NOTE

HIGH-FREQUENCY TRADING: SHOULD REGULATORS DO MORE?

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High-Frequency Trading ("HFT") is a diverse set of algorithmic trading strategies characterized by fast order execution. Its importance in international markets has increased vastly in recent years.[1] *From a regulatory perspective, HFT presents difficult and partially unresolved questions. The difficulties stem partly from the fact that HFT encompasses a wide range of trading strategies, and partly from a dearth of unambiguous empirical findings about HFT's effects on markets. Yet certain important conclusions are broadly accepted. HFT can increase systemic risk by causing or exacerbating events like the "Flash Crash" of May 6, 2010. HFT can also enable market manipulators to go undetected. Finally, HFT's supposed benefits to market quality (i.e., the complex and interrelated topics of liquidity, volatility, and price discovery) are questionable. Overall, the empirical research does not demonstrate that HFT has substantial social benefits justifying its clear risks. Regulatory measures including stronger monitoring, order cancellation taxes, and resting rules deserve more urgent attention.*

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[*] Matt Prewitt is a third-year student at the University of Michigan Law School. Many thanks to Professor Michael Barr, and to the editors of *MTTLR*, for their valuable assistance with this Note.

1. Jeremy Grant, *High-Frequency Trading: Up Against a Bandsaw*, FIN. TIMES (Sept. 02, 2010), http://www.ft.com/cms/s/0/b2373a36-b6c2-11df-b3dd-00144feabdc0.html (estimating that, in 2010, 56 percent of the equity trades in the United States and 38 percent in Europe were executed by high-frequency traders).

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INTRODUCTION

High-Frequency Trading ("HFT") has deservedly captured the attention of both regulators and the public. For some, HFT exemplifies the proposition that a financial elite is earning fortunes with socially useless techniques.[2] For others, HFT simply reflects the logical progression of technology in which markets operate with increasing speed, precision, and efficiency.[3] The truth lies between these caricatures; however, given the importance of HFT in modern markets, it is essential that regulators work assiduously to grasp the issues and ensure that these dynamic technologies do not cause unintended problems.

On May 6, 2010, HFT earned its place on the regulatory agenda when the Dow Jones Industrial Average lost nearly one thousand points in just a matter of minutes.[4] After the smoke cleared, it became apparent that no terrorist attack, sovereign default, mega-bankruptcy, or other fundamental event had occurred. Indices and stocks quickly recovered and closed the day down only about 3 percent.[5] But in an investigation of that frightening dislocation, the staffs of the Commodity Futures Trading Commission ("CFTC") and the Securities Exchange Commission ("SEC") determined that the sudden volatility had coincided with HFT activity.[6] A comprehensive report released several months later detailed the chain of events on May 6 and con-

2. *See generally* Charles Duhigg, *Stock Traders Find Speed Pays, in Milliseconds*, N.Y. TIMES (July 23, 2009), http://www.nytimes.com/2009/07/24/business/24trading.html.

3. *High-Frequency Trading*, THE ECONOMIST, http://www.economist.com/debate/overview/224 (last visited Oct. 22, 2012) (noting that 55 percent of The Economist's online voters believe that high-frequency trading contributes to the overall quality of markets).

4. Bruno Biais & Paul Woolley, High Frequency Trading 13 (Mar. 2011) (unpublished manuscript), *available at* http://idei.fr/doc/conf/pwri/biais_pwri_0311.pdf.

5. STAFFS OF THE COMMODITY FUTURES TRADING COMM'N & SEC. EXCH. COMM'N, FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010, at 1–3 (2010), *available at* http://www.sec.gov/news/studies/2010/marketevents-report.pdf [hereinafter CFTC-SEC FINDINGS].

6. *Id.*

cluded that HFT played a key role in exacerbating the markets' rapid downward movements.[7] By this time, it became clear to global regulators that HFT deserved their attention.

Several market events during the summer of 2012 renewed concerns about HFT. First, during Facebook's initial public offering on May 18, a high volume of rapid order cancellations overwhelmed NASDAQ's computer systems.[8] While the incident has not yet been comprehensively studied, HFT may have contributed to these technical problems, which interfered with many traders' orders.[9] Then, on August 1, HFT market maker Knight Capital caused rapid price movements in 150 NYSE stocks when one of its algorithms malfunctioned.[10] It appears that Knight's algorithm uncontrollably bought high and sold low, losing $440 million, causing irrational swings in affected stocks, and shaking the public's confidence in the integrity of the market.[11]

But how exactly does HFT work, and what issues does it raise? Have regulators properly evaluated these issues and taken steps to protect markets?[12] Section I of this Note summarizes the key strategies and methodologies that constitute HFT. Section II traces the thorny academic questions surrounding how HFT affects markets. Section III examines whether regulators in Europe and the United States have properly assessed the problem and taken the right regulatory steps. The Section further argues that regulators are moving in a good direction but nevertheless ought to place broader restrictions on HFT. In its conclusion, this Note argues that such broader restrictions—like cancellation taxes, transaction taxes, or resting rules—would mitigate HFT's proven downsides, but at the cost of HFT's speculative and unproven benefits.

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7. *Id.*

8. Michael J. De La Merced, *Nasdaq Concedes Facebook Missteps,* N.Y. TIMES (May 20, 2012), http://dealbook.nytimes.com/2012/05/20/nasdaq-chief-says-glitches-werent-at-fault-for-facebook-stock-plunge/.

