note 125, at 63–65.

161.   *Id.* at 64.

162.   *Id.* at 63–64.

the BATS IPO failed on account of reactions of traders to initial declines in prices that spurred further downward momentum.[163] And on August 1, 2012, the trading firm Knight Capital nearly went bankrupt due to new software that malfunctioned upon its introduction, leading to losses totaling $457 million and Knight's absorption into GETCO, a leading Chicago-based HFT firm.[164] These incidents highlighted the potentially dangerous state of the current equity markets, where human judgment has been pushed aside by lightning-fast algorithmic trading programs engaged in a "battle of the bots" against their competitors.

II. PROBLEMATIC VARIETIES OF HIGH FREQUENCY TRADING

HFT is best defined as computer-assisted trading that exploits incredibly small time differences to yield profits at minimal risk to those employing it.[165] While this definition captures most activities referred to as high frequency trading, it should be remembered that HFT is not one thing and it

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163. *Id.* at 64–65.

164. *Id.* at 65.

165. A number of commentators have noted the difficulty in coming to a precise definition of "high-frequency trading." *See, e.g.*, O'Hara, *supra* note 148, at 258 ("High frequency trading is a misnomer, a seemingly precise term used to describe a large and diverse set of activities and behaviors."); Gomber et al., *supra* note 49 (Section 3, "High Frequency Trading Definitions and Related Concepts," and Appendix III, "Academic and Regulatory Definitions of High-Frequency Trading"). The SEC offers a characteristic-based description of HFT stating that "high frequency trading . . . is relatively new and is not yet clearly defined." Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3606 (Jan. 14, 2010) (codified at 17 C.F.R pt. 242). The SEC then goes on to specify five characteristics of firms engaged in HFT:

> (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 over-night).

Id.; *see also* David Easley, Marcos M. López de Prado & Maureen O'Hara, *The Volume Clock: Insights into the High-Frequency Paradigm*, 39 J. PORTFOLIO MGMT. 19 (2012) ("Today's high frequency markets are not the old low frequency markets on steroids.").

exists on a continuum with its parent, algorithmic trading.[166] HFT refers to a wide variety of trading strategies, most of which exploit minute timing differences or use information technology to incorporate vast quantities of data into their determinations far more quickly than any human could.[167] While a number of the most-publicized types of HFT present serious fairness problems, HFT is no more intrinsically morally problematic than taking a taxi instead of walking. As will be shown in Part III, moral concerns arise if other market participants are kept in the dark as to the activities of high frequency traders, if exchanges cater to high frequency traders at the expense of other investors, or if HFT creates an intrinsically uneven playing field when other participants have a legitimate expectation of parity of position. Part II presents an overview of HFT that moves from its origins in algorithmic trading to its progressively more problematic aspects.

A. THE ORIGINS OF HFT: ALGORITHMIC TRADING

HFT developed out of algorithmic trading techniques used to implement sophisticated investment strategies.[168] The earliest algorithmic strategies were first-generation index funds, which bought and sold stocks to optimize an investor's portfolio in accordance with Markowitz's portfolio optimization theory.[169] Kirilenko and Lo state that widespread use of algorithmic trading began in 1975 when finance professor Barr Rosenberg founded Barr Rosenberg Associates, an investment advisory firm that calculated covariance matrices for U.S. equities and provided clients with software enabling them to trade on this information to achieve optimal portfolios.[170] Using algorithms in trading eliminated the need for human judgment, which at any rate would be impossible in quantitative strategies with thousands of variables or inputs.[171] Another early instance was the equal-weighted index fund, which required continual updating of its portfolio to maintain equal

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166. *See generally* Kirilenko & Lo, *supra* note 125, at 52 (describing the historical relationship between algorithmic trading and HFT).
167. *See id.* at 58–59.
168. *See id.* at 51–60 for an overview of this development.
169. *See generally id.* at 55–56.
170. *Id.* at 55.
171. *See id.* at 67; Stoll, *supra* note 21, at 153.

dollar amounts of equities. [172] In these early forms of algorithmic trading, human judgments concerning individual stock transactions were set aside in favor of quantitative strategies taking hundreds and even thousands of variables into account. [173] Algorithmic trading therefore represents a technique to overcome the computational limitations of the human mind and our limited human rationality.[174]

As both technology and financial economics progressed, more sophisticated strategies employing algorithms came into use. Arbitrage strategies based on the Black-Scholes/Merton capital asset pricing model (CAPM) and Merton's concept of "dynamic spanning" enabled hedge funds and other traders to exploit differences in payouts of various types of securities and derivative financial instruments.[175] While such strategies were not riskless, as the case of Long Term Capital Management showed, they often provided lucrative opportunities to sophisticated traders. [176] Other algorithmic trading strategies included software used to engage in market-making activities and automated order execution programs designed to carry out large transactions in the most advantageous manner.[177]

These types of algorithmic trading do not seem intrinsically morally problematic. Computerized trading programs are used as a sort of "mental prosthetic" that overcomes the failings of human rationality.[178] Our cognitive abilities are relatively limited. A human trader can only incorporate a small amount of data into her decision-making, and so investment strategies requiring the calculation of

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172.   *See* Kirilenko & Lo, *supra* note 125, at 55–56; *see also* Stoll, *supra* note 21, at 167–68 (discussing the importance of "index arbitrage" in the 1980s).

173.   *See, e.g.*, Kirilenko & Lo, *supra* note 125, at 54–55.

174.   *See, e.g.*, Kirilenko & Lo, *supra* note 125, at 53–60; Bruno Biais & Paul Woolley, *High Frequency Trading* § II.3 (Mar. 11, 2011) (unpublished manuscript), idei.fr/sites/default/files/medias/doc/conf/pwri/biais_pwri_0311.pdf   (HFT algorithms as mitigating traders' "cognition limits").

175.   *See* Kirilenko & Lo, *id.* at 55.

176.   *See* Stephanie Yang, *The Epic Story of How a 'Genius' Hedge Fund Almost Caused a Global Financial Meltdown*, BUS. INSIDER (July 10, 2014), http://www.businessinsider.com/the-fall-of-long-term-capital-management-2014-7.

177.   *See* Kirilenko & Lo, *supra* note 125, at 58–59.

178.   *See* Felix Salmon & Jon Stokes, *Algorithms Take Control of Wall Street*, WIRED (Dec. 27, 2010), http://www.wired.com/2010/12 /ff_ai_flashtrading/ (describing areas where algorithmic trading excels over human operators); *see also* Kirilenko & Lo, *supra* note 125, at 53–55.

matrices with hundreds of thousands of variables necessarily require computer technology. Likewise, human traders find it very difficult to monitor prices on more than a very small number of financial markets simultaneously, so common arbitrage strategies require computer assistance to implement. In none of these basic types of algorithmic trading do we feel that the use of algorithms or computers is intrinsically wrong any more than we feel that flying goods from one market to another does a moral wrong to those traders who continue to move them by ship. Arbitrage is fundamentally a trading activity, whereby parties profit by supplying a good to a market where it is sold at a higher price than where it is originally purchased.[179] And while HFT grows out of these strategies, its morally problematic aspects do not stem from the mere use of computer technology, or even of the speed at which this technology operates.

B. CO-LOCATION

"Co-location" is the first and most tangible manifestation of HFT. It refers to the exchanges' practice of renting space in the facilities that house their computer servers to traders who believe they can benefit from this proximity.[180] Co-location facilitates the practice of "latency arbitrage," trading between markets based on pure speed.[181] To succeed at latency arbitrage, a trader has to be first in line in the price-time order queues used by the exchanges. It is a zero-sum game where the order that is first in line with a bid or offer at an advantageous price wins the competition.[182]

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179. *See generally* ROBERT J. SHILLER, FINANCE AND THE GOOD SOCIETY 57–63 (2012) ("Traders and Market Makers").

180. *See* Jerry Adler, *Raging Bulls: How Wall Street Got Addicted to Light-Speed Trading*, WIRED (Aug. 8, 2012), http://www.wired.com/2012/08/ff_wallstreet_trading/; Geoffrey Rogow, *Colocation: The Root of All High-Frequency Trading Evil?*, WALL ST. J.: MKT. BEAT BLOG (Sept. 20, 2012), http://blogs.wsj.com/marketbeat/2012/09/20/collocation-the-root-of-all-high-frequency-trading-evil/; *see also* Michael A. Goldstein, Pavitra Kumar & Frank C. Graves, *Computerized and High-Frequency Trading*, 49 FIN. REV. 177, 188 (2014).

181. *See* David Gaffen, *Measuring Arbitrage in Milliseconds*, WALL. ST. J.: MKT. BEAT BLOG (Mar. 9, 2009), http://blogs.wsj.com/marketbeat/2009/03/09/measuring-arbitrage-in-milliseconds/.

182. *See, e.g.*, *id.* (quoting a hedge fund technology officer stating that, with HFT, "[t]he fastest one wins").

To illustrate the advantages afforded by co-location, a high frequency trader located next to a server would have its orders transmitted to the exchange's server nearly instantaneously,[183] while an order transmitted by a trader through the fiber-optic telecommunication networks from downtown Manhattan to the NYSE's facilities in Mahwah, New Jersey would arrive in four to seven milliseconds.[184] Michael Lewis's *Flash Boys* tells the story of the construction of a fiber optic line from Chicago to Mahwah intended to shave three to four milliseconds off the delivery time it would take for a message to be sent through a telephone company's lines. [185] Each millisecond is worth an estimated $100 million to a large brokerage firm,[186] and the firm constructing the line intended to profit by charging up to 200 firms an estimated $14 million each for a five-year lease to use the new line.[187]

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183. Round-trip transmission times for co-located computers are well under a millisecond. *See Co-location Services,* EUREX EXCH., www.eurexchange.com/exchange-en/technology/co-location-services/ (last visited Oct. 9, 2015). The Eurex Group states that co-location round-trip transmission times are from 0.2-0.35 milliseconds. *Id.* Interestingly—because of what it implies about fairness and the perception of fairness among HFT clients of the exchanges—all messages from co-located computers within an exchange's server facility travel the exact same length of fiber-optic cable to reach the exchange's server; for computers on racks closer to the exchange server, the cable is coiled up to equal the length of the most distant computers. *See* David Schneider, *The Microsecond Market*, IEEE SPECTRUM (Apr. 30, 2012), http://spectrum.ieee.org/computing/networks/the-microsecond-market.

184. This 4–7 millisecond amount is determined by an experiment performed by *Flash Boys* protagonist Brad Katsuyama. *See* LEWIS, *supra* note 1, at 69–71. In order to test their execution program "Thor," Katsuyama and Ronan Ryan test when messages sent from their offices at One Liberty Plaza in downtown Manhattan arrive at the various exchange servers in New Jersey. *Id.* On the other hand, the fastest a message can travel from one exchange server to another in their test is 465 microseconds, or 0.465 milliseconds. *Id.* at 71.

185. *See id.* at 69–71. For additional information on the project in *Flash Boys*, see Gregory Laughlin, Anthony Aguirre & Joseph Grundfest, *Information Transmission Between Financial Markets in Chicago and New York* 1–9 (Rock Ctr. for Corp. Governance, Working Paper No. 137, 2012). Laughlin et al. determine that the Spread Networks fiber optic line detailed in *Flash Boys* reduced the Chicago–New Jersey latency to approximately 6.65 milliseconds. *Id.* at 2. In 2011 such times were reduced further to 4.2–5.2 milliseconds through the use of microwave communications networks. *Id.*

186. *See* Ciamac C. Moallemi & Mehmet Saglam, *The Cost of Latency in High-Frequency Trading* 2 (Feb. 5, 2013) (unpublished manuscript), https://moallemi.com/ciamac/papers/latency-2009.pdf.

187. *See* LEWIS, *supra* note 1, at 15.

The major exchanges all rent space on their server racks to outside parties. It is difficult to determine the exact amounts charged for co-location, although industry observers believe they have increased in recent years.[188] Nevertheless, it does appear to constitute a substantial portion of the yearly revenues of the exchanges.[189] While such amounts may be affordable to a HFT firm paying them, they would be prohibitive for a retail investor,[190] even if such individual had the technical wherewithal to take advantage of a co-located position. Though institutional investors could presumably

188. *See* SHORTER & MILLER, *supra* note 126, at 14 ("[S]ecurities exchanges began charging HFT firms substantially more for the right to be connected to the exchange's data servers."); Goldstein et al., *supra* note 180, at 183 (attributing the decline in profits among HFT firms in part to the "costs of rights and hardware for keeping computers close to the major exchanges").

189. For example, the most recent 10K available of Intercontinental Exchange, Inc., the present operator of the NYSE as well as other securities, futures, and options exchanges, reports that data services revenues (which includes co-location fees) were $631 million in 2014, or 14.9% of total revenues of $4.221 billion. *See* Intercontinental Exch., Inc., 2014 Annual Report (Form 10-K) 41 (Feb. 5, 2015), http://ir.theice.com/financial-reports/annual-reports.aspx. This increased from 13.3% of revenues in 2013, 10.7% in 2012, and 9.4% in 2011. *Id.* ("Consolidated Statement of Income Data"). Likewise, the NASDAQ OMX Group, Inc. reports that Access and Brokers Services Revenues (which includes co-location fees) were $257 million out of $2.067 billion total revenues (less transaction-based expenses) in 2014, or 12.4%; $255 million out of $1.895 billion in 2013, or 13%; and $257 million out of $1.674 billion in 2012, or 15%. *See* NASDAQ OMX Group, Inc., 2014 Annual Report (Form 10-K) 39–40 (Feb. 17, 2015), http://files.shareholder.com/downloads/NDAQ/957273764x0xS1120193-15-3/1120193/filing.pdf. While it is difficult to base conclusions on these amounts, because specific co-location amounts are not broken out of their larger revenue categories, co-location is believed to be a significant revenue stream for the exchanges. *See* David Easley, Maureen O'Hara & Liyan Yang, *Differential Access to Price Information in Financial Markets* 1–2 (Feb. 2013) (unpublished manuscript), http://papers.ssrn.com/com/sol3/papers.cfm?abstract_id=1787029.

190. A 2009 article quotes an NYSE executive as stating that co-locating at exchanges costs as much as $500,000 per month. Kristi Oloffson & Stephen Gandel, *High-Frequency Trading Grows, Shrouded in Secret*, TIME (Aug. 5, 2009), http://content.time.com/time/business/article/0,8599,1914724,00.html. Donald MacKenzie reports that he was told that "a 'rack', a cabinet sized space that can accommodate thirty or forty computers, costs between $1500 and $15,000 a month," whereas an entire "'cage' . . . can easily cost more than $1 million a year." Donald MacKenzie, *Be Grateful for Drizzle*, 36 LONDON REV. BOOKS 27 (2014). And Ding et al. report that "a co-located server using only SIP data is approximately $7,000 per month," while one with a direct data feed from the exchange costs three times as much. Shenwei Ding, John Hanna & Terrence Hendershott, *How Slow is the NBBO? A Comparison with Direct Exchange Feeds*, 49 FIN. REV. 313, 315 n.3 (2014).

afford them, they only make sense as part of a larger investment in HFT, which involves considerable outlays for technology and scarce personnel.[191] While each millisecond saved in transmitting messages may be worth millions of dollars per year per HFT firm, it effectively requires a multi-million dollar investment in order to be able to capture these gains.

Co-location has given rise to numerous criticisms and complaints that it is unfair.[192] It is easy to see the basis for this complaint: if trading in computerized markets is essentially a race to get to the exchange fastest, co-located traders are given a head start that can never be caught up to. In this sense, co-location goes directly against the (moral) intuition that at some basic level, participants in the market should be on a level playing field.[193] Here that field is uneven, where the vast majority of participants have no chance of ever catching up. The exchanges have a very basic response to such criticisms: they do not discriminate among traders, and space in their facilities is open to anyone willing to pay the specified cost.[194] While such arguments are *prima facie* true, they neglect the fact that only a very small subset of stakeholders has the requisite ability to profit from co-location. Economically, co-location is better seen as a sort of collusion on the part of the exchanges with a small group of customers to profit at everyone else's expense.[195]

There is also the question of the government's role in allowing co-location. The SEC has permitted the practice, reasoning that as long as anyone wishing to pay for it can have

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191. *See* SHORTER & MILLER, *supra* note 126, at 22 (while theoretically open to all, co-location is only likely to make financial sense for "organized, institutional, strongly capitalized" HFT firms).

192. *See, e.g.*, SHORTER & MILLER, *supra* note 126, at 22–23; Goldstein et al., *supra* note 180, at 194–95; Gomber et al., *supra* note 49, at 34–35.

193. *See infra* Section III.D.

194. *See, e.g.*, Ameet Sachdev, *CME's Terry Duffy Talks Shop*, CHI. TRIB. (Sept. 5, 2014), http://www.chicagotribune.com/business/ct-cme-duffy-0908-biz-20140905-story.html ("We offer co-location to everybody . . . [and e]verybody can have it at the same speed if they want it."); *see also* James J. Angel & Douglas McCabe, *Fairness in Financial Markets: The Case of High Frequency Trading*, 112 J. BUS. ETHICS 585, 590–91 (2013) ("Does 'co-location' give traders an unfair head start? To certain extent, traders have always invested heavily to get closer to the scene of trading.").