9. *See, e.g.*, Ivy Schmerken, *Facebook: The Strangest IPO of All Time?*, WALL ST. & TECH. (May 24, 2012), http://www.wallstreetandtech.com/exchanges/facebook-the-strangest-ipo-of-all-time/240000996?pgno=1; *see also How HFT Caused the Opening Delay, and Later Benefited at the Retail Customer's Expense*, NANEX (May 18, 2012), http://www.nanex.net/aqck/3099.html.

10. *Knightmare on Wall Street*, NANEX (Aug. 13, 2012), http://www.nanex.net/aqck2/3522.html.

11. *Id.*

12. It is possible to conceive of HFT as a prudential issue in which regulators should ensure that HFT firms do not incur systemically harmful losses. From this viewpoint, HFT is merely a special case in the larger question of how to set capital and prudential requirements for hedge funds and other proprietary traders. This Note will focus primarily on the following inquiries: What are HFT's externalities in the market? How does the high volume of HFT on the market affect other participants? The answers to these questions reveal that HFT intimately affects general market quality, and therefore regulators should not view it as merely a risk to the firms that use it.

I. What is High-Frequency Trading?

HFT is an umbrella term referring to a diverse set of strategies whose common denominator is that they are algorithmic and attempt to use low latency (i.e., fast order execution) to gain an edge in the market. High-Frequency Traders ("HFTs") place many, if not most, of the trades on today's equity markets.[13] HFTs have achieved extraordinarily low latency, meaning that very little time elapses between when they send orders and when the orders are executed.[14] Top HFTs achieve latency of only a few thousandths of a second, such that millionths of a second are increasingly becoming the pertinent measure of latency.[15] Because additional increments of latency can be the difference between executing profitable trades and ceding opportunities to faster HFTs, the race to "zero latency" will likely continue unabated.

A range of institutions use HFT. Some hedge funds, like Citadel and Renaissance, make HFT a prominent part of their investing strategy.[16] Other firms, like Getco, focus exclusively on HFT strategies.[17] Banks engaging in proprietary trading have also used HFT, but the Volcker rule will diminish that activity by reducing banks' overall levels of proprietary trading.[18] Although traditional "buy-side" investors[19] do not generally use HFT, many institutional investors use order-execution services offered by HFT firms in order to optimize the price received or to escape detection by counterparties who want to avoid trading with them.[20]

A. *Strategies*

HFT strategies are diverse, proprietary, and complex, so it is not possible to describe them except at a somewhat unfortunate level of abstraction. Each strategy is susceptible to innumerable nuances, some of which I will describe in the following Sections. Furthermore, HFTs operate in diverse

13. *See* Grant, *supra* note 1.

14. Andrew G. Haldane, Exec. Dir. of Fin. Stability, Bank of Eng., Speech to the Int'l Econ. Ass'n Sixteenth World Congress: The Race to Zero 5 (July 8, 2011), *available at* http://www.bankofengland.co.uk/publications/Documents/speeches/2011/speech509.pdf.

15. *Id.*

16. Biais & Woolley, *supra* note 4, at 3.

17. *Id.*

18. *See* Dodd-Frank Act § 619, 12 U.S.C. § 1851 (2011). The Volcker Rule limits traditional banks' ability to trade with their own money.

19. "Buy-side" generally refers to institutions like mutual funds or pension funds which purchase large blocks of securities, typically for wealth management.

20. For example, Getco offers a service called "GETAlpha," which it describes on its website as follows: "GETAlpha is a customizable suite of trading tools built to capture advantages across rapidly changing markets, giving institutional investors a range of trading strategies expressly designed to navigate the complexities of today's multi-venue marketplace . . . . GETAlpha offers the investment community maximum liquidity with minimum detection." *GETAlpha*, GETCo, http://www.getcollc.com/GES/index.php/our_offerings/GETAlpha/ (last visited Nov. 23, 2012).

markets, from foreign exchanges ("FX") to derivatives and equities. Nonetheless, the principal strategies fall under this rubric: market making, momentum or event trading, liquidity detection, and arbitrage.

In market making, HFTs act like a faster version of traditional market makers who buy and sell securities in order to profit from the difference, or spread, between bid and ask prices.[21] In some cases, exchanges subsidize this type of trading because it makes trading easier for all participants. These subsidies come in the form of "rebates," or reduced transaction fees, which bolster the profitability of each liquidity-providing trade.[22] Speed provides an advantage in capturing the spread, because fast trades are less likely to be affected by price movements. A further difference between HFTs and traditional market makers is that traditional market makers have agreements with exchanges to continue providing liquidity even when they would rather not (for example, when the market is rapidly falling). In contrast, liquidity-providing HFTs sometimes do not participate in official market-making programs promoted by the exchanges. Such traders have the option of leaving the market, and thus ceasing their liquidity provision, at any time.[23]

In momentum or event trading, HFTs behave analogously to day traders. HFT algorithms use a variety of techniques to predict short-term price movements and place marketable orders in the direction of the movement. For example, momentum trading involves identifying price movements that are likely to persist in the short term, then trading directionally while the movement continues and ceasing when it stops.[24] HFTs may also make predictions involving statistical phenomena like mean reversion, which is the theory that prices tend to gravitate toward historically average levels.[25] Mean-reversion trading therefore involves betting that large deviations from historical average prices will not persist. Finally, HFTs may engage in event trading by betting on market responses to new information like economic data releases from the government or the Federal Reserve.[26]

In liquidity detection, HFT algorithms attempt to identify and profit from the actions of other large traders. For example, by aggregating multiple

21. Peter Gomber et al., High-Frequency Trading 25 (Mar. 2011) (unpublished manuscript), *available at* http://ssrn.com/abstract=1858626.

22. *Id.* Markets compete with each other in providing rebates in order to attract liquidity providers.

23. *See* Brian Weller, Liquidity and High Frequency Trading 7 (Nov. 10, 2012) (unpublished manuscript), *available at* http://home.uchicago.edu/~bweller/files/Liquidity_and_High_Frequency_Trading.pdf (discussing the categorization of fast traders who are not market makers as HFTs). For further discussion of HFT market making, see Albert J. Menkveld, High Frequency Trading and the New-Market Makers 27 (Feb. 6, 2012) (unpublished manuscript), *available at* http://ssrn.com/abstract=1722924.

24. Gomber et al., *supra* note 21, at 30.

25. BANK FOR INT'L SETTLEMENTS, HIGH-FREQUENCY TRADING IN THE FOREIGN EXCHANGE MARKET 5 (2011), *available at* http://www.bis.org/publ/mktc05.pdf.

26. *Id.*

data points from different exchanges and looking for characteristic patterns in variables like order depth, HFTs may determine the existence of a large hidden limit order or a large trader attempting to enter or exit a position.[27] Next, HFTs attempt to profit from the price movement created by other traders; for example, HFTs may buy just prior to the execution of other traders' large marketable orders.[28] A variant of this strategy involves attempting to detect and predict the behavioral patterns of other algorithmic traders and exploiting their impact on the market.[29]

Much HFT activity belongs in the broad category of arbitrage. Arbitrage involves identifying two or more securities that structurally tend to move in unison.[30] When they fall out of alignment, arbitrageurs buy the cheaper one and sell the more expensive one until the difference is eliminated.[31] Due to its speed, HFT can engage in arbitrage involving extremely short time frames and, consequently, extremely small price differences.[32] This makes it possible to profit from miniscule misalignments, for example, between identical assets on different exchanges.[33] HFT arbitrageurs can trade on misalignments between different markets, between derivatives and their underlying assets, between exchange-traded funds ("ETFs") and their constituent securities, or simply between statistically correlated assets on the same market.[34] "Latency arbitrage" involves trading in the sub-second time windows between when market prices move and when market makers update their quoted prices. During these time windows, HFTs have more information than slower traders, which allows them to profit at slower traders' expense.[35]

Unfortunately, these descriptions of HFT strategies come nowhere close to exhausting the topic; the possibilities and nuances surrounding each strategy are endless. It is important to note, however, that most of these strategies (in their high-frequency incarnations) involve not only fast ordering but also fast order cancellation.[36] HFT market makers, for example, constantly cancel orders to optimize their quotes and avoid entering into trades not informed by up-to-the-millisecond information.[37] Arbitrageurs

27. Gomber et al., *supra* note 21, at 28–29.
28. *Id.*
29. *Id.*
30. Biais & Woolley, *supra* note 4, at 6.
31. *Id.*
32. *Id.*
33. Gomber et al., *supra* note 21, at 27.
34. *Id.* at 27–28.
35. *See* BANK FOR INT'L. SETTLEMENTS, *supra* note 25, at 5.
36. Indeed, some researchers suggest using cancellation levels as a proxy for measuring HFT activity. *See* Bruno Biais, Thierry Foucault, & Sophie Moinas, Equilibrium High Frequency Trading 28 (Sept. 2011) (unpublished manuscript), *available at* http://ssrn.com/abstract=1834344.
37. INT'L ORG. OF SEC. COMM'NS, REGULATORY ISSUES RAISED BY THE IMPACT OF TECHNOLOGICAL CHANGES ON MARKET INTEGRITY AND EFFICIENCY 23 (2011).

and directional traders may also use rapid, frequent order cancellation for a range of purposes. For example, liquidity detection often involves sending out and immediately cancelling orders in order to gain information about invisible liquidity lurking off the public ticker (this is sometimes called "pinging").[38] If the ping results in a trade before it is cancelled, the HFT can use that information to infer the existence of a liquidity provider.

B. *Methodologies*

Familiarity with basic HFT methodologies helps one understand the toolbox available to HFTs and the current HFT environment more generally. In the immediate wake of the Flash Crash, U.S. regulators quickly took steps that served to limit some of the market-access methodologies available to HFTs. Regulations ensuring fairness in HFTs' methods of obtaining market access are, from a regulatory perspective, low-hanging fruit. Market participants have largely embraced these regulations,[39] and while the changes cannot eliminate fundamental concerns about HFT, they can meaningfully improve fairness and risk.

Prior to the Flash Crash, many HFT firms gained special access to exchanges using a technique called "naked access." With naked access, brokers allowed HFTs to essentially piggyback on the brokers' direct access to markets.[40] This permitted HFTs to reduce their trade latency while also avoiding the risk checks and capital requirements to which they would be subject if they were direct members of the market.[41] In November 2010, the SEC issued a new rule directed at brokers, Rule 15c3-5, that made this risk-exacerbating practice impossible.[42] The proposed revisions of the Markets in Financial Instruments Directive ("MiFID") would have the same effect in Europe.[43]

A second important tool for understanding the HFT environment is co-location. In the late 1990s through the early 2000s, many electronic exchanges began allowing firms to locate their servers at the same facility as the exchanges' servers.[44] This allows HFTs to achieve lower latency. It thus

38. Jaksa Cvitanic & Andrei Kirilenko, High Frequency Traders and Asset Prices 2 (Mar. 11, 2010) (unpublished manuscript), *available at* http://ssrn.com/abstract=1569075.