195. This is one of the central points of Arnuk and Saluzzi's criticisms of HFT. *See* ARNUK & SALUZZI, *supra* note 131, at 99–101; *see also infra* notes 441–42 and accompanying text.

access, it is acceptable.[196] Mary Jo White raised the issue of fairness of co-location in her recent speech to market participants, but from her comments it appears unlikely the SEC would attempt to put the genie back in the bottle.[197] And while regulators may have been lax in allowing the exchanges to rent space in their computer facilities, there are relatively straightforward proposals to mitigate the problems that result.[198]

C. FLASH ORDERS

Flash orders are another manifestation of HFT that have received extensive attention in the media, Congress, and even at the SEC.[199] Investors in particular are upset that they allow HFT firms a "sneak peek" at the market, in effect allowing them to "front-run" their slower orders on their way to the consolidated tape, now known as the SIP. [200] The SEC

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196. *See, e.g.*, Order Approving a Proposed Rule Change to Codify Prices for Co-Location Services, 75 Fed. Reg. 38,860, 38,861 (July 6, 2010) ("The Exchange has also represented that co-location services are generally available to all qualified market participants who desire them."); Notice of Filing and Immediate Effectiveness of Proposed Rule Change Expanding Co-location, 78 Fed. Reg. 69,907, 69,908 (Nov. 21, 2013) ("As is the case with all Exchange co-location arrangements . . . (ii) use of the co-location services proposed herein would be completely voluntary and available to all Users on a non-discriminatory basis . . . .").

197. *See* White, *supra* note 3 ("The SEC should not roll back the technology clock or prohibit algorithmic trading, but we are assessing the extent to which specific elements of the computer-driven trading environment may be working against investors rather than for them.").

198. *E.g.*, *id.* Regarding these proposals, SEC Chair White said she has "instructed the staff to prepare recommendations for the Commission to improve firms' risk management of trading algorithms and to enhance regulatory oversight over their use." *Id.*; *see also* ARNUK & SALUZZI, *supra* note 131, at 220–30 (offering proposals to improve the current state of the equity markets); *infra* note 357 and accompanying text (discussing proposal to institute batch auctions).

199. *See, e.g.*, Charles Duhigg, *S.E.C. Starts Crackdown on 'Flash' Trading*, N.Y. TIMES, Aug. 5, 2009, at B1; Nina Mehta, *Equities Industry Clashes over Flash and Step-up Orders*, TRADERS MAG., July 1, 2009. The U.S. Senate held hearings on HFT issues including flash orders on Oct. 28, 2009. *Dark Pools, Flash Orders, High-Frequency Trading, and Other Market Structure Issues: Hearing Before the Subcomm. on Sec., Ins., & Inv. of the S. Comm. on Banking, Hous., & Urban Affairs*, 111th Cong. (2009).

200. *See, e.g.*, Alan Chan, *Do High Frequency Traders Front-Run the Market by Using Their Speed Advantage?*, FORBES (Apr. 3, 2014), http://www.forbes.com/sites/quora/2014/04/03/do-high-frequency-traders-front-run-the-market-by-using-their-speed-advantage/; *see also* ARNUK & SALUZZI,

acknowledged this controversy with its 2009 Release [201] proposing the elimination of the exception to Regulation NMS Rule 602 that permits flash orders, but no action has been taken since.[202]

A flash order is an order that an exchange cannot immediately fill which is then submitted to certain market participants before it is transferred to the SIP pursuant to NMS Rule 602.[203] Rule 602(a)(1)(i)(A) provides an exception to the general requirement that an exchange submit its best bids and offers to the SIP in the case of bids and offers that are "executed immediately after communication" or "cancelled or withdrawn if not executed immediately after communication." [204] The precursor to Rule 602 was implemented in 1978[205] when the markets operated almost entirely without the use of computerized information technology.[206] This exception allowed an exchange to "flash" its order to floor brokers to see if it could be filled before it was sent to the consolidated tape.[207] Both the party submitting the order and the party filling it would benefit in the event the

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supra note 131, at 84 (describing flash orders as allowing a "sneak peek" into the market).

201.   Elimination of Flash Order Exception from Rule 602 of Regulation NMS, 74 Fed. Reg. 48,632 (Sept. 23, 2009) (to be codified 17 C.F.R. pt. 242). Flash orders were originally allowed under SEC Release No. 34-54422. Order Approving a Proposed Rule Change and Notice of Filing, 71 Fed. Reg. 54,537 (Sept. 15, 2006).

202.   This is probably because BATS, NASDAQ, and NASDAQ OMX BX decided to discontinue offering flash orders as of September 1, 2009 as they encountered controversy and the possibility of government regulation. *See* Elimination of Flash Order Exception from Rule 602 of Regulation NMS, 74 Fed. Reg. at 48,635. Direct Edge offered them until February 2011. *See* Jacob Bunge, *Direct Edge to Stop 'Flashing' Orders on Monday*, WALL ST. J. (Feb. 25, 2011),   http://www.wsj.com/articles /SB10001424052748703409304576166930877474292. An estimated 3.1% of total equity trading volume was executed by means of a flash order in July 2009. *See* Elimination of Flash Order Exception from Rule 602 of Regulation NMS, 74 Fed. Reg. at 48,635.

203.   17   C.F.R.   §   242.602   (2015)   (presenting   requirements   for "[d]issemination of quotations in NMS securities").

204.   *Id.* § (a)(1)(i)(A).

205.   For information on the precursor to the modern Rule 602, see Dissemination of Quotations for Reported Securities, 43 Fed. Reg. 4342 (Feb. 1, 1978) (formerly codified at 17 C.F.R. pt. 240).

206.   *See* Fox et al., *supra* note 12, at 198.

207.   *See* Elimination of Flash Order Exception from Rule 602 of Regulation NMS, 74 Fed. Reg. at 48,634–36.

order was filled, and the exchange benefitted by retaining the transaction.[208]

In the modern computerized context, the same economic principles can hold true, though the economics of flash orders are greatly affected by the maker/taker payment system.[209] When flash orders are used in the current environment, they are "flashed" to HFT traders for 30 to 150 milliseconds before they are sent on, if not filled, to the SIP.[210] Parties submitting an order can benefit by its immediate execution, often at a better price than would otherwise be available, and responders benefit by making a trade at a price they believe is advantageous.[211] Furthermore, in a maker/taker system, parties want their orders flashed to potential respondents, as they will garner a rebate for posting a quote another party hits.[212] That said, flash orders may be used in ways widely considered unfair.[213] A party that sees a flash order is in essence given an early picture of what the NBBO for a stock is likely to be, so they can then go into the market and trade on the basis of that information ahead of the order being incorporated into the NBBO disseminated by the SIP.[214] This "sneak peek" serves as grounds for the often heard complaint that flash trading enables "front-running."[215] While this is

208. *See generally id.* at 48,637–38 (detailing the benefits of flash orders to various market participants).

209. *See* Harris & Namvar, *supra* note 148, at 11–13. Harris and Namvar explain that flash orders are indirectly driven by the maker/taker payment system. *Id.* This is because "liquidity rebates allow Makers to quote better prices at make-or-take exchanges than they would quote at transaction fee exchanges, which forces transaction fee exchanges to route orders for the benefit of customers, who then receive better prices without paying the access fee." *Id.* at 12. Flash orders are an "ad hoc solution" to the pricing problems of exchanges that charge transaction fees, because they allow them to sidestep this pricing problem. *Id.*

210. *Id.* at 4. The longest allowable interval an exchange can flash an order is 500 milliseconds, or half a second. *See* Keith Spence, *Flash Trading*, 29 B.U. REV. BANKING & FIN. L. 98, 100 (2009).

211. *See* Harris & Namvar, *supra* note 148, at 5–6.

212. *See id.* at 3; *see also supra* note 148 and accompanying text.

213. *See* Harris & Namvar, *supra* note 148, at 9.

214. Elaine Wah & Michael P. Wellman, *Latency Arbitrage, Market Fragmentation, and Efficiency: A Two-Market Model*, 14 ASS'N FOR COMPUTING MACH. CONF. ON ELEC. COM. 855 (2013), http://web.eecs.umich.edu/srg/wp-content/uploads/2013/02/ec38-wah.pdf.

215. One of Lewis's central themes is that a great deal of HFT activity amounts to "electronic front-running." LEWIS, *supra* note 1, at 89–127, 172; *accord* Korsmo, *supra* note 12, at 558 (characterizing front-running by HFT as "parasitic" order anticipation); Wah & Wellman, *supra* note 214. Because of

(usually) not technically true, as HFT traders are not generally the brokers for clients submitting the order, and so do not have a duty to refrain against trading on this information,[216] it otherwise amounts to the same thing.

Another aspect of the criticism over flash orders is the more general charge that they are a factor in the creation of a "two-tiered" system, where certain inside players have access to fundamentally better information than everyone else.[217] There is much to this charge, and it illustrates the basic phenomena of "unfairness" that many associate with HFT.[218] In a two-tiered system, certain players will be given information—in case of flash orders, prior to its general release to the public—that everyone else lacks. Since information is the basis of all investment, this timing advantage will allow for HFT to earn riskless profits at the expense of the general investing public.[219]

time delays in messages travelling from exchanges to the SIP, and then to other traders, HFT firms have the technical ability to use information gained in one market to trade in other markets before non-HFT traders can; flash orders are only one mechanism by which this can occur. *See Wah & Wellman, supra* note 214. The question for investors, regulators, and legal scholars is whether this is illegal. Insofar as most small HFT firms are not trading on behalf of clients or customers, it would not be illegal, as they are not bound by any restrictions that apply to broker-dealers. See, however, *infra* note 235 on the question of HFT and insider trading. On the other hand, the proprietary trading operations of the large banks would likely be in violation of these obligations, particularly when they are trading ahead of customer trades in their own dark pools.

216.   *See supra* note 33 (discussing front-running and securities law). It is important to note that a multi-district lawsuit against the exchanges alleging, among other things, liability under Exchange Act Section 10(b) for enabling "electronic front-running" by means of co-location and proprietary data feeds, was rejected for failure to state a claim under FED. R. Civ. P. 12(b)(6). *See In re* Barclays Liquidity Cross & High Frequency Trading Litig., No. 14-MD-2589 (JMF), 2015 U.S. Dist. LEXIS 113323, at *2–3 (S.D.N.Y. Aug. 26, 2015). Relying on *Central Bank of Denver N.A. v. First Interstate Bank of Denver N.A.*, 511 U.S. 164 (1994), as well as other precedent, the court determined that manipulative scheme claims pursuant to Section 10(b) must be primary, not secondary, violations, and that merely providing services to HFT firms that post quotes does not qualify as a manipulative act. *See id.* at *42–47.

217.   *E.g.*, Elimination of Flash Order Exception from Rule 602 of Regulation NMS, 74 Fed. Reg. 48,632, 48,636 (Sept. 23, 2009) (to be codified 17 C.F.R pt. 242).

218.   *Id.* at 48,635–39.

219.   While profits of HFT appear to have suffered significant decline in recent years, in the heyday of HFT the most successful firms made consistent and remarkably risk-free returns. Baron et al. analyze the profits made on E-mini S&P 500 futures contracts from August 2010 to August 2012, finding that HFT firms achieved abnormally high Sharpe ratios in their trading, indicating unusually high risk-adjusted returns. *See* Matthew Baron,

Flash orders may also have important second-order effects on the exchanges and brokers posting orders there. At base, the motivation for an exchange to issue flash orders may be to get "HFT firms to play in one exchange's sandbox over another's."[220] Exchanges compete intensely for order flow, and in a maker/taker system they provide a small rebate for orders that are filled. In order to get HFT firms to post quotes in its market or to fill orders there, an exchange may use flash orders to entice such firms to be present in the first place.[221] While flash orders appear to have considerable benefits for both suppliers and responders to quotes, they may also in some circumstances work against the interests of quote suppliers.[222] This would therefore be an instance of exchanges privileging their best customers, the HFT firms, at the expense of their less important ones. Finally, flash orders are part of a web of forces perverting the relationship of brokers to their clients.[223] In order to get customer orders, exchanges are willing to pay brokers for their orders, which are then flashed to their best

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Jonathan Brogaard & Andrei Kirilenko, *Risk and Return in High Frequency Trading* 20 (May 5, 2014) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2433118 ("[W]hile HFTs bear some risk, their risk-adjusted returns are unusually high."). In addition to the trading data, reports that firms such as Tradebot and Virtu Financial suffered virtually no trading losses for years on end indicate that, at least for a time, certain firms made riskless profits. *See* Gandel, *supra* note 8; Reuters, *High-speed Trader Virtu Financial Eyes $2.6 Billion Valuation in IPO*, FORTUNE (Apr. 6, 2015), http://fortune.com/2015/04/06/virtu-financial-ipo/. This has prompted some commentators to liken the returns in HFT to economic rents. *See* Coffee, *supra* note 86 ("[S]ome high frequency traders have made enormous profits that resemble economic rents."); Wallace C. Turbeville, *Cracks in the Pipeline Part Two: High Frequency Trading*, DEMOS (Mar. 8, 2013), http://www.demos.org/publication/cracks-pipeline-part-two-high-frequency-trading ("These findings persuasively suggest that HFT does not merely provide liquidity to the market, but rather extracts value well beyond the value of liquidity provided."); Fox et al., *supra* note 12, at 241–44 (explaining how slow market arbitrage by HFT "adds a third party, the liquidity supplier, whose only social purpose is to facilitate trades between regular traders but who instead is the only gainer from the so-called arbitrage activity," and that "[t]he regular practice of HFT exploitation of dark pool midpoint orders provides rents to HFTs").

220.   ARNUK & SALUZZI, *supra* note 131, at 84.

221.   *See id.* at 75 (flash orders as a favor to HFT); *see also* Harris & Namvar, *supra* note 148, at 5–6 (benefits of flash orders).

222.   *See* Harris & Namvar, *supra* note 148, at 2 (although in most instances "Submitters" would be expected to benefit through flash orders, they do open themselves up to being front-run by "Responders").

223.   *See, e.g.,* ARNUK & SALUZZI, *supra* note 131, at 58–59.

clients.[224] The payment for order flow means that brokers may not be acting strictly in the interests of their clients.[225] Rather, they are acting to some extent in their own interests by allowing the decision of where to send a customer order to be influenced by payment from an exchange.[226] Insofar as they constitute a reason that exchanges have for paying for order flow, flash orders seem to be a corrupting influence on brokers.[227]

D. DIRECT AND ENRICHED DATA FEEDS

Flash orders and the controversy surrounding them are just one instance of how, in the process of solving existing market problems, the exchanges create other ones in the form of informational disparities. In some cases, the solutions are enabled by a provision of Regulation NMS that existed before the computerization of the markets, as in the case of the flash order exception and the intermarket sweep order.[228] The "problem" solved by direct data feeds on the other hand is a very basic one created by the intersection of Regulation NMS with the information technology infrastructure of the SIP: the NBBO mandated by Regulation NMS will always be a few milliseconds, or even microseconds, behind the true state of the market as reflected in the prices at the various computer servers that constitute the real national market system.[229] As a result, traders will want access to the prices at the same time or even before they are sent to the SIP for inclusion in the NBBO.[230] Direct data feeds are the exchanges' product that

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224. *See id.* at 59 (linking flash orders to payment for order flow). On payment for order flow in the HFT environment, see Scott Patterson, *TD Ameritrade Executive Says Orders Go to Venues that Pay Highest Fees*, WALL ST. J., June 17, 2014, http://www.wsj.com/articles/td-ameritrade-executive-says-orders-go-to-venues-that-pay-highest-fees-1403043559.

225. *See* Patterson, *supra* note 224.

226. *See* ARNUK & SALUZZI, *supra* note 131, at 58–59.

227. *Id.*

228. For further discussion of ISOs, see *infra* Section II.F.

229. *See* Yoon, *supra* note 12, at 925 n.74 (stating that direct data feeds will be five to ten milliseconds faster than the NBBO disseminated by the SIP).

230. *Id.* at 925 ("An arbitrage strategy involves identifying and capturing the price discrepancies . . . ."); *see also* Larry Tabb, *Is the Increased Speed of Direct Market Data Worth the Price?*, WALL ST. & TECH. (Oct. 20, 2006), http://www.wallstreetandtech.com/is-the-increased-speed-of-direct-market-data-feeds-worth-the-price/d/d-id/1258127? (describing the costs and benefits of investing in direct data feeds).

meets this demand.[231] Data is released directly to clients at precisely the same time that it is sent to the SIP; given the inherent delays in transmission and processing by the SIP, a direct data feed is therefore a few milliseconds ahead of the SIP.[232] Enriched data feeds, on the other hand, provide a greater breadth of information than is sent to the SIP.[233] As with many of the techniques by which HFT operates, both direct and enriched data feeds implicate very basic questions of fairness in the electronic marketplace.[234] Unlike many of the other techniques, however, questions concerning the legality of the transactions they enable have also been raised.[235]

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231. *See* Yoon, *supra* note 12, at 925 n.74 ("[T]raders can receive the information in their individual data feeds provided by exchanges and ATSs before the rest of the market.").

232. *Id.; see also* Ding et al., *supra* note 190, at 318–21 (contrasting differences in latency between "the public (SIP NBBO) and proprietary (synthetic NBBO) data").

233. *See, e.g.*, *Stop the Press – Exchanges See No Unfairness!*, THEMIS TRADING BLOG (Sept. 27, 2012), http://blog.themistrading.com/2012/09/stop-the-press-exchanges-see-no-unfairness/ ("We all know a few things about the Stock Exchanges enriched data feeds. We all know they have more information – like order IDs, cancel replace information, order identifiers and modifiers, and of course hidden order information."); *see also* ARNUK & SALUZZI, *supra* note 131, at 111–17.

234. *See, e.g.*, *Stop the Press – Exchanges See No Unfairness!*, *supra* note 233.

235. Regulators, legal academics, and plaintiffs have all raised the issue of insider trading violations resulting from direct and enhanced data feeds from the exchanges to their HFT clients. *See, e.g.*, *FY 2015 Budget Hearing: U.S. Department of Justice: Hearing Before the Subcomm. on Com., Just., Sci. & Related Agencies of the H. Comm. on Appropriations*, 113th Cong. (2014) (statement of Eric Holder, Att'y Gen. of the United States); Mercer E. Bullard, *HFT Isn't the Problem—Insider Trading Is*, CNBC (Apr. 4, 2014), http://www.cnbc.com/id/101553082#; Coffee, *supra* note 86 ("[I]f a dark pool leaked information to a preferred, high frequency trader about the liquidity in its pool, then an insider trading violation may have occurred. Material information would have been passed by the dark pool to the high frequency trader, arguably in return for high fees paid by the trader. That would satisfy even a conservative definition of insider trading."); Eric T. Schneiderman, N.Y. State Att'y Gen., Keynote Address at the New York Law School Symposium: Insider Trading 2.0 – A New Initiative to Crack Down on Predatory Practices (Mar. 18, 2014), http://www.ag.ny.gov/pdfs/HFT_and_market_structure.pdf. The plaintiff in *City of Providence v. BATS Global Markets, Inc.*, 14-CV-2811 (S.D.N.Y. Apr. 18, 2014) included "insider trading" violations in its complaint at ¶¶ 124–28, but the complaint was dismissed. *In re* Barclays Liquidity Cross & High Frequency Trading Litig., No. 14-MD-2589 (JMF), 2015 U.S. Dist. LEXIS 113323, at *2–3 (S.D.N.Y. Aug. 26, 2015) (dismissing consolidated litigation including *City of Providence*).

Direct data feeds involve the provision of price information to traders for higher, "premium" fees than those paid to the Consolidated Tape Association (or Consolidated Quote Association) for the NBBO.[236] Examples of direct data feeds include NYSE Best Quote, NYSE Open Book, NYSE Amex Best Quote, and NASDAQ ITCH.[237] The SEC allows exchanges to disseminate data to their trader clients simultaneously with the provision of such data to the SIP,[238] despite the fact that this inevitably contributes to the problem of the "staleness" of the NBBO.[239] The SEC has determined that the simultaneous release of market data to traders and the SIP is consistent with the requirement of Rule 603(a) that information be released on terms that are "fair and reasonable" and "not unreasonably discriminatory."[240] While the SEC's position is logical, it has struggled with its implications in the HFT environment, where any small difference in timing leads to an informational advantage that cannot be overcome by slower traders. [241] Furthermore, at least one exchange, the NYSE, was found to be violating the existing rule by sending data on its proprietary data feeds ahead of its transmission to the SIP,[242] and timing disparities in the release of financial data were at the heart of the unsuccessful lawsuits against the exchanges for HFT practices.[243]

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236.   *See* ARNUK & SALUZZI, *supra* note 131, at 101–02.
237.   *See id.* at 101–03; Easley et al., *supra* note 189, at 1 n.3.
238.   *See* SEC Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3611 (Jan. 14, 2010) (codified at 17 C.F.R pt. 242).
239.   *Id.* at 3608.
240.   17 C.F.R. § 242.603(a) (2015); *see also* Fox et al., *supra* note 12, at 271 (exploring an interpretation of Rule 603(a)(2) in which sending the data signal simultaneously to HFT firms and the SIP is "unreasonably discriminatory . . . [since] it is predictable that some [end users] will consistently receive it faster than others").
241.   *See* SEC Concept Release on Equity Market Structure, 75 Fed. Reg. at 3611. Frank Pasquale draws attention to an analogous problem with the release of material information by companies to the market. *See* Pasquale, *supra* note 12, at 2106 n.114. While Regulation FD requires that companies issuing material information release it at the same time to everyone, news-release distributors sell direct access to such information to HFT firms, which result in them receiving the "information slightly before the rest of the market." *Id.*
242.   *See* N.Y. Stock Exch., LLC, Admin. Proc. File No. 3-15023 (Sept. 14, 2012),   http://www.sec.gov/litigation/admin/2012/34-67857.pdf;   Jenny Strasburg & Scott Patterson, *NYSE Is Fined in Data Probe*, WALL ST. J., Sept. 15, 2012, at A1.
243.   Complaint at 7–8, Lanier v. BATS Exch., Inc., 105 F. Supp. 3d 353 (S.D.N.Y 2015) (No. 14-CV-3745). Similar to the 2012 NYSE probe, see *supra*

The proprietary, "enriched" data feeds offered by the exchanges also offer a greater breadth of information than those relying solely on the NBBO disseminated by the SIP can obtain. Whereas the NBBO disseminated by the SIP offers only the best bid and best offer, enriched data feeds will offer an exchange's information on other customers' orders, including order cancellations, modifications, and executions.[244] This even includes information concerning order types that customers believed were hidden from public view, so-called "hidden order" types.[245] A HFT firm making a substantial investment in the required software can use an enriched data feed to discern the direction of the market and then trade as quickly as possible on that basis.[246] Similar to flash orders, enriched data feeds allow for what would be termed "front-running" if engaged in by a broker-dealer.[247] According to critics, enriched data feeds allow high-frequency traders to effectively "reverse engineer" the forces that led to a particular transaction (or the failure to consummate a transaction), offering a valuable insight into the market's direction.[248] And insofar as the exchanges pay brokers for their order flow to offer information concerning these orders to HFT firms, the relation between a broker and its clients is also compromised.

The questions of fairness raised by proprietary data feeds are essentially similar to those raised by co-location and flash orders: the exchanges offer one group of participants, who possess the wherewithal and interest in profiting from data, access to this data in return for high fees. What are the expectations of market participants when they enter the stock market? Is the creation of a two-tiered system, even when all are, in principle, permitted to enter into the privileged cohort,

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note 242, the plaintiff in *Lanier* alleged that data is provided by the defendant exchanges ahead of its transmission to the SIP. *See id.* at 13–14. The *Lanier* complaint was dismissed on federal preemption grounds, as well as failure to state a claim under FED. R. CIV. PRO. 12(b)(6). *See Lanier*, 105 F. Supp. 3d 353, 357.

244.   ARNUK & SALUZZI, *supra* note 131, at 111–17.

245.   *Id.* at 113–15.

246.   *Id.* at 112; *see also id.* 121–22 (stating that some exchanges are even disseminating machine-readable news).

247.   For a recap of "front-running" and its implications, see *supra* note 215 and accompanying text.

248.   *See* ARNUK & SALUZZI, *supra* note 131, at 102 (stating that information in proprietary data feeds "is valuable because it enables high frequency traders to model the behavior of institutional and retail investor orders to predict the short-term price movements of stocks").

fair? Is it inevitable? Or should limitations be put upon the information that exchanges are permitted to disseminate, either for a fee or for free? Should the SEC reconsider its policy that exchanges may disseminate their information to HFT clients simultaneously with its transmission to the SIP and instead focus on the time information is received by various market players? And what about the effects enriched data feeds may have on the relationship of brokers to their customers? Direct and enriched data feeds give rise to many questions that concern the fundamental fairness of the markets and the creation of a two-tiered system.

E.   SPOOFING, LAYERING, QUOTE STUFFING, ETC.: HFT AS MARKET MANIPULATION

The next type of HFT activity involves the use of information technology to engage in practices that are essentially very high-speed versions of the "pump-and-dump" schemes long known to regulators.[249] These activities do not rely on an intrinsic advantage in speed or data given to them by a third party, such as the exchange; rather, they involve the use of HFT technology to create certain conditions in the market, often manipulating other algorithmic trading programs, which the original HFT firms then takes advantage of. It is as if HFT creates the weather in the financial ecosystem and then profits from it.[250]

The most basic type of this activity involves creating momentum through posting orders that are then cancelled before they can be acted upon. Such strategies are often referred to as "momentum ignition" strategies, as they involve inducing other players in the market to act in a certain way, driving the price of a security up or down.[251] A simple example of this might be if the NBBO for General Motors stock consists of a bid at $15.10 and an offer at $15.14. "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 response

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249.   *See* Kirilenko & Lo, *supra* note 125, at 66–68; Korsmo, *supra* note 12, at 551–57. For limitations on the ability of HFT to engage in pump-and-dump strategies within the Eurobound futures market, see Irene Aldridge, *Can High-Frequency Traders Game Futures?*, 7 J. TRADING 75 (2012).

250.   *See* Korsmo, *supra* note 12, at 548–49 (discussing momentum ignition strategies).

251.   *See id.* at 548.

to the higher offer.[252] Finally, the original offer to buy at $15.12 will be cancelled before other parties can act on it.[253] In this way prices in the market are manipulated higher or lower without the manipulating party having to act on the quotes it has placed on an exchange or other trading venue. The fact that an estimated 95% of orders entered onto markets are cancelled may illustrate how frequently this technique, along with quote-stuffing, is used.[254]

"Layering" involves essentially the same technique but in a series of successive steps. Here, a series of successively higher (or lower) quotes are placed on one side of the market in order to drive a price up or down; after the price has been manipulated, a quote is then placed on the opposite side of the market.[255] The purpose of this technique is to trick other traders' algorithms into detecting a pattern in the market, and to then take advantage of their reaction.[256] For instance,

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252. Kirilenko & Lo, *supra* note 125, at 66–67; Goldstein et al., *supra* note 180, at 187. Section 747 ("Antidisruptive Practices Authority") of the Dodd-Frank Act of 2010, which added § 4c(a)(5) to the Commodities Exchange Act (CEA), prohibits spoofing in the commodities markets. *See* Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, Pub. L. 111-203, § 747, 124 Stat. 1376, 1739 (codified as amended at 7 U.S.C. § 6c(a)(5)); D. Denis Aktas, *Spoofing*, 33 B.U. REV. BANKING & FIN. L. 89, 93–95 (2013). Both the Commodity Futures Trading Commission and the SEC have actively prosecuted enforcement actions against traders alleged to be spoofing. *See* Huw Jones & John McCrank, *U.S. and U.K. Fine High-Speed Trader for Manipulation*, REUTERS (July 22, 2013), http://www.reuters.com/article /2013/07/22/us-britain-fca-hft-idUSBRE96L0G620130722 (noting that a $6 million fine was levied by regulators against Panther Energy Trading LLC for spoofing). The SEC has long prosecuted spoofing cases. *See, e.g.*, Visionary Trading, LLC, Exchange Act Release No. 71871, 2014 WL 1338258 (Apr. 4, 2014); Leonid Shpilsky, Exchange Act Release No. 17221, 2001 WL 1408740, at *2 (Nov. 5, 2001). The first criminal conviction under CEA § 4c(a)(5)(C), of Panther Energy Trading LLC principal Michael Coscia, occurred on Nov. 3, 2015 in *United States v. Coscia*, No. 14-CR-00551 (N.D. Ill. 2015). *See* Bradley Hope, *U.S. Wins Conviction in First Spoofing Case*, WALL ST. J., Nov. 3, 2015, at C3.

253. *See* Kirilenko & Lo, *supra* note 125, at 66–67.

254. ARNUK & SALUZZI, *supra* note 131, at 32; Easley et al., *supra* note 165, at 24 ("[E]stimates by [the] TABB group put this [order cancellations] at 98%."). For discussion of the linked nature of submissions and cancellations, see Joel Hasbrouck & Gideon Saar, *Low-Latency Trading*, 16 J. FIN. MKTS. 646, 658–64 (2013). For the contribution quote-stuffing may make to the cancellation rate, see Jiading Gai, Chen Yao & Mao Yang, *The Externalities of High Frequency Trading* 6–10 (Aug. 7, 2013) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2066839.

255. *See* SHORTER & MILLER, *supra* note 126, at 23; Korsmo, *supra* note 12, at 555.

256. *See* Korsmo, *supra* note 12, at 555.

assume the price of a mid-cap stock with a low trading volume has a best bid of $6.25 and a best offer of $6.75. Layering would involve posting a bid of $6.28, then posting a bid of $6.30, and then posting a bid of $6.32. After other parties then follow the rising price, making bids at, say, $6.30, the original party will sell the stock in the market at this higher price it itself has induced. Finally, it will cancel its earlier bids that are still open. Layering operates to trick other algorithmic traders into acting on quotes that are never meant to be filled.[257] The SEC has prosecuted parties for layering activities;[258] they are essentially the same as pump-and-dump schemes, although the entire sequence of activity can occur in less than half a second.[259]

Finally, "quote stuffing" involves using rapid-fire quotes to overwhelm the capacity of exchange servers or other traders to process them.[260] As Charles Korsmo explains, this activity has a two-fold purpose: since the trader making the burst of rapid fire quotes can safely ignore them, while the algorithms of other traders will not know to do this, the original trader engaging in quote stuffing can slow his competitors down, thereby gaining an advantage over them.[261] Quote stuffing can also be done to slow down the process of transmitting prices from an exchange to the SIP, thereby creating arbitrage opportunities between markets.[262] Quote stuffing involves the

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257. *See, e.g., id.* at 556 ("[T]he Trillium case shows how more sophisticated HFTs can potentially exploit other traders entirely through the use of orders the HFTs never intend to execute.").

258. *See* Kirilenko & Lo, *supra* note 125, at 66–67 (describing SEC actions against Hold Brothers On-Line Investment Services); *see also* Press Release, Sec. & Exch. Comm'n, SEC Charges New York Based High Frequency Trading Firm with Fraudulent Trading to Manipulate Closing Prices (Oct. 16, 2014) (announcing that Athena Capital used its algorithm "Gravy" to manipulate prices of stock during the final seconds of the trading day); Korsmo, *supra* note 12, at 555 n.155 (noting that Trillium Brokerage Services was subject to FINRA sanctions for engaging in repeated instances of layering).

259. Kirilenko & Lo, *supra* note 125, at 67 (providing example of market manipulation occurring within 839 milliseconds).

260. Korsmo, *supra* note 12, at 575–76; *see also* Gai et al., *supra* note 254, at 6 ("'[Q]uote stuffing' . . . involves submitting a profuse number of orders to the market to generate congestions on purpose.").

261. *See* Korsmo, *supra* note 12, at 575.

262. The rapid cancellation of quotes in "quote stuffing" delays the speed at which trade information is reported, thus distorting the information sent to other participants and creating arbitrage points for investors aware of the delay. *See* Gai et al., *supra* note 254, at 27–28.

use of HFT technology to increase the opportunity for latency arbitrage activities.

F. SPECIAL ORDER TYPES: "HIDE NOT SLIDE," ISOS, AND JUMPING THE QUEUE

The proliferation of special order types is a final set of phenomena that tops off the complaints about market fairness and HFT. [263] Given the market microstructure conditions dictated by Regulation NMS, special order types are integral to the suite of techniques HFT firms use to wring profits from the equity markets.[264] While these order types are ostensibly open to all, they contain certain features that, in conjunction with the high technical barriers to their use, give an unfair advantage to HFT in the eyes of many observers. [265] Specifically, they allow their users to jump the queue in certain situations that enable them to trade or collect a liquidity provision rebate in a risk-free manner.[266] While a number of order types have come under fire as ethically questionable,[267] and each exchange has its own variant, two of the most

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263. For articles detailing the complaints concerning special order types, see generally Herbert Lash, *Complaints Rise over Complex U.S. Stock Orders*, REUTERS (Oct. 19, 2012), http://www.reuters.com/article/2012/10/19/us-exchanges-ordertypes-idUSBRE89I0YU20121019; Scott Patterson & Jenny Strasburg, *For Superfast Stock Traders, a Way to Jump Ahead in Line*, WALL ST. J. (Sept. 19, 2012), http://www.wsj.com/articles/SB100008723963904439892045775992436935616 70; Tom Steinert-Threlkeld, *Out of Order; New Ways to Buy and Sell Shares on Exchanges Are Arriving Daily. Are Controls Needed on Choice, Complexity and Competition?*, TRADERS MAG., Jan. 2013, at 20. HFT practitioner-turned-whistleblower Haim Bodek played a central role in publicizing the role special order types play in HFT; his story is central to the narrative of Patterson's *Dark Pools*. PATTERSON, *supra* note 11. On special order types generally, as well as Bodek's contribution to this issue, see Stanislav Dolgopolov, *High-Frequency Trading, Order Types, and the Evolution of the Securities Market Structure: One Whistleblower's Consequences for Securities Regulation*, 2014 J.L. TECH. & POL'Y 145, 147–54 (2014). Special order types have attracted the attention of Congress as well as regulators. *See Computerized Trading: What Should the Rules of the Road Be?: Hearings Before the Subcomm. on Sec., Ins. & Inv. of the S. Comm. on Banking, Hous. & Urban Affairs*, 112th Cong. (2012); White, *supra* note 3.

264. *See* Dolgopolov, *supra* note 263, at 148–51.