39. Gomber et al., *supra* note 21, at 41.

40. *Id.*

41. *Id.*

42. 17 C.F.R. § 240.15c3-5 (2012).

43. *Proposal for a Directive of the European Parliament and of the Council on Markets in Financial Instruments Repealing Directive 2004/39/EC of the European Parliament and of the Council*, at 25–26, COM (2011) 656 final (Oct. 20, 2011), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0656:FIN:EN:PDF [hereinafter *Proposed Directive*] ("It is desirable to ensure that all high frequency trading firms be authorised when they are a direct member of a trading venue. This should ensure they are subject to organisational requirements under the Directive and are properly supervised.").

44. *See, e.g.*, Graham Bowley, *The New Speed of Money*, N.Y. TIMES (Jan. 1, 2011), http://www.nytimes.com/2011/01/02/business/02speed.html?pagewanted=all.

confers advantages over other fast traders who are not co-located. Out of fairness concerns, the CFTC proposed a rule in June 2010 requiring uniform fees and access to co-location facilities.[45] The proposed new version of MiFID would likewise require equitable co-location practices.[46]

Perhaps the most controversial form of privileged market access for HFTs is the "flash order." Flash orders are particularly pertinent in the U.S. due to SEC Regulation NMS, which requires orders to be routed to the exchange offering the best price.[47] A flash order is a marketable order that, immediately prior to being rerouted in accordance with Regulation NMS, is flashed for milliseconds on the exchange where it is initially placed.[48] Because flash orders persist for only milliseconds, regular traders cannot place trades against them before they are withdrawn. HFTs, on the other hand, sometimes act quickly enough to execute against flash orders. Thus, observers have voiced concern about creating a "two-tier" market in which HFTs could trade amongst themselves, increasing their informational advantage over slow traders.[49] The SEC proposed eliminating the rule exception permitting flash orders in 2009, but has not finalized that change.[50] While some smaller exchanges have held out, most major exchanges have voluntarily stopped the practice. For example, Direct Edge stopped offering flash orders for stock trading in 2011, but apparently continued to allow flash orders for options trading.[51] Some smaller exchanges, like the Chicago Board Options Exchange ("CBOE"), have continued to allow flash orders on certain kinds of trades.[52]

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45. Co-Location/Proximity Hosting Services, 75 Fed. Reg. 33198 (proposed June 11, 2010); Gomber et al., *supra* note 21, at 43.

46. *Proposed Directive*, *supra* note 43, at 117 ("Member States shall require a regulated market to ensure that its rules on co-location services and fee structures are transparent, fair and non-discriminatory.").

47. 17 C.F.R. § 242.602(a)(1)(i) (2012) ("Each national securities exchange shall at all times such exchange is open for trading, collect, process, and make available to vendors the best bid, the best offer, and aggregate quotation sizes for each subject security listed or admitted to unlisted trading privileges which is communicated on any national securities exchange by any responsible broker or dealer, but shall not include: (A) Any bid or offer executed immediately after communication and any bid or offer communicated by a responsible broker or dealer other than an exchange market maker which is cancelled or withdrawn if not executed immediately after communication . . . .").

48. Gomber et al., *supra* note 21, at 42.

49. *Id.*

50. Elimination of Flash Order Exception from Rule 602 of Regulation NMS, Exchange Act Release No. 34-60684, 74 Fed. Reg. 48632 (Sept. 23, 2009), *available at* http://www.sec.gov/rules/proposed/2009/34-60684.pdf. For the Rule 602(a)(1)(i)(A) exception permitting flash orders, see 17 C.F.R. § 242.602 (2012).

51. Jacob Bunge, *Direct Edge to Stop "Flashing" Orders on Monday*, WALL ST. J. (Feb. 25, 2011), http://online.wsj.com/article/SB10001424052748703409304576166930877474292.html.

52. *See NBBO Step-Up*, CHI. BD. OF EXCH., https://www.cboe.org/hybrid/nbbosu.aspx (last visited Oct. 25, 2012) (describing the CBOE's National Best Bid and Offer "Step Up" system, which allows orders to be flashed for 150 milliseconds).

II. The Effects of High-Frequency Trading on the Market

While proponents argue that HFT is a socially beneficial liquidity provider,[53] many regulators and scholars worry that HFT harms various aspects of market functioning[54] and that HFT's liquidity benefits have been overstated.[55] This Section will summarize and evaluate the small but growing body of academic research pertaining to HFT's effect on markets. It will further discuss five distinct yet interrelated market qualities that HFT has been thought to influence: liquidity, volatility, price discovery, market resiliency, and market integrity.

A. *Liquidity*

A substantial body of literature suggests that HFT supplies liquidity to markets.[56] Liquidity refers generally to the ease of transacting; in this context, it is useful to think of liquidity as the ability to find ready buyers and sellers at or near the prevailing market price of a given security.[57] Uncontroversially, HFT can provide liquidity, such as by intermediating large orders: algorithms break large orders into pieces and rapidly find smaller buyers or sellers willing to transact at a price close to the prevailing market price.[58] By contrast, human intermediaries are slower and might need to find larger counterparties, potentially exposing themselves to delays and larger spreads.