265. *See, e.g.*, Haim Bodek, *HFT Checkmate — The Alpha in Order Types*, TABB F. (Jan. 21, 2013) [hereinafter Bodek, *HFT Checkmate*], http://tabbforum.com/opinions/hft-checkmate-the-alpha-in-an-order-type.

266. *See* Dolgopolov, *supra* note 263, at 157.

267. Bodek, *HFT Checkmate*, *supra* note 265.

controversial are "Hide Not Slide" (or "Hide and Light") orders and Intermarket Sweep Orders.[268]

The Hide Not Slide order is designed to solve a problem created by Rule 610(d) of Regulation NMS.[269] Rule 610(d) prohibits quotations that "lock" or "cross" the NBBO. Locking occurs when a buy order (bid) is posted at the same price as an order to sell (or offer) elsewhere in the national market system, or an offer posted at the same price as a bid.[270] Crossing occurs when a bid is posted at a higher price than the best offer, or an offer at a lower price than the best bid.[271] The Hide Not Slide order allows traders to sidestep the prohibition against locks and crosses.[272] In so doing, it also allows a trader to jump ahead in the queue of orders, violating the principle of price-time priority.[273]

When a broker posts a Hide Not Slide order, if it locks another market, the exchange will "slide" the price down to the next available price.[274] For example, a $15.50 Hide Not Slide bid that locks another market would be automatically changed to $15.49, thereby avoiding a lock. Then, when the market unlocks, the original bid $15.50 will be placed first in line. The Hide Not Slide order accomplishes two things. First, it allows a user to avoid sliding down to a lower bid (or higher offer) when a bid or offer locks or crosses the market.[275] Second, it allows the user, when the market unlocks, to be at the top of the queue.[276]

This queue-jumping feature is the key to the Hide Not Slide order.[277] The party successfully using a Hide Not Slide

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268. *See* Sugato Chakravarty, Pankaj Jain, James Upson & Robert Wood, *Clean Sweep: Informed Trading Through Intramarket Sweep Orders*, 47 J. FIN. & QUANTITATIVE ANALYSIS 415 (2012); Haim Bodek, *Locked Markets, Priority and Why HFTs Have an Advantage: Part 2: Hide & Light*, TABB F. (Oct. 16, 2012) [hereinafter Bodek, *Locked Markets*], http://tabbforum.com/opinions/locked-markets-priority-and-why-hfts-have-an-advantage-part-2-hide-and-light (explaining "Hide and Light").

269. 17 C.F.R. § 242.610(d) (2015) (prohibiting "[l]ocking or crossing quotations").

270. *See* Schmerken, *supra* note 89, at 14.

271. *Id.*

272. Bodek, *Locked Markets*, *supra* note 268.

273. *See id.*

274. *See* Scott Patterson & Jenny Strasburg, *How 'Hide Not Slide' Orders Work*, WALL ST. J., Sept. 19, 2012, at A12.

275. Bodek, *Locked Markets*, *supra* note 268.

276. *Id.*

277. *Id.*

order is now first in line, able to trade at the new best price in the market, and to position itself advantageously to capture any available liquidity rebates if the exchange uses a maker/taker system. [278] This queue-jumping feature led to significant controversy, but the exchanges could counter that its use was in fact open to all.[279] In addition to its unusual characteristics, the manner in which the Hide Not Slide order was introduced also led to criticism. Haim Bodek claims that the documentation about these order types was insufficient, and that the exchanges selectively disclosed their features to their privileged HFT clients. [280] These allegations appear to have been substantiated by the SEC in its recent Administrative Order against EDGA Exchange, Inc. and EDGX Exchange, Inc.[281] Although the Respondents do not admit or deny the SEC's findings, they agreed to pay a $14 million fine for, among other things, not accurately disclosing to all market participants how the Hide Not Slide order type worked.[282]

Another key order for HFT activity is the Intermarket Sweep Order or "ISO."[283] The ISO[284] is specifically listed in

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278. It is important to note that only the first party using a Hide Not Slide order will jump the queue—all others will be behind the slid regular orders. This feature gives rise to particular suspicion that the Hide Not Slide order was specifically formulated to benefit HFT traders, as it would only afford a benefit to the one lucky firm that was first in line of all firms placing Hide Not Slide orders. This suspicion appears to have been confirmed by the January 12, 2015 SEC Administrative Order against EDGA Exchange, Inc. and EDGX Exchange, Inc., the successors to the Direct Edge exchange. *See* EDGA Exchange, Inc., Exchange Act Release No. 74032, 2015 WL 137640, at *3 (Jan. 12, 2015); *see also* PATTERSON, *supra* note 11, at 339; O'Hara, *supra* note 148, at 262.

279. *See* Patterson & Strasburg, *supra* note 263 ("The exchanges' position is that these [advantages] are fully disclosed; they can be used by anyone with the right hardware and technical savvy . . . .").

280. *See* Bodek, *Locked Markets*, *supra* note 268. *But see* MacKenzie, *supra* note 6, at 44 (HFT interviewees "denied that these order types were secret").

281. EDGA Exchange, Inc., 2015 WL 137640, at *11.

282. *See* Bradley Hope, *BATS to Pay $14 Million to Settle Direct Edge Order-Type Case*, WALL ST. J. (Jan. 12, 2015), http://www.wsj.com/articles/direct-edge-exchanges-to-pay-14-million-penalty-over-order-type-descriptions-1421082603.

283. For the importance of ISOs to HFT, see MacKenzie, *supra* note 6, at 42–45. For their appeal to traders, see Chakravarty et al., *supra* note 268, at 416 ("The benefits of ISO usage include faster execution speed and the ability to capture larger counterparty depth by concurrently submitting orders to several markets . . . ."). For the role of ISOs in the "flash crash" of May 6, 2010, see Madhavan, *supra* note 153, at 23 ("[T]hese [ISO] orders may have triggered the flash crash by aggressively taking bid-side liquidity.").

Rule 611(b)(5) as an exception to Rule 610's prohibition on trade-throughs.[285] The stated purpose of this exception is to facilitate the execution of block trades by broker-dealers on behalf of institutional clients.[286] An ISO allows for the purchase or sale of stock at prices inferior to those listed in the NBBO in order to access quotes deeper in the limit order book of an exchange.[287] For example, assume the NBBO for GM stock is $18.00 best bid and $18.03 best offer. Exchange X has 3,000 shares of GM at the best offer price, and Trader B wants to purchase 20,000 shares. Trader B can submit an ISO for 20,000 GM shares, purchasing the 3,000 at the NBBO price, and then going deeper into the limit order book to purchase more shares at inferior prices.[288]

The rationale for ISOs in the pre-electronic trading world as facilitating block trades is easy to understand. Even though an ISO may cause the client to pay a higher total price for a block of shares than it would were those shares all available at the NBBO, it may wish to acquire a greater amount of stock than is immediately available at the NBBO.[289] In this case, the client likely fears the effect of a block trade on the price. In the world of electronic trading, however, an ISO offers a number of other potential advantages. First, in a market where speed is

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284.   17 C.F.R. § 242.600(b)(30) (2015) (defining "[i]ntermarket sweep order").

285.   *Id.* § 242.611(b)(5).

286.   Regulation NMS, 70 Fed. Reg. 37,496, 37,536 (June 29, 2005) (codified at 17 C.F.R. pt. 242) ("This exception particularly will facilitate the immediate execution of block orders by dealers on behalf of their institutional clients."); *see also* Chakravarty et al., *supra* note 268, at 417–19 (discussing "The ISO Mechanism"); Stavros Gadinis, *Market Structure for Institutional Investors: Comparing the U.S. and the E.U. Regimes*, 3 VA. L. & BUS. REV. 311, 350–51 (2008).

287.   *See* Gadinis, *supra* note 286, at 350.

288*.   See Fred and Ethel Called and Wanted to Know About Intermarket Sweep Orders (ISOs)*, THEMIS TRADING BLOG (Dec. 6, 2015) [hereinafter *Fred and Ethel*], http://blog.themistrading.com/fred-and-ethel-called-and-wanted-to-know-about-intermarket-sweep-orders-isos/. 17 C.F.R. § 242.611(c) specifies that "[t]he trading center, broker, or dealer responsible for the routing of an intermarket sweep order shall take reasonable steps to establish that such order meets the requirements set forth in § 242.600(b)(30)." Simultaneously with an ISO, § 242.600(b)(30) requires traders using an ISO to purchase the full displayed size of shares on other markets that constitute protected offers or bids, as applicable, at prices superior to the limit price of the ISO. 17 C.F.R. § 242.600(b)(30).

289.   Gadinis, *supra* note 286, at 350–51 ("Despite these costly features, ISOs offer the most straightforward method of executing large trades in the National Market System.").

paramount, it may allow traders to trade at better prices than those on the SIP, when the SIP is stale.[290] Second, exchanges offer variants on the ISO such as the "Post Only ISO" that will only be used in situations where the trader is attempting to capture a rebate in a maker-taker pricing market.[291] Third, some ISO order types allow users to jump the queue just as Hide Not Slide orders do.[292] In short, ISOs can be valuable in a variety of circumstances, and they are a key order type for HFT firms.

III. AN ETHICS OF ALGORITHMIC TRADING

The techniques used by high frequency traders outlined above generated intense controversy upon the publication of Michael Lewis's *Flash Boys*.[293] While the controversy was encapsulated in the perhaps overstated claim that the markets were "rigged," a close look at some of the objectionable techniques of HFT supports the notion that some HFT practices are indeed unfair.[294] The purpose of Part III is to

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290. *See* Chakravarty et al., *supra* note 268, at 416 ("The benefits of ISO usage include faster execution speed.").

291. *See Fred and Ethel*, *supra* note 288.

292. *See id.*

293. *See* LEWIS, *supra* note 1, at 2.

294. The academic literature to date presents some discussion of why HFT is often perceived as unfair. *See, e.g.*, Angel & McCabe, *supra* note 194, at 586–91 (describing various techniques used by HFTs); Dolgopolov, *supra* note 263, at 149–50 (citing selective disclosure of special order types as especially unfair); Goldstein et al., *supra* note 180, at 194–95 ("The fairness of very high-speed trading"); Kirilenko & Lo, *supra* note 125, at 60, 67–68 (advantages conferred by technological expertise as giving rise to fairness concerns); Korsmo, *supra* note 12, at 528 (characterizing the "speed and technological sophistication" of HFT firms as "generating an appearance of unfairness"); O'Hara, *supra* note 148, at 269 ("[T]he greater complexity, lower transparency, and higher uncertainty of high frequency markets all contribute to a sense that markets can be more fair for some than for others."); McGowan, *supra* note 12, ¶ 45 (discussing how costs to retail traders in maker-taker payment system prompt fairness concerns); Gomber et al., *supra* note 49, at 34–36 (explaining fairness concerns as driven by the speed advantages derived from co-location); MacKenzie, *supra* note 6, at 5–6 (attributing the hostility surrounding HFT to its hidden nature). The SEC also questions the fairness of investments in IT and human resources that effectively result in a two-tiered marketplace. Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3605 (Jan. 14, 2010) (codified at 17 C.F.R. pt. 242) ("[I]s it unfair for market participants to obtain a competitive advantage by investing in technology and human resources that enable them to trade more effectively and profitably than others?"); *cf.* Charles Jones, *What Do We Know About High-Frequency Trading?* 42 (Colum. Bus. Sch., Research Paper No. 13-11, 2013), http://ssrn.com/abstract=2236201 ("[M]any of the

explain why many in the investing public reacted as they did upon learning about HFT. In other words, Part III offers a theoretical grounding to support the claim that some of HFT's techniques are unfair.

It is important at the outset to acknowledge that HFT is simultaneously part of the transformation of the equity markets that has greatly reduced transaction costs for many investors, and so has brought great benefits.[295] Many defenders of HFT repeatedly point this out, and a number of academic studies document market benefits attributable, at least in part, to HFT.[296] However, a general rebuttal to the unfairness argument that HFT has lowered costs for many market participants, even if true, misses the point. HFT may be part of a transformation of the markets benefitting the average investor at the same time that some of its more aggressive techniques commit objectionable wrongs.[297] We may be forced to "pick our poison," to paraphrase Professor Pirrong,[298] but is it wrong to hope for no poison at all? It is important to explain the legitimate bases for complaints and to see how HFT implicates a number of issues of wider concern to the financial system.

In order to evaluate the moral status of the various HFT strategies, a framework for normative analysis is required. The framework must be detailed enough to apply in a determinative fashion to financial markets activity, at the same time that it should connect to at least one of the major ethical schools that inform economic and public policy discussions. In fact, relatively little has been written on specifically ethical issues in finance.[299] This is likely because

issues associated with HFT are the same issues that arise in more manual markets."). In addition to the academic literature, the narratives of Michel Lewis and Scott Patterson are largely driven by fairness concerns. LEWIS, *supra* note 1; PATTERSON, *supra* note 11.

295. Jones, *supra* note 294, at 51 ("Based on the vast majority of the empirical work to date, HFT and automated, competing trading venues have substantially improved market liquidity and reduced trading costs for all investors.").

296. *See id.*; *see also infra* Section III.A.

297. *See, e.g.*, Korsmo, *supra* note 12, at 528–29, 577–80 (suggesting that the technological advantages of HFT can "inadvertently—or even deliberately—cause extreme volatility events such as the Flash Crash").

298. *See* Pirrong, *Pick Your Poison*, *supra* note 70, at 14.

299. *See* John R. Boatright, *Ethics in Finance*, *in* FINANCE ETHICS 3, 3 (John R. Boatright ed., 2010) ("[T]he academic study of finance ethics has received surprisingly little attention from scholars in either finance or

implicit in financial markets discussion, and economics more generally, is a relatively well-defined ethical position. This is of course utilitarianism. [300] While economics is not necessarily

business ethics."). Within FINANCE ETHICS, the most relevant to this discussion of HFT are Robert W. Kolb, *Ethical Implications of Finance*, *in* FINANCE ETHICS, *supra*, at 23; John Dobson, *Behavioral Assumptions of Finance*, *in* FINANCE ETHICS, *supra*, at 45; and Eugene Heath, *Fairness in Financial Markets*, *in* FINANCE ETHICS, *supra*, at 163. In the wider business ethics literature, see also JOHN R. BOATRIGHT, ETHICS IN FINANCE (3d ed. 2014); BOUDEWIJN DE BRUIN, ETHICS AND THE GLOBAL FINANCIAL CRISIS (2015); Angel & McCabe, *supra* note 194, at 585; John Dobson & Ken Reiner, *The Rationality of Honesty in Debt Markets*, 22 MANAGERIAL FIN. 20, 31–32 (1996) (characterizing honest borrowers as necessary for the function of debt market equilibrium); James O. Horrigan, *The Ethics of the New Finance*, 6 J. BUS. ETHICS 97 (1987) (presenting normative ideas implicit in the "New Finance"); Timothy C. Johnson, *Reciprocity as a Foundation of Financial Economics*, 131 J. BUS. ETHICS 43, 43 (2014) (arguing for reciprocity as a fundamental principle of contemporary finance); Hersh Shefrin & Meir Statman, *Ethics, Fairness and Efficiency in Financial Markets*, 49 FIN. ANALYSTS J. 21, 21–22 (1993); Meir Statman, *Regulating Financial Markets: Protecting Us from Ourselves and Others*, 65 FIN. ANALYSTS J. 22, 22–24 (2009). For articles exploring the links between ethics, trust, and finance in the legal literature, see Dan Awrey et al., *Between Law and Markets: Is There a Role for Culture and Ethics in Financial Regulation?*, 38 DEL. J. CORP. L. 191 (2013); Margaret M. Blair & Lynn A. Stout, *Trust, Trustworthiness, and the Behavioral Foundations of Corporate Law*, 149 U. PA. L. REV. 1735, 1737–39 (2001) (arguing for the important role of trust as an internal constraint in the corporation); Tamar Frankel, *Regulation and Investors' Trust in the Securities Markets*, 68 BROOK. L. REV. 439 (2002) (examining "the relationship between investors' trust and government regulation of the markets"); Peter H. Huang, *Trust, Guilt, and Securities Regulation*, 151 U. PA. L. REV. 1059, 1159 (2003); Kevin T. Jackson, *The Scandal Beneath the Financial Crisis: Getting a View from a Moral-Cultural Mental Model*, 33 HARV. J.L. & PUB. POL'Y 735 (2010); Ian B. Lee, *Efficiency and Ethics in the Debate About Shareholder Primacy*, 31 DEL. J. CORP. L. 533, 535–37 (2006); Susanna Kim Ripken, *The Dangers and Drawbacks of the Disclosure Antidote: Toward a More Substantive Approach to Securities Regulation*, 58 BAYLOR L. REV. 139, 203–04 (2006); Lynn A. Stout, *The Investor Confidence Game*, 68 BROOK. L. REV. 407, 408 (2002) (investor trust as a foundation of the securities markets); John H. Walsh, *A Simple Code of Ethics: A History of the Moral Purpose Inspiring Federal Regulation of the Securities Industry*, 29 HOFSTRA L. REV. 1015, 1016 (2001). For critical appraisals of the role of ethical concepts in explaining financial phenomena, see Robert T. Miller, *Morals in a Market Bubble*, 35 U. DAYTON L. REV. 113 (2009); Larry E. Ribstein, *Law v. Trust*, 81 B.U. L. REV. 553 (2001).

300. *See* Kenneth J. Arrow, *Some Ordinalist-Utilitarian Notes on Rawls's Theory of Justice*, 70 J. PHIL. 245, 246 (1979) ("The implicit ethical basis of economic policy judgment is some version of utilitarianism."). For a philosophical examination of the relationship between economics, utilitarianism, and policy science, see Jeanne L. Schroeder, *The Stumbling Block: Freedom, Rationality, and Legal Scholarship*, 44 WM. & MARY L. REV. 263 (2002).

utilitarian, as Judge Posner points out,[301] it is conventionally so.

Economics bears the stamp of utilitarianism because its prescriptive counsels center around choosing the path of action that results in the greatest amount of "social welfare."[302] Social welfare is usually defined as the state of affairs resulting in the greatest amount of utility for a given population.[303] In order to make this concept more susceptible to measurement, subjective and amorphous elements such as fairness, justice, and morality are commonly excluded from its definition.[304] The concept of social welfare is implicitly utilitarian because it defines the good as the maximization of a possible amount of utility.[305] Such a definition hearkens back to John Stuart Mill's "Greatest Happiness Principle," in which "actions are right in proportion as they tend to promote happiness, wrong as they tend to produce the reverse of happiness. By happiness is intended pleasure, and the absence of pain; by unhappiness, pain, and the privation of pleasure."[306] Social welfare therefore bridges the divide between ethical inquiry and the discipline and techniques of modern economics, and in so doing, illuminates the roots of economics in utilitarianism.[307]

Despite its appeal, and the natural affinity of utilitarianism and economics, utilitarianism faces a number of powerful objections at the theoretical level, as well as obstacles to its application in practice. Two are particularly relevant to the discussion of HFT. The first is the problem of determining the appropriate frame of reference for the distribution of costs

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301. *See* Richard A. Posner, *Utilitarianism, Economics, and Legal Theory*, 8 J. LEGAL STUD. 103 (1979).

302. Schroeder, *supra* note 300, at 351 ("In conventional economic analysis, normative analysis is no different from prescriptive analysis, since the goal of the legal system is to maximize 'social welfare' . . . .") (quoting Christine Jolls, Cass R. Sunstein & Richard H. Thaler, *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1474–75 (1998)).

303. *See* STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 597 (2004).

304. *See id.* at 664–65 (presenting the concept of social welfare as a narrow aggregate of utilities, excluding fairness and distributional concerns).

305. *See* Amartya Sen, *Utilitarianism and Welfarism*, 76 J. PHIL. 463, 464 (1979) ("'[W]elfarism' . . . [as] the principle that the goodness of a state of affairs depends ultimately on the set of individual utilities in that state, and— more demandingly—can be seen as an increasing function of that set.").

306. JOHN STUART MILL, *Utilitarianism*, *in* 10 COLLECTED WORKS OF JOHN STUART MILL 203, 210 (John M. Robson ed., 1969) (1861).

307. *See* SHAVELL, *supra* note 303, at 608–12 (discussing "Welfare Economics and Notions of Morality").

and benefits: a straightforward utilitarianism only compares the sum total of pleasures and pains in various possible states of the world, neglecting their distribution through the population in general. [308] A world where one individual experienced intense pleasure and a complete absence of pain while four others lived miserably could be deemed superior to one in which five individuals lived very moderate but relatively equal lives. A straightforward utilitarianism therefore countenances the sacrifice of certain individuals, or their interests, for the greater good.[309] The discussion of HFT faces an analogous framing problem: do the general market benefits it may bring compensate for, or even cancel out, the wrongs it commits against specific investors, or classes of investors, in specific instances? What is the appropriate frame of reference for evaluating costs and benefits? Is it the equity trading market as a whole? Doesn't this imply that the interests of some investors, or classes of investors, may be sacrificed for the greater good, in the form of the efficiency of the larger trading system? While we do not want to ignore the benefits of the current market system, it seems obtuse to deny that sometimes HFT operates in a manner that is unfair.[310]

Second, the attempt to put utilitarianism into practice in many contemporary settings is hampered by the complexity of causal relationships among components of a given social, technological, or ecological system, and the concomitant difficulty of measuring inputs and outputs in such a system.[311] For example, in the field of finance, standard economic policy prescriptions are subject to debate because of the inherent complexity of the system and the difficulty of assessing whether a given policy in fact results in an increase in social

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308. *See* Samuel Scheffler, *Introduction*, *in* CONSEQUENTIALISM AND ITS CRITICS 1, 2–3 (Samuel Scheffler ed., 1988) (pointing out the objection that "[p]rovided net aggregate satisfaction is maximized . . . utilitarianism is indifferent as to how satisfactions and dissatisfactions are distributed"); John Rawls, *Classical Utilitarianism*, *in* CONSEQUENTIALISM AND ITS CRITICS *supra*, at 14, 17 ("Thus there is no reason in principle why the greater gains of some should not compensate for the lesser losses of others . . . .").

309. *See* Scheffler, *supra* note 308.

310. *E.g.*, RISHI NARANG, INSIDE THE BLACK BOX 283 (2d ed. 2013) ("In sum, it's hard to see any merit in the idea that HFT is unfair or creates a two-tiered marketplace.").

311. *See, e.g.*, Jeffrey N. Gordon, *The Empty Call for Cost-Benefit Analysis in Financial Regulators*, 43 J. LEGAL STUD. S351 (2013) (emphasizing the difficulty of making predictions about the financial system, which is itself constructed by regulation and subject to unpredictable second-order effects).

welfare.[312] While it is only a part of the much larger financial system, these same problems affect the attempt to offer policy prescriptions concerning HFT. We know that a large amount of equity trading occurs in the "dark" markets—though exactly how much we don't know—while at the same time the system of trading venues, market participants, regulators, and regulation is sufficiently complex that definitive statements about the operation of cause and effect in this system are often impossible.

Because the current equity trading markets present considerable obstacles to the successful implementation of the standard economic framework taken from utilitarianism, Part III presents an alternative ethical framework for financial markets activity. While economic costs and benefits are taken into account in this framework,[313] at its base is the principle of reciprocity, which reflects a fundamentally deontological ethical stance. Upon this foundation we can construct the additional principles of freedom from misrepresentation, a level playing field, and institutional integrity. While the exact extent of these principles is subject to disagreement, it is likely that

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312. *See* John C. Coates IV, *Cost-Benefit Analysis of Financial Regulation: Case Studies and Implications*, 124 YALE L.J. 882, 887 (2015) ("[C]ase studies show that quantified . . . [cost-benefit analysis] amounts to no more than 'guesstimation,' entailing: (a) causal inferences that are unreliable under standard regulatory conditions; (b) the use of problematic data; and/or (c) the same kinds of contestable, assumption-sensitive macroeconomic or political modeling used to make monetary policy."); *see also* Gordon, *supra* note 311, at S351 ("Instead of weighing costs and benefits, financial regulation necessarily is based on a series of trade-offs of normatively derived values, which may entail principles of pragmatic design."). *But see* Robert B. Ahdieh, *Reanalyzing Cost-Benefit Analysis: Toward a Framework of Function(s) and Form(s)*, 88 N.Y.U. L. REV. 1983, 1983–84 (2013) (proposing a framework for cost-benefit analysis of regulations); Eric Posner & E. Glen Weyl, *Benefit-Cost Analysis for Financial Regulation*, 103 AM. ECON. REV. 393, 393 (2013) (offering suggestions for how "regulatory benefits can be quantified"); Cass R. Sunstein, *Cost-Benefit Analysis and the Knowledge Problem* (Mossavar-Rahmani Ctr. for Bus. & Gov't, Harv. Kennedy Sch., Harv. U., Working Paper No. RPP-2015-03, 2014) (presenting a solution-based defense of cost-benefit analysis despite the "knowledge   problem"), http://papers.ssrn.ssrn.com/sol3/papers.cfm?abstract_id=2508965.

313. *See* BOATRIGHT, *supra* note 299, at 26–29 (providing a framework for finance ethics that includes the utilitarian concept of welfare as well as duties, rights, and fairness); Shefrin & Statman, *supra* note 299, at 23 ("Policymakers operate as if they have utility functions that depend on both efficiency and fairness."). This approach implicates the well known "equity/efficiency trade-off." *See* ARTHUR M. OKUN, EQUALITY AND EFFICIENCY: THE BIG TRADEOFF (1975).

their very real, yet imperfect, instantiation in economic life allows for the flourishing of our financial markets.[314] These principles also allow us to understand why critics claim that HFT is "not fair" and in what sense they are correct. First, however, it is important to survey the finance literature exploring the costs and benefits of HFT.

A. COSTS AND BENEFITS OF HFT

In response to the rapid development of HFT over the course of the past decade, numerous academic studies have attempted to quantify the benefits and costs of HFT. The effects of HFT on price discovery, liquidity, spreads, and stock market volatility are the subjects of detailed studies, as well as HFT's potential role in creating a socially wasteful "arms race" among traders and heightening systemic risk in the financial system. Benefits commonly discussed relate to the role HFT plays in advancing price discovery and the provision of liquidity; alternatively, costs relate to liquidity, technological arms races, adverse selection, and contribution to systemic risk.

Contribution to the process of price discovery is frequently claimed to be a benefit of HFT. In *High Frequency Trading and Price Discovery*, Jonathan Brogaard, Terrence Hendershott, and Ryan Riordan examine transaction level data from 2008 to 2009 for 120 randomly selected NASDAQ and NYSE stocks, dividing them into large, medium, and small cap categories.[315] Dividing traders into HFT and non-HFT categories, the authors find that HFT contributes to price discovery through selling in the direction of permanent price changes and away from transitory pricing errors.[316] Overall, HFT traders benefit

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314. *See, e.g.*, Tamar Frankel, *Trusting and Non-Trusting: Comparing Benefits, Cost and Risk* (B.U. Sch. L., Working Paper No. 99-12, 1999), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=214588 ("[A] stable financial system requires the support of fiduciary law principles, judicial enforcement, and monitoring by independent regulatory agencies."); *see also* Lawrence E. Mitchell, *Fairness and Trust in Corporate Law*, 43 DUKE L.J. 425, 425 (1993) (citing "trust in the corporate fiduciary's fairness" as a precondition of the corporate enterprise); Stout, *supra* note 299, at 408 ("Investor trust provides the foundation on which the American securities market has been built."). *See also infra* note 456 and accompanying text.

315. Jonathan Brogaard, Terrence Hendershott & Ryan Riordan, *High Frequency Trading and Price Discovery*, 27 REV. FIN. STUDIES 2267, 2271 (2014) [hereinafter Brogaard et al., *Price Discovery*].

316. *Id.* at 2280; *see also* Jonathan Brogaard, Al Carrion, Thibaut, Ryan Riordan, Andriy Shkilo & Konstantin Sokolov, *High Frequency Trading and*

from price discovery,[317] but the information HFT uses is limited to a three to four second span.[318] Consequently, "[i]f this information would become public without HFTs, then the potential welfare gains may be small or negative if HFTs impose significant adverse selection on longer-term investors."[319] Similarly, in a study of the foreign exchange markets between 2003 and 2007, Alain Chaboud, Benjamin Chiquoine, Erik Hjalmarsson, and Clara Vega find that algorithmic trading improves price efficiency.[320] They also determine that algorithmic trading increases the efficiency of prices through liquidity provision, not from reaction to posted quotes.[321]

Perhaps even more importantly, HFT is said to benefit measures of marketplace liquidity. Terrence Hendershott, Charles Jones, and Albert Menkveld study a group of 943 stocks from February 2001 through December 2005 in *Does Algorithmic Trading Improve Liquidity?*[322] The NYSE introduced its "Autoquote" system over the course of January 29, 2003 to May 27, 2003.[323] This provides an important opportunity to test the effects of algorithmic trading on the market because Autoquote enabled algorithmic traders to place quotes on a market that previously operated manually.[324] The authors "use the rate of electronic message traffic as a proxy for

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Extreme Price Movements (Mar. 2014) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2531122.

317. *See* Terrence Hendershott & Ryan Riordan, *Algorithmic Trading and Information* 4 (June 21, 2011) (unpublished manuscript), http://faculty.haas.berkeley.edu/hender/atinformation.pdf ("AT [(algorithmic trading)] contribute[s] more to the efficient price by having more efficient quotes and AT demanding liquidity so as to move the prices towards the efficient price."). For a theoretical model with this same implication, see Bruno Biais, Thierry Foucault & Sophie Moinas, *Equilibrium High Frequency Trading* 27 (Sept. 2011) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1834344 ("HFT orders impound information into prices faster.").

318. Brogaard et al., *Price Discovery*, *supra* note 315, at 2302.

319. *Id.*

320. Alain P. Chaboud, Benjamin Chiquoine, Erik Hjalmarsson & Clara Vega, *Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market*, 69 J. FIN. 2045, 2045 (2014).

321. *Id.* at 2048.

322. Terrence Hendershott, Charles M. Jones & Albert Menkveld, *Does Algorithmic Trading Improve Liquidity?*, 66 J. FIN. 1, 6 (2011).

323. *Id.* at 14.

324. *See id.* at 13 (describing the purpose of Autoquote).

the amount of AT [algorithmic trading]"[325] and the reduction in effective spreads as a liquidity measure.[326] They conclude that "AT does in fact improve liquidity for large-cap stocks."[327] Likewise, Hasbrouck and Saar look at NASDAQ data for two groups of stocks from October 2007 and June 2008.[328] Focusing on "strategic runs" of messages ranging from three to more than ten, they find that "higher low-latency activity implies lower posted and effective spreads, greater depth, and lower short-term volatility."[329] Interestingly, they find that the effect of HFT activity on measures of market quality increased in the June 2008 sample, which was a time of heightened market stress caused by the first tremors of the financial crisis of 2008.[330] They suggest that "[i]t is reasonable to assume that higher volatility creates more profit opportunities for high-frequency traders."[331]

Despite these papers detailing certain benefits, some financial economists present results that appear to support the popular criticisms of HFT regarding liquidity voiced by Sal Arnuk and Joseph Saluzzi,[332] Michael Lewis,[333] and Scott Patterson.[334] Andrei Kirilenko and Andrew Lo note that "[i]n contrast to a number of public claims, high-frequency traders do not as a rule engage in the provision of liquidity like traditional market makers. In fact, those that do not provide liquidity are the most profitable and their profits increase with the degree of 'aggressive,' liquidity-taking activity."[335]

More specifically, economist Vincent van Kervel examines trading data for a group of ten randomly selected FTSE 100

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325. *Id.* at 6.
326. *Id.* at 7–10.
327. *Id.* at 3; *cf.* Eric Budish, Peter Cramton & John Shim, *The High Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response* 37 (June 4, 2015) (unpublished manuscript), http://faculty.chicagobooth.edu/eric.budish/research/HFT-FrequentBatchAuctions.pdf (arguing that while liquidity has improved in recent years, it is probably from the increased role of informational technology as "there is little support for the proposition that the speed race per se has improved liquidity").
328. Hasbrouck & Saar, *supra* note 254, at 648.
329. *Id.* at 667.
330. *Id.* at 670.
331. *Id.* at 673.
332. ARNUK & SALUZZI, *supra* note 131, at 27–28.
333. LEWIS, *supra* note 1, at 107–09.
334. PATTERSON, *supra* note 11, at 253.
335. Kirilenko & Lo, *supra* note 125, at 60.

stocks trading on the London Stock Exchange as well as the Chi-X, BATS, Turquoise, and NASDAQ OMX Europe venues.[336] He finds that a trade on one venue results in substantial cancellations of limit orders on the other venues: "within 100 milliseconds after a trade on some venues, 39–85% of the order size is cancelled on competing venues. After one second this number increases to 98–125%, which shows that the impact of a trade on liquidity is in fact twice the trade size." [337] He therefore concludes that "the interrelation of liquidity across trading venues causes substantial overestimation of liquidity aggregated over these trading venues."[338]

Jiading Gai, Chen Yao, and Mao Ye look at the very fastest trading environments, where orders occur at microsecond (and even nanosecond) [339] speeds. [340] They contrast the HFT environment, where time is infinitely divisible but prices are constrained by a minimum $0.01 tick size, with the ideal world of Walrasian economics where "price is infinitely divisible but time is not."[341] In the HFT world, then, the competition for speed is a consequence of a failed price competition, and an increase in speed does not change the cost of liquidity— although it does decide who supplies this liquidity.[342] Looking at a variety of datasets including NASDAQ TotalView ITCH, the authors conclude that in the nanosecond environment, "[o]ur empirical results suggest that the impact of speed on liquidity is insignificant."[343]

Two recent papers in the legal literature also cast doubt upon the alleged benefits of HFT on share prices. In *The New Stock Market: Sense and Nonsense*,[344] Merritt Fox, Lawrence Glosten, and Gabriel Rauterberg argue that "electronic front running" harms informed traders[345] and so "[t]he elimination of electronic front running would make it more profitable for

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336.   Vincent van Kervel, *Liquidity: What You See Is What You Get?* 3, 18–19 (May 2012) (unpublished manuscript), http://www.rsm.nl/fileadmin /home/Department_of_Finance__VG5_/LQ5/VanKervel.pdf.
337.   *Id*. at 29.
338.   *Id*. at 2.
339.   A microsecond is one millionth of a second, and a nanosecond one billionth. A nanosecond is to one second as one second is to 31.71 years.
340.   Gai et al., *supra* note 254, at 2.
341.   *Id*. at 4.
342.   *See id*. at 16.
343.   *Id*. at 25.
344.   Fox et al., *supra* note 12.
345.   *Id*. at 230–32.

these traders to engage in their activity . . . . As a result, prices will be more accurate."[346] This would benefit the economy at large by improving the allocative efficiency of the capital markets and the signals given to management, boards, and investors. [347] Likewise, in *How Algorithmic Trading Undermines Efficiency in Capital Markets*, Yesha Yadav focuses on harm to the accuracy of prices and the consequences for the financial regulatory system at large, which has relied in recent decades on the assumption that stock market prices accurately reflect the available information concerning securities.[348] While these papers do not present econometric analyses of HFT data, they do present theoretical arguments that call into question the belief that the effects of HFT on prices will be on net socially beneficial.