53. Terrence Hendershott et al., *Does Algorithmic Trading Improve Liquidity?*, 66 J. Fin. 30, 30–31 (2011), *available at* http://faculty.haas.berkeley.edu/hender/Algo.pdf; Menkveld, *supra* note 23, at 27–28; Ray Riordan & Andreas Storkenmaier, *Latency, Liquidity and Price Discovery*, 20–21, 15 J. Fin. Mkts. 416 (2012).

54. *See generally* X. Frank Zhang, High Frequency Trading, Stock Volatility, and Price Discovery 33–35 (2010) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1691679; *Public Consultation: Review of the Markets in Financial Instruments Directive (MiFID)*, at 14–17, COM (2010), *available at* http://ec.europa.eu/internal_market/consultations/docs/2010/mifid/consultation_paper_en.pdf; *see also* CFTC-SEC Findings, *supra* note 5.

55. Andrei A. Kirilenko et al., The Flash Crash: The Impact of High Frequency Trading on an Electronic Market 37–38 (May 26, 2011) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1686004.

56. *See generally* Hendershott et al., *supra* note 53; Riordan & Storkenmaier, *supra* note 53.

57. Usually, liquidity is thought of as being "supplied" by limit orders, which execute only after the market price moves to a predetermined point, and "taken" by market orders that execute at whatever price is currently on offer, thereby diminishing depth on the other side of the book and potentially moving the price. HFT uses both kinds of orders routinely. *See* Joel Hasbrouck & Gideon Saar, Low-Latency Trading 12 (Feb. 2011) (unpublished manuscript), *available at* http://www.bus.umich.edu/academics/departments/finance/Sem%20Papers/W%202011%20Hasbrouck.pdf. However, algorithmic trading somewhat confounds this traditional way of thinking about liquidity, because some algorithms use limit orders in ways that effectively diminish liquidity. *Id.*

58. Hendershott et al., *supra* note 53, at 2.

HFTs have thus been analogized to a more efficient version of the pre-digital market maker or floor specialist.[59]

However, HFT does not always play this liquidity-supplying function. HFT firms may engage in rapid liquidity-taking trades or abruptly stop supplying liquidity.[60] Additionally, lower spreads caused by HFT's liquidity provision are partially illusory because HFT also tends to provide low order depth.[61] In other words, HFT market makers sometimes quote narrow spreads without being willing to buy or sell substantial quantities at those prices. Therefore, the low spread does not last if anyone tries to transact a significant quantity. Compounding these issues, HFT displaces other kinds of liquidity suppliers, like exchange-certified specialists—legacy market makers who might have been more likely to stay in the market during turbulence, thus preserving market liquidity and stability.[62]

HFT may also cause liquidity to dry up for more complex reasons. During the Flash Crash, the pressure of a single large sell order in the E-Mini—a major S&P 500 futures index—caused HFTs to acquire large blocks of E-Mini shares, which they then rapidly unloaded to escape their net-long position.[63] However, the only parties willing to rapidly purchase those shares were other HFT firms who had posted "stub quotes," or unrealistically cheap limit orders to buy.[64] These firms in turn resold to avoid holding a net-long position. This meant that many orders were executed at extremely cheap prices, so that the index fell rapidly, frightening traditional liquidity suppliers and fundamental buyers out of the market.[65] Under these conditions, HFT's creation of high trading volume did not correspond to a provision of real, high-quality liquidity.[66]

Thus, an overarching concern emerges from the literature: HFT might add liquidity to markets in good times, while having a negative effect when market conditions are adverse or volatile. Not reassuringly, one of the most important studies showing algorithmic trading's positive effect on liquidity was conducted during times of low volatility and rising prices.[67] Nonetheless, the literature broadly indicates that HFT does not negatively affect

59. Menkveld, *supra* note 23, at 6.

60. Hasbrouck & Saar, *supra* note 57, at 36.

61. Hendershott et al., *supra* note 53, at 22.

62. Hasbrouck & Saar, *supra* note 57, at 31 ("In the face of transient supply and demand, NYSE specialists were obligated to stabilize prices and maintain continuous presence in the market. They were subject to restrictions on reaching across the market to take liquidity (i.e., making destabilizing trades). Low-latency traders have no such obligations.").

63. CFTC-SEC FINDINGS, *supra* note 5, at 3.

64. *Id.* at 35–36.

65. *Id.* at 3–4.

66. *Id.* at 3.

67. Hendershott et al., *supra* note 53, at 31. This study shows that algorithmic trading (a broader category that includes HFT) had the effect of narrowing spreads by examining the periods before and after NYSE's introduction of Autoquote—a tool that facilitated the entry of many algorithmic traders. This occurred during the stable bull market of 2003.

liquidity conditions on a day-to-day basis when trading conditions are normal. Because concerns about HFT's effect on liquidity focus on the possibility that HFT takes liquidity during periods of unusual or volatile trading patterns,[68] this issue is interrelated with worries about HFT's effect on volatility.

B. *Volatility*

Probably the most prominent concern about HFT is that it may exacerbate volatility, a concern intensified by the Flash Crash. Yet when researchers discuss HFT's effect on volatility, they sometimes have very different conceptions of the term in mind.[69] Much research has focused on the kind of severe, sudden volatility exemplified by the Flash Crash (and more recently, the price fluctuations caused by Knight Capital's rogue algorithm). I will call this "anomalous volatility." Research on the Flash Crash has established beyond serious dispute that HFT has the potential to create anomalous volatility, as this Section will discuss. However, questions about HFT's effect on volatility under normal circumstances remain contested and warrant further research attention. I will call this kind of volatility "normal volatility." This Section will examine HFT's relationship with anomalous volatility, followed by an examination of HFT's effect on normal volatility.

1. Anomalous Volatility

Academic research surrounding the Flash Crash,[70] in concert with a joint report by the staffs of the SEC and CFTC,[71] depicts a concrete situation in which HFT exacerbated volatility initiated by an unusually large sell order in the E-Mini. The chain of events on that day is complicated. But, most notably, the SEC staff concluded that when HFT firms held too many shares of the E-Mini at a moment of sub-normal fundamental demand, they played "hot potato" by repeatedly selling to each other at very low prices, causing an abnormal decline in the E-Mini index.[72] HFT algorithms were transacting on the buy side, despite having an unwanted long position, because they were trying to take advantage of the liquidity that they expected other opportunistic buyers to supply in light of the sharply lower price.[73] Cross-index arbitrageurs and other liquidity suppliers did indeed buy the E-Mini while it was low, but not in quantities sufficient to stop the downward spiral.[74] Simultaneously, arbitraging HFTs sold the S&P 500 stocks to which the E-Mini was linked, reinforcing the illusion of a fundamental market event that

68. Kirilenko et al., *supra* note 55, at 22.
69. *Compare id.*, *with* Zhang, *supra* note 54.
70. *See, e.g.*, Kirilenko et al., *supra* note 55, at 25–26.
71. CFTC-SEC FINDINGS, *supra* note 5.
72. *Id.* at 3–4.
73. *Id.* at 15.
74. *Id.* at 5.

scared fundamental buyers out of the market.[75] The Flash Crash has become the paradigmatic instance of HFTs causing or exacerbating anomalous volatility.

Unusual market conditions triggered the Flash Crash: a sell order of rare magnitude against a backdrop of deep anxiety about European defaults.[76] Thus, the Flash Crash does not necessarily indicate that HFT has a general, everyday volatility-exacerbating effect. Of course, it is cold comfort if HFT only exacerbates volatility in situations of extreme stress, and the distinction has important regulatory implications. If HFT exacerbates volatility only in certain anomalous situations,[77] it might make sense for regulators to focus on preventing sudden crashes. But if HFT increases volatility more generally, broader regulatory action curtailing HFT under everyday circumstances might be justified.

2. Normal Volatility

Research conflicts on whether HFT increases volatility under normal market conditions. At least one study has suggested that stocks traded heavily by HFTs are causally linked with greater volatility.[78] Consistent with this finding, officials from the Bank of England have pointed toward higher cross-stock correlation as a proxy for HFT activity and have shown a positive relationship between cross-stock correlation and volatility.[79] Nevertheless, credible empirical research muddies this picture by showing that HFT decreases volatility in the short term.[80] Indeed, it makes sense that HFT's

75. *Id.* at 16–18.

76. The crash was initiated by a kind of perfect storm: one of the largest sell orders of the year, placed against a background of "thinning liquidity." *Id.* at 2–3. Under normal circumstances, arbitrageurs presumably absorb anomalous movements caused by HFT.

77. David Easley et al., *The Microstructure of the "Flash Crash": Flow Toxicity, Liquidity Crashes, and the Probability of Informed Trading*, J. PORTFOLIO MGMT., Winter 2011, at 118. The authors suggest the creation of a new futures contract linked to a metric of the probability of informed trading activity. They claim they have designed such a metric, which would have registered unusual activity just prior to the Flash Crash. They argue such a contract might help avoid future flash crashes for two reasons. First, HFTs could use it to hedge against insufficient liquidity from informed traders (also known as adverse selection), as occurred in the E-Mini during the Flash Crash. Therefore, at these dangerous moments, HFTs might be willing to remain liquidity-providing market makers, instead of turning into liquidity takers. Second, such a contract might give regulators or exchanges warning so that they could shut down or slow trading when informed traders are providing dangerously little liquidity.

78. Zhang, *supra* note 54, at 34–35. Zhang establishes a correlation between HFT activity and volatility, and supports a causal relationship between HFT and volatility by examining the 2003 NYSE Autoquote introduction as a natural experiment.

79. Haldane, *supra* note 14, at 14.

80. Jonathan Brogaard et al., High Frequency Trading and Volatility 30 (July 30, 2012) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1928510. Brogaard uses the temporary 2008 Short Sale Ban (with which the SEC banned short sales in the wake of the 2008 crash) as an exogenous shock, discerns the amount of HFT that was de facto banned by that measure, and then measures the resultant changes in volatility. He finds that HFT decreases intraday volatility. His study also indicates, however, that HFT

liquidity-providing function should dampen short-term volatility by making it possible to buy and sell without significantly altering prices. However, the research does not establish that HFT dampens volatility with any consistency, or that this short-term volatility dampening helps volatility in the longer term.