The idea that HFT may be at base a socially wasteful arms race is behind one of the most celebrated recent papers on HFT, *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*.[349] Eric Budish, Peter Cramton, and John Shim look at market data from the Chicago Mercantile Exchange and the NYSE relating to two related securities, the SPDR S&P 500 exchange-traded fund (SPY) and the S&P 500 E-mini futures contract (ES), from the period 2005–2011.[350] They find that while the prices of the SPY and the ES are almost perfectly correlated in normal human time, at the millisecond level at which HFT occurs the correlation breaks down completely.[351] This breakdown allows for the HFT practice of "sniping," picking off stale quotes as an arbitrage activity. [352] Most importantly, while the time horizon over which the arbitrage opportunities exist shrinks drastically over the period studied, the value of the arbitrage does not. [353] Similar to Gai, Yao, and Ye, Budish, Cramton, and Shim believe that the current market design forces traders into a socially wasteful arms race to avoid being picked off.[354] HFT firms face a prisoner's dilemma: they would all be better off not

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346. *Id*. at 234.
347. *Id*.
348. Yadav, *supra* note 12, at 1607–08.
349. Budish et al., *supra* note 327.
350. *Id*. at 2.
351. *Id*. at 2–3, 12 (Figure 1.1, "ES and SPY Time Series at Human-Scale and High-Frequency Time Horizons").
352. *Id*. at 5.
353. *Id*. at 2.
354. *Id*. at 1.

engaging in such a competition, but avoiding it individually would doom a firm to failure.[355] Budish and others, are careful to point out that their model does "not imply that on net HFT has been negative for liquidity or social welfare," but simply "that sniping is negative for liquidity and that the speed race is socially wasteful."[356] Their paper proposes the introduction of batch auctions every 100 milliseconds as a mechanism that could undercut the arms race and force traders to compete on price, not speed.[357]

While the costs of HFT arms races are borne directly by the competitors in the tournament for speed, HFT imposes substantial adverse selection costs on all those who choose not to enter this competition.[358] These slower traders are typically institutional investors and their brokers.[359] They may attempt to avoid the worst of the costs by using smart order routers to send large orders, or by trading in dark pools, but they pay higher costs because they cannot compete in the race for speed. A variety of economists have explored adverse selection costs in the HFT context,[360] though coming to a reliable estimate of the total amount would seem to be impossible.

Finally, HFT may contribute to systemic risk in the financial system, although its exact role as a cause is far from clear. It appears to have been a contributing factor in the "Flash Crash" of May 6, 2010, though not a fundamental cause.[361] HFT is also suspected of contributing to the numerous

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355. *Id.* at 35.

356. *Id.* at 37.

357. *Id.* at 39–42.

358. *See* Brogaard et al., *Price Discovery*, *supra* note 315, at 2268; *see also* Budish et al., *supra* note 327, at 35.

359. *See* Fox et al., *supra* note 12, at 231.

360. *See, e.g.*, Brogaard et al., *Price Discovery*, *supra* note 315, at 2268 ("We show that HFTs impose adverse selection costs on other investors."); Easley et al., *supra* note 189, 13–14 (including an "adverse selection effect" in their model which ultimately makes the market less liquid); Lin Tong, *A Blessing or a Curse? The Impact of High Frequency Trading on Institutional Investors* 31 (Oct. 5, 2015) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2330053 ("I find strong evidence that an increase in HFT is associated with an increase in the trading costs of institutional investors.").

361. Kirilenko et al., *supra* note 153, at 2; *see also* Kirilenko & Lo, *supra* note 125, at 62–63. For a far more skeptical reading, see Nanex, *Reexamining HFT's Role in the Flash Crash*, NANEX RES. (June 12, 2014), www.nanex.net/aqck2/4650.html.

"mini flash crashes" that have occurred.[362] HFT can contribute to systematic risk by speeding up the response to financial information and removing the ability of humans to sense risk in the trading environment, in effect putting trading systems on an extremely fast autopilot.

In the final analysis, it is hard to know whether HFT provides a net benefit to the financial markets because of the complexity of the trading environment and the incredible difficulty of accurately estimating costs and benefits.[363] It seems safe to conclude that HFT is part of the revolution that greatly lowered transaction costs for investors, although decimalization and the general application of information technology to the financial markets would also appear to account for much of the benefit. On the other hand, it seems clear that HFT imposes significant adverse selection costs on slower traders, and the liquidity benefits it provides are subject to important caveats. Moreover, its benefits to the price discovery process may be questionable if it only imparts information to the markets a few seconds sooner than it would otherwise arise.[364] It appears impossible in practice, if not theory, to answer the question "Is HFT good or bad?" using a conventional economic analysis that relies on enumeration of costs and benefits.

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362. *See* Bowley, *supra* note 157; Neil Johnson, Zhao Guannan, Eric Hunsader, Jing Meng, Amith Ravinder, Spencer Carran & Brian Tivnan, *Financial Black Swans Driven by Ultrafast Machine Ecology* 1 (Feb. 7, 2012) (unpublished manuscript)*,* http://arxiv.org/abs/1202.1448.

363. Craig Pirrong's conclusion on the relation of informed to uniformed traders captures this point:

> I cannot see any way of evaluating the welfare effects of financial trading, and in particular informed trading. The social benefits (how do more informative prices improve the allocation of real resources) are impossible to quantify: they are often difficult even to identify, except in the most general way ('capital allocation is improved'). Unlike the trade for most goods and services, there is no reason to believe that social and private benefits align.

Craig Pirrong, *Pinging: Who Is the Predator, and Who Is the Prey?*, STREETWISE PROFESSOR BLOG (Apr. 5, 2014), http://streetwiseprofessor.com/?p=8340.

364. *See generally* Joseph E. Stiglitz, *Tapping the Brakes: Are Less Active Markets Safer and Better for the Economy?* 2–3 (Fed. Res. Bank of Atlanta, Apr. 15, 2014) (unpublished manuscript), https://www.frbatlanta.org /news/conferences/2014/140415-fmc/agenda.aspx (surveying issues of excessively active markets).

B. THE ULTIMATUM GAME, RECIPROCITY, AND THE DUTCH BOOK

Modern stock markets present a highly unusual context for ethical analysis. On a scale representing the degree of interpersonal interaction they are at an extreme, even when compared to other arm's-length bargaining contexts such as corporate transactions, commercial sales, or employment negotiations.[365] Stock markets present an environment devoid of face-to-face contact between counterparties, an important contextual factor in moral analysis that has also had important legal significance.[366] Stock markets dominated by algorithmic

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365. *See, e.g.*, MacKenzie, *supra* note 6, at 58 ("Algorithmic markets in which most actors are themselves algorithms are the most depersonalized of current market forms."). At the beginning of his study MacKenzie distinguishes between three types of markets:

> 1. Market actors are all human beings, and 'the market' involves direct interaction among human beings. 2. The market is an algorithm, but the actors remain mostly human beings; they interact with the market via computer screen, keyboard and mouse. 3. The market is an algorithm, and most actors in it are also algorithms.

Id. at 3. In the economic sociology literature, Mark Granovetter emphasizes "the role of concrete personal relations and structures (or 'networks') of such relations in generating trust and discouraging malfeasance." Mark Granovetter, *Economic Action and Social Structure: The Problem of Embeddedness*, 91 AM. J. SOC. 481, 490 (1985). He argues further that "the anonymous market of neoclassical models is virtually nonexistent in economic life and that transactions of all kinds are rife with the social connections described." *Id.* at 495; *see also* Wayne E. Baker, *The Social Structure of a National Securities Market*, 89 AM. J. SOC. 775, 807 (1984) (explaining that computerized trading may "affect the social structure of the market, but it would never escape the fact that markets are socially structured"). While this Article argues that the contemporary, computerized equity markets represent an extreme type of market that in some ways approaches the anonymous and abstract market of neoclassical theory, the fact that HFT is controversial at all demonstrates that we still bring our moral beliefs to questions surrounding the functioning of the algorithms and computer servers that constitute this market.

366. Whether a transaction was conducted face-to-face or on an anonymous exchange was often determinative under the early twentieth century state law governing insider trading. *See* A.C. Pritchard, United States v. O'Hagan*: Agency Law and Justice Powell's Legacy for the Law of Insider Trading*, 78 B.U. L. REV. 13, 22–26 (1998); Stephen M. Bainbridge, *The Law and Economics of Insider Trading: A Comprehensive Primer* 7–8 (Feb. 2001) (unpublished   manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=261277; *see also* Elinor Ostrom, *Collective Action and the Evolution of Social Norms*, 14 J. ECON. PERSPS. 137, 140 (2000) (highlighting the importance of face-to-face communication in public goods games).

trading take this aspect to its extreme, where "traders" in the conventional sense really just represent algorithms.[367] Yet as the outcry over HFT shows, even in this highly attenuated context many individuals still feel moral principles do, or should, apply.

Because of this unusual social context, any ethics of the financial markets will inevitably be spare. We understand that our potential trading partners on an exchange are wholly motivated by self-interest in transacting with us, and there will be no ongoing relationship beyond a single sale.[368] Unlike other business relationships, there is no reliance on another party concerning future behavior. Nevertheless, there is a set of minimal expectations, and thus a limited form of trust, surrounding a one-time transaction in the anonymous, mediated trading environment of the modern stock exchange.

The results of the Ultimatum Game as presented by behavioral economist Richard Thaler are an appropriate starting point.[369] In the Ultimatum Game an individual, the Allocator, is given a sum of money and told to divide it between himself and the Recipient. [370] The Recipient then decides whether to accept this allocation. [371] If he does, both parties receive the amounts as determined by the Allocator; if the Recipient rejects the proposed allocation, both receive nothing. [372] According to the view of rationality espoused by conventional economic theory, Recipients should accept any offers greater than zero, and the offers proposed by Allocators should approach zero.[373]

The results of experimental testing diverge considerably from this view. Both Allocators and Recipients demonstrate a preference towards divisions approaching a 50/50 split, which Thaler interprets as demonstrating that "notions of fairness can play a significant role in determining the outcomes of negotiations."[374] In an Ultimatum Game conducted by German

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367.   MacKenzie, *supra* note 6, at 58.

368.   *See generally* Joel Sobel, *Interdependent Preferences and Reciprocity*, 43 J. ECON. LITERATURE 392, 411–12 (2005) (discussing "Repeated Games").

369.   Richard H. Thaler, *Anomalies: The Ultimatum Game*, 2 J. ECON. PERSPS. 195 (1988).

370.   *Id.* at 195.

371.   *Id.* at 195–96.

372.   *Id.*

373.   *Id*. at 196 (citing Ariel Rubinstein, *Perfect Equilibrium in a Bargaining Model*, 50 ECONOMETRICA 97 (1982)).

374.   *Id*. at 205.

economists Werner Güth, Rolf Schmittberger, and Bernd Schwarze, 21 pairs divided a sum "c," between 4 and 10 Deutschmarks, with a mean offer of .37c.[375] In 7 out of 21 cases the offer was a 50/50 split. [376] In a further experiment conducted by Kahneman, Knetsch, and Thaler, Allocators were presented with the choice of dividing $20 with Recipients in either an 18/2 or a 10/10 split; 76% of the subjects divided the $20 evenly.[377]

The Ultimatum Game indicates that humans gauge what is appropriate in a transaction on some basis other than a narrowly defined rationality alone. If rationality is defined as "the maximization of utility under a budget constraint,"[378] a rational Recipient would accept any offer, no matter how small, made by an Allocator. Likewise, Allocators would offer amounts as small as possible in order to retain the maximum amount for themselves. Yet such extreme self-interest does not comport with the results of the Ultimatum Game. Human behavior lies somewhere between the extremes of complete generosity and complete greed, as Thaler observes.[379] Most importantly, our inherent greediness is tempered by the notion of fairness both as Allocators and Recipients.[380]

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375. *Id.* at 196–97 (citing Werner Guth, Rolf Schmittberger & Bern Schwarze, *An Experimental Analysis of Ultimatum Bargaining*, 3 J. ECON. BEHAV. & ORG. 367 (1982)).

376. *Id.* at 197.

377. *Id.* at 198.

378. *See* Kolb, *supra* note 299, at 24 (citing Kenneth J. Arrow, *Rationality of Self and Others in an Economic System*, 59 J. BUS. S385, S388 (1986)) ("Key Assumptions in Finance: Rationality and Self-Interest"); *see also* Dobson, *supra* note 299, at 47–49 ("The Axioms of Rationality"); Nien-hê Hsieh, *Efficiency and Rationality*, *in* FINANCE ETHICS, *supra* note 299, at 63.

379. *See* Thaler, *supra* note 369, at 205 ("[I]t is safe to say that most people are not well described by either extreme view. Rather, most people prefer more money to less, like to be treated fairly, and like to treat others fairly.").

380. Evolutionary psychologists posit that the tendency to incorporate a concept of fairness into strategic negotiation behavior, which both departs from strict rationality and is grounded in reciprocity, promoted survival in the environment of evolutionary adaptation. *See* John Tooby, Leda Cosmides & Michael E. Price, *Cognitive Adaptations for* n-*Person Exchange: The Evolutionary Roots of Organizational Behavior*, 27 MANAGERIAL & DECISION ECON. 103, 118 (2006). Reciprocity would therefore be a superior survival strategy to greed in environments characterized by significant uncertainty, where bonds of trust between members of a group could mean the difference between survival and extinction. For the presentation of these ideas in the language of economics, see Sobel, *supra* note 368, at 397–412. *Cf.* Armen A. Alchian, *Uncertainty, Evolution, and Economic Theory*, 58 J. POL. ECON. 211, 211 (1950) (discussing the insufficiency of the typical rational economic theory

The Ultimatum Game points towards reciprocity as a grounding principle of our moral beliefs concerning exchange.[381] The deviation from rationality observed in the Ultimatum Game results in Allocators giving more than would seem necessary, or rational, and Recipients demanding more than a minimal amount. While not all Allocators split their sums evenly, a surprising portion of them do. The movement towards an equal division implies that we conceive fairness on the basis of putting ourselves in a counterparty's shoes—we ask, what would we hope for if we were in the other person's position? An even 50/50 split would be the ideal reflection of the other's interests in this case.

The principle of reciprocity is reflected in many of the world's major ethical and religious traditions. Aristotle's treatment of exchange as proportionate equality captures this,[382] as does the Golden Rule of the New Testament, "Do to others as you would have them do to you." [383] The intersubjectivity implicit in Kant's Categorical Imperative captures the notion of reciprocity as well. In commanding that one ought never act except in such a way that I "will also that [my] maxim should become a universal law," the Categorical Imperative places the self on the same plane as its fellow humans.[384] Indeed, Kant's notion of the Kingdom of Ends takes

of "predictable, individual behavior," and the need to incorporate ideas of uncertainty and "environmental adoption" in economic models).

381.   *See generally* Johnson, *supra* note 299, at 43. While Johnson grounds his claims in what he terms "pragmatic philosophy," which is in turn based on Aristotle's ethics, what follows in Part III is based on Kantian deontology. *Id.* While Johnson discusses and rejects the philosophy of Rawls as a possible basis for his theory that reciprocity is the foundation of financial economics, on the grounds that Rawls believed that his conception of justice was "political not metaphysical," he does not explore Kantian deontology as a basis for reciprocity. *Id.* at 45.

382.   *See* ARISTOTLE, NICHOMACHEAN ETHICS bk. V, at 88–91 (Albert Keith Whitaker ed., Joe Sachs trans., Focus Publishing 2002) (c. 384 B.C.E.). Johnson bases his discussion of reciprocity on Aristotle's conception of "justice in associations for exchange." *See* Johnson, *supra* note 299, at 48. Aristotle believed that a fair exchange was characterized by proportionate equality, so that there was no giving in exchange. *See* Lindsay Judson, *Aristotle on Fair Exchange*, *in* 15 OXFORD STUDIES IN ANCIENT PHILOSOPHY 147, 147–51 (C.C.W. Taylor ed., 1997).

383.   LUKE 6:31 (New International Version); *see also* MATTHEW 7:12 (New International Version) ("So in everything, do to others what you would have them do to you, for this sums up the Law and the Prophets.").

384.   *See* IMMANUEL KANT, GROUNDWORK FOR THE METAPHYSICS OF MORALS 19 (Allen W. Wood ed. & trans., Yale Univ. Press 2002) (1785). The first presentation of the Categorical Imperative in *Groundwork* is commonly

this to its conclusion, as we are to treat all persons as ends in themselves, not means.[385] While Kant is clear that the Categorical Imperative is not synonymous with the Golden Rule,[386] both ask us to place ourselves in the position of others when exercising moral judgment.

Reciprocity as a fundamental principle of ethics has important implications for finance.[387] First, it means that we should not act in a way that we would wish others not act towards us.[388] While this might appear at first glance to rule out the overwhelming majority of market transactions, which are of course based on self-interest, this is not really the case.[389] As Aristotle's discussion of proportionate equality in exchange makes clear, a fair exchange occurs when a party exchanges something of equal value for something else.[390] This allows for parties to trade when they have differing needs. For example, if I sell a loaf of bread for two dollars, I may do so because I have three loaves already and cannot eat them all. It also crucially allows for individuals to trade on the basis of differing beliefs about future events.[391] If I believe the country

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referred to as the "Formula of the Universal Law of Nature" by philosophers. *See, e.g.*, Robert Johnson, *Kant's Moral Philosophy*, STAN. ENCYCLOPEDIA PHIL., http://plato.stanford.edu/entries/kant-moral/ (last modified Apr. 6, 2008).

385.   KANT, *supra* note 384, at 45–46.

386.   *Id.* at 48. Kant here states that the principle *quod tibi non vis fieri* [do not do to others what you do not want done to yourself]

> is only derived from that principle . . . it cannot be a universal law, for it does not contain the ground of duties toward oneself, nor that of the duties of love toward others (for many would gladly acquiesce that others should not be beneficent to him, if only he might be relieved from showing beneficence to them), or finally of owed duties to one another, for the criminal would argue on this ground against the judge who punishes him, etc.

Id. For a detailed exposition of the relation between Kant's Categorical Imperative and the Golden Rule, see Daniel Berthold, *The Golden Rule in Kant and Utilitarianism*, *in* THE GOLDEN RULE: ANALYTICAL PERSPECTIVES 83 (Jacob Neusner & Bruce Chilton eds., 2009).

387.   *See, e.g.*, Johnson, *supra* note 299, at 43.

388.   *See id.* at 55.

389.   *See* BOATRIGHT, *supra* note 299, at 1 ("[A] moment's reflection reveals that finance would be impossible without ethics.").

390.   *See* ARISTOTLE, *supra* note 382, at 88–91.

391.   *See generally* ARISTOTLE, POLITICS, bk. I, ch. 11 (Trevor J. Saunders trans., Oxford Univ. Press 1995) (c. 350 B.C.E.). After he was reproached for his poverty, Thales put a deposit down on all the olive presses on the Greek islands of Chios and Miletus, knowing that the coming year would bring a large olive crop. *Id.* at 1258. When the crop came in, he was able to rent out the olive presses at a high price, earning a substantial amount. *Id.* at 1259.

will enter a period of drought, I may be willing to pay ten dollars for a portion of grain, and if my counterparty believes rainfall will be good this year he may want to sell to me at this price. Reciprocity does not mean that one won't trade on the basis of comparative advantage or differing beliefs about the future, or even differing levels of information, but merely that one can envision making the trade on the given terms if one were on the opposite side of the transaction.

Reciprocity does, however, conflict with trading practices generally considered abusive. For example, insider trading violates the principle of reciprocity, as we instinctively feel we would *not* want to trade with someone who had information about a security that was, in principle, only available to a few.[392] Likewise we feel that front-running on the part of our broker is unfair, as it negatively affects the price we receive for a stock, if only by a small amount.[393] Both of these activities strike most of us as fundamentally unfair. Still, it must be remembered that reciprocity is a moral ideal: we hope it will be respected when we act in the marketplace, even though we know it sometimes is not, and we succumb on occasion to the temptation to treat others as we would not want to be treated.

Reciprocity fundamentally represents an equality between the two sides of an exchange. One interesting violation of reciprocity is the "Dutch Book." [394] This is when the probabilities in a betting game add up to more or less than one.[395] If the probabilities are less than one, a gambler can make a certain profit against the house; if more than one, the

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While Aristotle relates this story for the purpose of illustrating how a monopoly can be profitable, there is no hint that what Thales did was immoral or shameful, even though Aristotle believes that the pursuit of wealth is inferior to philosophy. *Id.*

392.   *See* Steven McNamara, *Insider Trading and Evolutionary Psychology: Strong Reciprocity, Cheater Detection, and the Expanding Boundaries of the Law*, 22 VA. J. SOC. POL'Y & L. 241, 244 (2015) (noting that "we intuitively feel that [insider trading] is unfair" and examining the relationship between this social understanding and the law).

393.   *See id.* ("[W]e still bring our moral intuitions to the contemporary environment of complex technological and financial systems.").

394.   *See* Johnson, *supra* note 299, at 55. The "Dutch Book" argument was presented by the mathematician Bruno de Finetti in 1931. *See* Klaus Heilig, *Carnap and de Finetti on Bets and the Probability of Singular Events: The Dutch Book Argument Reconsidered*, 29 BRIT. J. PHIL. SCI. 325, 326–27 (1978); *see also* William M. Briggs, *Dutch Book: Or, How to Gamble*, W. M. BRIGGS BLOG (Feb. 21, 2012), wmbriggs.com/?s=dutch+book (providing examples of the Dutch Book).

395.   *See* Briggs, *supra* note 394.

house will always come out ahead.[396] In the conventional situation where a casino, lottery agency, pari-mutuel betting operation, or Mafia numbers racket makes a Dutch Book, the house in effect pays itself through the lopsided odds.[397] Such an amount is known as the "skim," "juice," "vigorish," or "vig."[398] It may be that this amount of guaranteed profit to the house is just the cost of gambling, and that gamblers consent to paying it because it is understood that in the long run the house always wins.[399]

Query, however, whether such an understanding obtains for transacting in the stock market. Do we believe that in the long run, our investments will always lose or, more precisely, that they will always be compromised by some small amount? Equally important, do we feel that it is a violation of the principle of reciprocity if there are such small amounts by which we invariably lose, as a sort of tax or rent on our transactions, and we do not know beforehand of either their existence or extent? One of the fundamental criticisms of HFT is that it exacts a small and hidden cost on all other traders in the markets.[400] If so, HFT resembles a Dutch Book. The analogy may be imperfect, but a casino and a successful HFT firm both generate (relatively) riskless profits.[401]

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396. *Id.* Consider the following example given by William Briggs: A bookie gives even odds, or 1:1, for the Event occurring, and odds of 3:1 for the Non-event occurring. Here the probabilities sum to 0.75 (0.50 for the Event plus 0.25 for the Non-event). A gambler can make a certain profit by simultaneously wagering $20 on the Event and $10 on the Non-event. Should the Event come to pass, the gambler will receive a payout of $40, comprised of the original $20 wagered plus another $20. In the alternative, the Non-Event comes to pass and the gambler receives a payout of $40, comprised of the original $10 plus another $30. The gambler wagers a total of $30 and in either case receives $40 because the probabilities sum to less than 1. Where the probabilities sum to greater than 1, the house always wins. *See id.*

397. *See, e.g.*, *id.* (explaining how American Roulette is a Dutch Book for the casino).

398. *See id.*

399. *See id.* (stating that the amount skimmed may also be referred to as a "transaction cost").

400. *See, e.g.*, ARNUK & SALUZZI, *supra* note 131, at 47 ("Explicitly your transaction costs may have come down . . . . Implicitly, you pay more for the stocks you buy or you receive less from those you sell.").

401. *See* Briggs, *supra* note 394 (describing the riskless profits generated by a Dutch Book); *see also* sources cited *supra* note 8 (describing how some HFTs experience virtually no losses).

C. Freedom from Misrepresentation

The principle of reciprocity serves as a foundation for three more particular ethical principles that will apply in the specific environment of the financial markets. First among these is freedom from misrepresentation.[402] We do not want to be lied to about the particulars of a specific security or about a particular state of affairs in the markets.

Freedom from misrepresentation is a cornerstone of market regulation and forms the basis of American securities law.[403] At base, market participants want some assurance that they can rely on the information communicated to them. Examples of this include the disclosure required by securities regulation, as well as more short-lived aspects relating to prices.[404] Can we assume that a quote posted is actually available to be acted upon? Since HFT has transformed the basic unit of market information from the trade to the order,[405] quotes themselves are now the primary items of information in the high frequency markets, and there is substantial concern about their reliability.[406] An estimated 96%–98% of quotes are now cancelled before they can be filled.[407] The environment of flickering, constantly revised quotations calls into question some of the basic assumptions of securities markets, but it does

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402. Freedom from misrepresentation is a focus of the business ethics literature dealing with the financial markets. *See, e.g.*, BOATRIGHT, *supra* note 299, at 175–77 ("Fraud and manipulation"); Shefrin & Statman, *supra* note 299, at 25.

403. *See* James M. Landis, *The Legislative History of the Securities Act of 1933*, 28 GEO. WASH. L. REV. 29, 34–35 (1959); Elaine A. Welle, *Freedom of Contract and the Securities Laws: Opting Out of Securities Regulation by Private Agreement*, 56 WASH. & LEE L. REV. 519, 534–35 (1999).

404. Shefrin & Statman, *supra* note 299, at 24.

405. O'Hara, *supra* note 148, at 263 ("Algorithmic trading means that trades are not the basic unit of market information – the underlying orders are.").

406. The inability of Haim Bodek to execute trades at the prices offered formed the impetus for his quest to understand the new trading environment. *See* PATTERSON, *supra* note 11, at 54–57. Maureen O'Hara reports that, by some estimates, upwards of 98% of quotes are cancelled, "creating uncertainty as to the actual level of current prices." O'Hara, *supra* note 148, at 259, 267; *see also* Joel Hasbrouck, *High Frequency Quoting: Short-Term Volatility in Bids and Offers* 4 (Jan. 20, 2015) (unpublished manuscript), http://ssrn.com /abstract=2237499 (examining the relationship between short-term volatility in bids and high frequency quoting).

407. *See* O'Hara, *supra* note 148, at 259 ("[I]t is now common for upward of 98% of all orders to be canceled instead of being executed as trades."); Gai et al., *supra* note 254, at 6 ("[A]n increase in trading speeds leads to a dramatic increase in the cancellation/execution ratio from 26:1 to 32:1 . . . .").

not necessarily indicate a violation of the principle of freedom from misrepresentation. There seems to be nothing wrong in principle with cancelling an order, even if it leads to a vast majority of orders being cancelled. A consequence of the marked increase in the order-to-cancellation ratio, however, is that traders can no longer rely on the assumption that a quote represents shares actually available to be bought or sold.[408]

On the other hand, there are numerous abuses in the high frequency arena that do amount to a violation of the principle of freedom from misrepresentation. As seen above, the momentum ignition strategies of spoofing and layering are in essence contemporary forms of stock market manipulation.[409] These are part of the cat and mouse game of dueling algorithms, but they also involve the misuse of a quote that amounts to an implicit misrepresentation. If we post a quote that indicates that we are willing to buy something with the intent of changing the price, and then turn around and sell it, the original quote misrepresents our intent.[410] Of course, we could say the same about posting a quote and then cancelling it, but momentum ignition strategies take this one step further. In the context of spoofing and layering, a quote is posted 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. Not surprisingly, these activities have been targeted with the laws proscribing market manipulation.[411]

The belief in public protection from misrepresentation is a cornerstone of securities law, and business law in general, yet its application presents serious difficulties in the HFT world.[412] This is because we want to continue to rely on signals that we

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408. *See* O'Hara, *supra* note 148, at 267; Gai et al., *supra* note 254, at 5–6.

409. *See supra* notes 249–59 and accompanying text (discussing momentum ignition and spoofing).

410. *See* Pasquale, *supra* note 12, at 2106–12 ("Responding to Misrepresentation of Market Conditions").

411. *See* Aktas, *supra* note 252, at 93–94 (discussing market manipulation); Scopino, *supra* note 12, at 660–63 ("Spoofing as Violating Commodity Exchange Act Sections 4c(a)(2)(B) and 9(a)(2)"); *see, e.g.*, Kirilenko & Lo, *supra* note 125, at 66 (SEC issued a cease-and-desist order against an investment firm using "spoofing" and "layering" techniques to manipulate prices); Korsmo, *supra* note 12, at 554–55 (Trillium Brokerage Servs., LLC was fined $2 million for utilizing a momentum ignition strategy).

412. *See generally* Tara E. Levens, Note, *Too Fast, Too Frequent? High-Frequency Trading and Securities Class Actions*, 82 U. Chi. L. Rev. 1511 (2015).

have always assumed were reliable—for example, that quotes posted are in fact open to be filled—but for reasons of technological advance may no longer be so. [413] Part of the consternation traders such as Haim Bodek have felt stems from an implicit feeling of deception in the markets, that quotes posted are not in fact available to be filled but are merely there to induce other behavior from other traders.[414] Freedom from fraud and misrepresentation are just as much preconditions of computerized markets as they were of earlier ones. Increased enforcement of the existing law concerning market manipulation against deceptive use of quotations is required to police such behavior.

D. A Level Playing Field

One of the most frequent complaints of HFT is that it creates a two-tiered system in which a small amount of players have preferential treatment or are otherwise advantaged.[415] This criticism assumes that somehow the securities markets are, or should be, a level playing field.

The notion of a level playing field in financial law means that like market participants will be treated alike. [416] In securities markets this means that with the necessary prerequisites—the required investments of time and material resources—anyone should be able to compete successfully in

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413. *See, e.g.*, *id.* at 1511–12.

414. Bodek, *HFT Checkmate*, *supra* note 265.

415. Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3605 (Jan. 14, 2010) (codified at 17 C.F.R. pt. 242).

416. *See* Jesse M. Fried, *Insider Abstention*, 113 YALE L.J. 455, 460–62 (2003) (characterizing the "disclose or abstain" rule of insider trading law as an attempt to "level the playing field"); Zachary J. Gubler, *Reconsidering the Institutional Design of Federal Securities Regulation*, 56 WM. & MARY L. REV. 409, 424–26 (2014) (characterizing the disclosure regime of the Exchange Act as an attempt to "level the playing field" for exchange-listed firms); *see also* Guhan Subramanian, *The Drivers of Market Efficiency in* Revlon *Transactions*, 28 J. CORP. L. 691, 699–700 (2003) (noting the creation of a "level playing field" under Delaware corporate law for bidders in corporate auctions). For discussions of a level playing field in the law itself, see *Sec. Exch. Comm'n v. Texas Gulf Sulphur Co.*, 401 F.2d 833, 852 (2d Cir. 1968) (reiterating congressional intent that "all members of the investing public should be subject to identical market risks"); Selective Disclosure and Insider Trading, 65 Fed. Reg. 51,716, 51,716 (Aug. 24, 2000) (codified at 17 C.F.R. pts. 240) ("[I]nvestors lose confidence in the fairness of the markets when they know that other participants may exploit 'unerodable informational advantages' . . . .").

the securities markets, and that these prerequisites should be available to all.[417] Of course, in reality not all market players will make these investments, and more fundamentally, these prerequisites may not be available to all.[418] A level playing field exists more as a goal or ideal than as a concrete reality.[419] An example of this comes from the law of insider trading. One of the motivations of insider trading law is to prevent individuals from trading on the basis of information that is in principle not available to all, because this is thought to be unfair.[420] No one presumes that traders in fact trade on equal information, but the law does—to some degree at least—aim to restrict trading on information that is not accessible to all.[421] *Equal access* to information is key to what a level playing field means in U.S. securities law generally.[422] In the HFT arena a level playing field also implicates issues of speed and processing power, and equal treatment by the law and key market institutions.[423]

The race for speed and co-location call into question the notion of a level playing field because the small advantages that accrue to HFT can never be made up by other traders. In the zero-sum game of trading, traders with speed advantages will always win the competition to come in first, as others can never make up for any initial delay.[424] Since trading in the current markets often reduces to a mere competition for speed,

417.   *See* Shefrin & Statman, *supra* note 299, at 28 ("The idea of the level playing field is associated with the view that investment activity is a game of skill.").

418.   *See supra* notes 188–90 (describing the large investments necessary to compete in HFT).

419.   *See* United States v. O'Hagan, 521 U.S. 642, 658 (1997) ("Although informational disparity is inevitable in the securities markets, investors likely would hesitate to venture their capital in a market where trading based on misappropriated nonpublic information is unchecked by law.").

420.   Of course in American securities law, trading on nonpublic information is not, in principle, enough to result in an insider trading violation; access to such information must also involve the violation of a fiduciary duty. *O'Hagan*, 521 U.S. at 647. For perceptions of unfairness on trading in a wide variety of scenarios, see Stuart P. Green & Matthew B. Kugler, *When Is It Wrong to Trade Stocks on the Basis of Non-Public Information? Public Views of the Morality of Insider Trading*, 39 FORDHAM URB. L.J. 445 (2011).

421.   *See O'Hagan*, 521 U.S. at 658–67 (detailing the purpose and previous court interpretations of the misappropriation theory).

422.   *See* Gubler, *supra* note 416, at 424–26 (arguing that one of the principles that motivated Congress to enact securities laws is a concern for fairness and a level playing field).