Until the question is more clearly resolved, regulators will face hurdles arguing that HFT creates general volatility costs (as opposed to anomalous Flash Crash–like events). Research on the severe Eurodebt-related volatility of summer and fall 2011, which some believe to have been exacerbated by HFT,[81] may eventually provide insight. But in the absence of more conclusive research on HFT's effect on everyday volatility, regulators are likely to remain focused on exceptional volatility events analogous to the Flash Crash or the Knight Capital rogue algorithm. There is little controversy over the thesis that HFT can take liquidity and exacerbate volatility in these kinds of anomalous circumstances.[82]

C. *Price Discovery and Market Efficiency*

Another important concern about HFT is that it damages price discovery processes.[83] In plain language, this is the worry that, either by introducing unreliable information into prices or by making conditions difficult for traders with sound information, HFT diminishes markets' ability to incorporate information into share values.[84] Price discovery is important because one of the most critical functions of public markets is communicating reliable economic information—even to non-market participants—through price levels.

becomes a liquidity taker when macro (i.e., not stock-specific) news induces market volatility, perhaps because macro news is hard to hedge against. This aspect of Brogaard's finding may therefore lend support to the hypothesis that HFT contributed to the extreme macro news–driven volatility of summer and fall 2011. Hasbrouck & Saar, *supra* note 57, at 36, find that HFT decreases short-term volatility. *But see* Brogaard et al., *supra*, at 5 (noting that the Hasbrouck & Saar study only looks at order book activity, an indirect proxy for HFT).

81. A sharp rise in the Chicago Board Options Exchange Market Volatility Index ("VIX") was fundamentally driven by uncertainty about the future of European economies, but may have been amplified by HFT. *See Off the Charts: Excess Stock Market Volatility*, N.Y. TIMES (Nov. 4, 2011), http://www.nytimes.com/interactive/2011/11/04/business/economy/Off-the-charts-excess-stock-market-volatility.html.

82. *See* Brogaard et al., *supra* note 80, at 30. Brogaard's study is perhaps the most-cited empirical work suggesting that HFT decreases intraday volatility. However, his study is consistent with the theory that HFT exacerbates volatility under turbulent circumstances. He finds that although HFT activity *overall* reduces *net* intraday volatility, HFT exacerbates volatility following macroeconomic news-induced movements.

83. INT'L ORG. OF SEC. COMM'NS, *supra* note 37, at 27.

84. It is important to note the interconnections between questions about HFT's role in price discovery, liquidity, and volatility. As explained *supra* note 57, a traditional supplier of liquidity places limit orders. Limit orders allow transactions to take place without a change in the price. Liquidity suppliers tend to dampen a price's response to new information. Marketable orders, on the other hand, are generally understood as facilitating price discovery. Accordingly, Hendershott et al., *supra* note 67, at 23 conclude that HFTs aid price discovery through their marketable orders.

Rightly or wrongly, the issue of HFT's potential harm to price discovery has generated less public concern than the issue of volatility. Some regulators accept the argument that HFT helps price discovery.[85] Nonetheless, many academics consider HFT's effect on price discovery to be a key concern.[86]

HFT might either harm or help price discovery processes for several intuitive reasons, and it is helpful to keep these in mind. First, HFTs hold their securities for short periods of time to avoid exposure to fundamental-driven price movements[87] and therefore have little interest in the fundamental value of the securities they trade. This suggests that HFTs do not contribute new information to security prices, unlike long-term investors who carefully analyze the underlying value of assets. On the other hand, HFTs outperform traders not using high-frequency strategies in some price discovery contexts. Many HFTs are, in one form or another, arbitrageurs.[88] Thus, when asset *A*'s value is affected by changes in the price of asset *B*, HFTs incorporate this information more quickly and accurately than slower human traders.[89]

Different HFT strategies, just like various traditional trading strategies, have differing effects on price discovery. This makes it problematic to study the price discovery implications of HFT as an umbrella category.[90] Unfortunately, much of the leading empirical research on price discovery research does just that:[91] its findings pertain to HFT's aggregate contribution to price discovery. This creates interpretive difficulties. The problem is that an overall positive effect of HFT on price discovery might hide the fact that some subset of HFT harms price discovery.[92] For example, even if cross-market price arbitrage helps price discovery, some statistical arbitrage strategies might contribute unreliable information to prices.[93] Further, market-making

85. Eur. Sec. & Mkt. Auth., *Consultation Paper: Guidelines on Systems and Controls in a Highly Automated Trading Environment for Trading Platforms, Investment Firms and Competent Authorities* 51, ESMA/2011/224 (July 20, 2011), *available at* http://www.esma.europa.eu/system/files/esma_2012_122_en.pdf.

86. *See, e.g.*, Zhang, *supra* note 54, at 1–2; Biais & Woolley, *supra* note 4, at 14–15.

87. Kirilenko et al., *supra* note 55, at 17.

88. *See supra* notes 30-35 and accompanying text.

89. Biais & Woolley, *supra* note 4, at 6. Arbitrage strategies also target differing price movements in the same asset on different exchanges, triangular arbitrage as in FX trading, and more complex strategies.

90. Zhang, *supra* note 54, at 10 ("A tick by tick study using open market data is likely to be influenced by HFT's market making activities, which tend to be more beneficial to the capital market than aggressive HFT strategies.").

91. *See id.* at 3–4; *see also* Jonathan Brogaard, High Frequency Trading and Its Impact on Market Quality 6 (July 16, 2010) (unpublished manuscript), *available at* http://www.futuresindustry.org/ptg/downloads/HFT_Trading.pdf. One partial exception is Jonathan Brogaard et al., High Frequency Trading and Price Discovery 26–28 (July 30, 2012) (unpublished manuscript), *available at* http://ssrn.com/abstract=1928510, which separately analyzes the price discovery implications of HFT's limit orders and marketable orders.