423.   Levens, *supra* note 412, at 1512.

424.   *See supra* note 182 and accompanying text.

slower traders feel that they cannot hope to compete with co-located traders for the best trades, leading to the belief that there is a two-tiered market.[425]

A level playing field is a concept that represents an ideal, not a real, condition. [426] Even where the law is relatively successful in creating a level playing field, in reality there is significant asymmetric information in markets. [427] Much, though not all, of this is the result of varying investments in human capital, technology, research, and analysis. [428] And behind these differences sit our different human endowments, which result in varying levels of ambition, intelligence, and interests that in turn contribute to varying levels of material success. That said, the concept of fairness in the financial markets requires that regulators strive to keep access to information and the inherent ability to profit from it open to all.[429] While in theory all may have the opportunity to use this information, in practice HFT calls into question the notion of a level playing field by restricting the ability to profit from it to only the very most sophisticated actors.[430]

E. INSTITUTIONAL INTEGRITY

The final basic principle of a financial markets ethics for HFT is the presumption of institutional integrity. A number of the practices outlined above implicate questions of the integrity of the institutions central to the financial markets. Primary among these are the stock exchanges, but the practices of dark pools and broker-dealers have also come under fire as unfair to certain of their customers. Before we examine these charges, however, it is useful to define institutional integrity.[431]

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425. A level playing field also implicates the (un)equal treatment of different classes of traders by key market institutions, primarily the exchanges and other trading venues. Since this relates to business decisions made by these institutions, they are treated in *infra* Section III.E.

426. *See O'Hagan*, 521 U.S. at 658.

427. *See* Subramanian, *supra* note 416, at 694 (noting that "information will not be widely distributed" because "information costs are high").

428. *See id.*; Levens, *supra* note 412, at 1511.

429. *See* Coffee, *supra* note 86 ("To this point, we have been ducking the larger issue and focusing only on whether Regulation NMS was violated. But should co-location and private data feeds from exchanges to preferred shareholders be permissible?").

430. Bodek, *HFT Checkmate*, *supra* note 265.

431. Institutional integrity has received substantial discussion in the business ethics literature. *See, e.g.*, Thomas Maak, *Undivided Corporate Responsibility: Towards a Theory of Corporate Integrity*, 82 J. BUS. ETHICS 353

At the core of institutional integrity is the idea that an institution displays integrity when it acts in the furtherance of its prior commitments to stakeholders.[432] While honesty is important to integrity, the two concepts are not synonymous.[433] Integrity denotes the will to honor obligations in a way that demonstrates a coherence of the actions and commitments of the institution in question both through time and across the range of the institution's obligations to its various stakeholders.[434] At base institutional integrity means living up to an institution's commitments.[435] An important sub-question asks how we know an institution has made a commitment to a particular stakeholder. Many of these commitments or obligations arise naturally in the course of business and are implicit rather than explicit.[436] While there may be substantial room for disagreement as to identifying particular commitments, it is important to recognize that they can arise implicitly in the course of business. Such implicit commitments form a legitimate basis for many of the complaints found in the HFT debate as well as in wider questions of business ethics.

Problems at the stock exchanges are not new, but the conjunction of Regulation NMS and rapid technological change transformed the exchanges. They went from being relatively transparent entities that privileged members at the expense of retail clients, to opaque ones privileging one set of clients at the expense of others.[437] The temptation of catering to HFT in the

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(2008); Lynne McFall, *Integrity*, 98 ETHICS 5 (1987); Lynn Sharp Paine, *Managing for Organizational Integrity*, HARV. BUS. REV., Mar.–Apr. 1994, at 106.

432.   *See* Maak, *supra* note 431, at 358.

433.   *See* McFall, *supra* note 431, at 7–8.

434.   *See* Maak, *supra* note 431, at 364; McFall, *supra* note 431, at 7–9.

435.   *See* Maak, *supra* note 431, at 362.

436.   *See* Ronald Jeurissen, *The Social Function of Business Ethics*, 10 BUS. ETHICS Q. 821, 823 (2000) (characterizing the "social contract model" of business ethics as an "implicit 'social contract'"); *cf.* Anita Jose & Mary S. Thibodeaux, *The Institutionalization of Ethics: The Perspectives of Managers*, 22 J. BUS. ETHICS 133, 135 (1999) (discussing implicit forms of ethics in organizations). For an analogous argument in the legal literature, see Lon. L. Fuller, *Human Interaction and the Law*, 14 AM. J. JURIS. 1 (1969) (arguing customary law originates in reciprocal expectations); Gerald Postema, *Implicit Law*, 13 L. & PHIL. 361, 362 (1994) ("Implicit Rules and Social Interaction").

437.   This contrast is the fulcrum point of Craig Pirrong's *Pick Your Poison*, which emphasizes the ability of the exchanges to profit from natural trading monopolies prior to the introduction of Reg. NMS's Order Handling Rule, which "effectively socialized order flow." Pirrong, *Pick Your Poison*, *supra* note 70, at 11.

new and highly competitive environment—where revenue comes from the spread between maker and taker fees—compromised the institutional integrity of the exchanges.[438] In the race to capture a viable flow of orders, exchanges were incentivized to cater to their best customers, the HFT shops.[439] While the maker/taker pricing system is a large factor in the competition for order flow, perhaps equally important to HFT clients is the nature of the order flow on an exchange with many institutional and retail clients: it is generally not well informed, i.e., not "toxic." This uninformed order flow holds great appeal for HFT, and the exchanges have offered HFT clients a number of tools to profit from trading with it.

The various techniques reviewed in Part II can all be seen as mechanisms that facilitate HFT's mission to profit from slower and less informed traders.[440] One of the most trenchant criticisms of HFT is that the exchanges engineered these techniques specifically to allow HFT firms to profit at the expense of their other customers.[441] The fees garnered for facilitating HFT activity can therefore be seen as the exchanges' "cut" of the profits.[442] The compromised institutional integrity of the exchanges consists of offering up one group of customers as prey to another, more lucrative group. A commitment to institutional integrity would entail resisting the temptation to profit at their slower customers' expense by refusing to facilitate the abusive forms of HFT. While defenders of HFT and the exchanges may argue whether such a strategy would even be feasible in an environment where the bulk of trading is accomplished algorithmically and the maker/taker system predominates, at least one trading venue is currently testing this proposition in the market.[443]

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438. *See supra* notes 148–50 and accompanying text (describing the maker/taker payment system).

439. *Cf. supra* notes 189–90 and accompanying text (exchanges as deriving substantial revenue from the sale of data to HTFs).

440. A few of the techniques discussed above are co-location, flash orders, spoofing, layering, quote-stuffing, and ISOs. *See supra* Part II.

441. *See, e.g.*, Bodek, *HFT Checkmate*, *supra* note 265; Hope, *supra* note 282 (noting the BATS exchange was fined $14 million to settle claims that it, among other things, "gave some high-speed traders an advantage over others by not providing details about certain order types").

442. *Cf.* Fox et al., *supra* note 12, at 233 ("If electronic front running were eliminated tomorrow, HFT co-location facilities would be worth less to the HFTs . . . . This might reduce the rents collected by the exchanges.").

443. *See* Karl Antle, *IEX & the Re-Mutualization of Market Infrastructure*, WALL ST. & TECH. (May 28, 2014), http://www.wallstreetandtech.com

IEX stands as an important test of whether the trading environment will support a trading venue that markets itself to traders, in large part, on ethical grounds.[444] While it has only been in operation since October 2013, [445] it has enjoyed a successful launch.[446]

In addition to the exchanges, at least one dark pool has allegedly been tempted to misrepresent itself to clients in a bid to profit from HFT. [447] Dark pools are often seen as more favorable to institutional and retail traders than lit exchanges because no quotes are posted before trades are made and the HFT firms are therefore deprived of a key element of the information needed to trade ahead of slower investors. [448] Conversely, HFT practitioners find dark pools a lucrative environment due to the slowness and relatively uninformed nature of the average institution seeking to trade there. [449] According to New York Attorney General Eric Schneiderman, Barclays claimed it prevented HFT firms from trading in its dark pool, Barclays LX, while simultaneously and covertly

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/infrastructure/iex-and-the-re-mutualization-of-market-infrastructure/a/d-id/1252879.

444. *See generally id.* (describing the structure and support of IEX).

445. *IEX Announces: Production Launch Friday, October 25th, 2013 as a Non-Displayed ATS*, IEX (Oct. 11, 2013), http://www.iextrading.com/trading/alerts/2013/001/.

446. IEX now accounts for 0.8–0.9% of the daily stock trading volume, and is raising funds to become a registered exchange. *See* Michael J. De la Merced, *Lower-Frequency Platform Raises Funding to Become Full Stock Market*, N.Y. TIMES: DEALBOOK (Sept. 2, 2014), http://dealbook.nytimes.com/2014/09/02/iex-upstart-trading-platform-raises-75-million-in-new-financing/.

447. *See* Keri Geiger, Sam Mamudi & Chris Dolmetsch, *Dark Pool Greed Drove Barclays to Lie to Clients, N.Y. Says*, BLOOMBERG: BUSINESS (June 25, 2014), http://www.bloomberg.com/news/articles/2014-06-25/barclays-dark-pools-said-to-face-suit-from-n-y-attorney-general; Scott Patterson & Bradley Hope, *Barclays Dark Pool Drew Early Alarms*, WALL ST. J. (July 20, 2014, 7:14 PM), http://www.wsj.com/articles/barclays-dark-pool-drew-early-alarms-on-fast-trading-1405898592. Also relevant is the SEC's $2 million fine of dark pool Liquidnet for disclosing information concerning traders to issuers whose stock was traded on its dark pool; such disclosure violates Regulation ATS Rule 301(b)(10). Press Release, U.S. Sec. & Exch. Comm'n, SEC Charges New York-Based Dark Pool Operator with Failing to Safeguard Confidential Trading Information (June 6, 2014), http://www.sec.gov/News/PressRelease/Detail/PressRelease/1370542011574; *see also* William Alden, *Liquidnet, a Dark Pool Operator, Is Fined $2 Million over Customer Data*, N.Y. TIMES: DEALBOOK (June 6, 2014), http://dealbook.nytimes.com/2014/06/06/liquidnet-a-dark-pool-operator-is-fined-2-million-over-customer-data/?_r=0.

448. *See* SHORTER & MILLER, *supra* note 126, at 5.

449. *See* Geiger et al., *supra* note 447.

marketing itself to HFT firms. [450] The misrepresentation allegedly consisted of providing false numbers for the estimated amount of trading done by HFT firms under Barclays' "liquidity profiling" metric. [451] If the allegations in Attorney General Schneiderman's complaint are true, Barclays comprised its institutional integrity in an attempt to profit in the competitive world of dark pools.

Broker-dealers are the final group of market actors who may have succumbed to the temptation to profit at the expense of their clients. The maker/taker payment system appears to incentivize brokers to route their clients' limit orders to the trading venue that offers the highest liquidity rebate, rather than the one offering the best likelihood of execution. [452] Since most brokers charge clients fixed commissions, while the exchanges offer various levels of rebates in the maker/taker pricing system, "it may be profit maximizing for brokers to consider liquidity rebates rather than the probability of limit order execution when making routing decisions." [453] As a result, the current market structure appears to incentivize broker-dealers to violate their duty of best execution for clients. [454] Along with the exchanges and dark pools, the current trading

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450. *See* Complaint at 2–4, People v. Barclays Capital Inc., 1 N.Y.S.3d 910 (N.Y. Sup. Ct. 2015) (Index No. 451391/2014). Unlike the consolidated litigations *In re Barclays Liquidity Cross & High Frequency Trading Litig.*, No. 14-MD-2589 (JMF), 2015 U.S. Dist. LEXIS 113323, at *81 (S.D.N.Y. Aug. 26, 2015), and *Lanier v. BATS Exch., Inc.*, 105 F. Supp. 3d 353, 367 (S.D.N.Y. 2015), Attorney General Schneiderman's suit survived a motion to dismiss. People v. Barclays Capital Inc., 1 N.Y.S.3d 910, 917 (N.Y. Sup. Ct. 2015).

451. *See* Sam Mamudi & Doni Bloomfield, *Cracks Open in Dark Pool Defense with Barclays Lawsuit*, BLOOMBERG: BUSINESS (June 26, 2014), http://www.bloomberg.com/news/articles/2014-06-26/cracks-open-in-dark-pool-defense-with-schneiderman-barclays-suit.

452. *See* Robert H. Battalio, Shane A. Corwin & Robert Jennings, *Can Brokers Have it All? On the Relation Between Make-Take Fees and Limit Order Execution Quality* 1–5 (Oct. 20, 2015) (unpublished manuscript), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2367462; *see also* BLACKROCK, US EQUITY MARKET STRUCTURE: AN INVESTOR PERSPECTIVE 7 (2014), http://www.blackrock.com/corporate/en-us/literature/whitepaper/viewpoint-us-equity-market-structure-april-2014.pdf.

453. *Conflicts of Interest, Investor Loss of Confidence, and High Speed Trading in U.S. Stock Markets*: *Hearing Before the Permanent Subcomm. on Investigations of the S. Comm. on Homeland Sec. & Governmental Affairs*, 113th Cong. (2014) (statement of Robert H. Battalio, Professor of Finance, Mendoza College of Business, University of Notre Dame).

454. *See* BLACKROCK, *supra* note 452, at 2.

environment appears to offer incentives tempting broker-dealers to compromise their institutional integrity.[455]

Like the other principles outlined above, institutional integrity depends on the expectations of parties entering the financial markets. When we enter the financial marketplace, we do not expect that the venue on which we trade is complicit in ordering us up as prey to another class of traders. Similarly, we presume institutions are not lying when they make representations to participants in the markets and that, at some basic level, there is a "level playing field." These principles are the "conditions of the possibility of"[456] financial markets in general, and that is why critics of HFT ultimately believe it has a serious effect on market confidence. While market actors can violate these principles to some degree, in order for financial markets to flourish to the greatest extent possible, these principles, which are essentially moral, must be respected.

CONCLUSION

The four principles outlined above are abstract and essentially moral, but they also reflect bedrock principles of American securities regulation. In mandating extensive disclosure and policing the markets for fraud, insider trading, and other abuses, American securities law goes significantly beyond a "caveat emptor" approach.[457] Since it is difficult to draw useful estimates of costs and benefits in a system as complicated as the current equity markets, the principles of

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455. *See id.*

456. This mode of argument is modeled on Kant's philosophical method. Kant believed that the "categories of human understanding" functioned as the "a priori conditions of a possible experience in general" which in turn allow us to answer the questions: "How is pure mathematics possible? How is pure science of nature possible?" IMMANUEL KANT, CRITIQUE OF PURE REASON 56, 138 (N. Kemp-Smith trans., St. Martin's Press 1965) (c. 1781). Likewise, a modicum of trust in the ethical principles outlined above seems a necessary precondition for the possibility of financial markets. For a related argument based on the intersection of Kant's moral theory with economics, see Jean-Jacques Laffont, *Macroeconomic Constraints, Economic Efficiency and Ethics: An Introduction to Kantian Economics*, 42 ECONOMICA 430 (1975). This Kantian mode of argument is also found in the law and economics literature. *See* Pasquale, *supra* note 12, at 2117 ("Law is *constitutive* of so-called financial markets, not some mere side constraint on them."). Pasquale's argument is based on Pistor's "Legal Theory of Finance." *Id.* at 2087–89 (citing Katharina Pistor, *A Legal Theory of Finance*, 41 J. COMP. ECON. 315 (2013)).

457. *See* Gubler, *supra* note 416, at 415–23.

freedom from misrepresentation, a level playing field, and institutional integrity should play a strong role in building a regulatory strategy for HFT that best serves the goal of a stable, healthy, and just economy. These principles ultimately reflect a belief that financial markets transactions should qualify as reciprocal exchange.

While equity concerns are often pushed to the background in questions of financial regulation, where fundamental uncertainty surrounds the operation of causes and effects in a system as complex as the current financial markets, they are particularly useful as *ex ante* regulatory guides. A set of ethical principles can also function as a floor or minimum where a cost-benefit analysis fails to adequately safeguard the interests of individuals or groups of market actors, as is arguably the case with HFT. Despite HFT's role in the market revolution that has greatly lowered costs for most investors, the detailed look at the objectionable HFT practices presented in Part II illustrates that the interaction of various groups of financial market stakeholders with HFT provides grounds for the complaint that HFT is not fair.

A close look at HFT is also illuminating because it suggests that the greatest challenge presented by HFT may be that it undermines some of the implicit assumptions of Regulation NMS. As Donald MacKenzie observes, Regulation NMS is predicated upon a Newtonian world while HFT ushers in an Einsteinian one.[458] Regulation NMS makes sense if prices can be transmitted instantaneously to the SIP, but the speed at which HFT operates reveals gaps between different markets, i.e., the servers used by the exchanges, which HFT exploits. Regulation NMS was also formulated with little attention to the radical shift underway in the business model of the exchanges, and it seems to presume that exchanges could continue to earn money in their traditional manner as they competed with one another in a national market system. In reality the adoption of maker/taker pricing systems forces exchanges to compete with one another under a radically new business model. If the exchanges are forced to compromise their institutional integrity for the sake of their very survival in the new trading environment, this poses the question of whether there is a need for multiple trading venues in a world where all exchanges are closely knit together into a digitized

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458. *See* MacKenzie, *supra* note 6, at 41–42.

national market system. At the very least, the current travails show that the disruptions brought about by the information technology revolution require a new vision of an equitable trading environment.