92. *See* Zhang, *supra* note 54, at 3.

93. While cross-market arbitrageurs trade on information about the same asset in other fora, statistical arbitrage strategies trade on more speculative relationships between different assets. *See supra* notes 30–36 and accompanying text.

HFT strategies have wholly different price discovery implications.[94] Researchers who treat HFT as a monolithic whole do so due to the impracticability of distinguishing between strategies in the datasets, but regulators have the option of regulating different HFT strategies differently.[95] Regulators should pay attention to this interpretive problem. Nonetheless, regulators can gain considerable insight from existing studies.

Empirical findings conflict regarding HFT's aggregate contribution to price discovery. However, the view advanced in Jonathan Brogaard's research has been broadly endorsed.[96] Brogaard suggests that price movements initiated by HFT have a more lasting effect than price movements initiated by non-HFT, indicating that HFT helps price discovery.[97] Brogaard, Hendershott, and Riordan lend support to this view, finding that HFT's marketable orders tend to move in the direction of non-transitory price changes.[98] On the other hand, X. Frank Zhang finds that—consistent with traditional (i.e., pre-HFT) theories about short-run trading—HFT causes prices to overreact to news about a company's fundamentals.[99] Yet Zhang's findings do not necessarily contradict those of Brogaard, or of Hendershott and Riordan, because Zhang purports to examine price efficiency over longer time frames than his colleagues.[100] Zhang's study examines price efficiency over the course of months, whereas his colleagues look at price efficiency within the day.[101] Acknowledging this distinction, Hendershott and Riordan raise a serious concern that Zhang's methodology may be overinclusive, capturing the effects of non-HFT short-term trading.[102]

The scholarly debate over HFT's effect on price discovery therefore continues. But the research proclaiming that HFT helps price discovery should fail to ease regulators' minds. What do these findings really mean?

94. Gomber et al., *supra* note 21, at 59; Zhang, *supra* note 54, at 10.

95. In September 2011, the SEC and FINRA requested computer code used in trading from several HFTs in order to examine it in detail. Although most observers believe this request was aimed at finding illegal or market-manipulating algorithms, it was also a potential first step towards differentiating between different HFT strategies in regulation. *See* Sarah N. Lynch & Jonathan Spicer, *U.S. Regulators Seek High-Frequency Trading Secrets*, REUTERS (Sept. 2, 2011, 9:34AM), http://in.reuters.com/article/2011/09/02/idINIndia-59107920110902.

96. *See, e.g.*, Eur. Sec. & Mkt. Auth., *supra* note 85, at 63; BANK FOR INT'L SETTLEMENTS, *supra* note 25, at 13.

97. *See* Brogaard, *supra* note 91, at 46, 53.

98. Brogaard et al., *supra* note 91, at 2. They also find that HFTs' limit orders, which have less of an effect on price, tend to lose money and to execute against informed counterparties. *Id.* Costs are recouped in these trades through the bid-ask spread and liquidity rebates. *Id.*

99. Zhang, *supra* note 54, at 26.

100. Zhang examines accumulated effects on price discovery over the course of quarters. *Id.* at 9–10. Brogaard, Hendershott, and Riordan, on the other hand, examine whether HFT primarily participates in short-term price movement versus utterly ephemeral "noise." Brogaard et al., *supra* note 91, at 2–3.

101. *See* Zhang, *supra* note 54, at 26.

102. Brogaard et al., *supra* note 91, at 4 n.5.

Brogaard, Hendershott, and Riordan's findings show that "HFT predicts price movements for only tens of seconds."[103] If this short-term price discovery is predicated on information that slower traders would otherwise have soon acted upon, HFT's price discovery function creates little or no social benefit.[104] On the contrary, it may discourage beneficial market participation by trading ahead of market participants who have valid information.[105] Brogaard's finding that HFTs successfully strive to provide liquidity disproportionately to uninformed traders bolsters this possibility.[106] The picture that emerges from the literature is one in which HFTs trade in the same direction as price movements, but in doing so make trading cheaper for uninformed investors, and more expensive for investors who know something about where the price ought to move. Regulators also cannot forget that this nominal contribution to short-term price discovery likely cloaks subsets of HFT activity that are harmful to price discovery—or even outright manipulative, a subject further explored in Section II.E.

D. *Cross-Market Propagation, Systemic Risk, and Market Resiliency*

Although the Flash Crash began with a plunge in the E-Mini, it did not remain confined to that derivative alone. Rather, the plunge was rapidly mirrored in every major index and in individual company stocks.[107] This happened even though no fundamental economic event triggered the plunge. SEC and CFTC investigators concluded that the E-Mini plunge spread rapidly to other stocks and indices through the activity of HFTs that automatically arbitrage misalignments between related indices, and between indices and the basket of stocks to which they correspond.[108] This phenomenon, sometimes called cross-market propagation,[109] raises concerns that HFT may increase systemic risk by making markets less resilient to serious price dislocations.

HFT may cause price dislocations to propagate through markets via various channels. As in the Flash Crash, HFT may send a shock spreading from a derivative to its underlying assets. Similarly, HFT may rapidly propagate price dislocations between similar stocks, between stocks and ETFs, and between different trading platforms and exchanges.[110]

The flipside of this potential problem is that HFT helps investors deal with fragmented markets by arbitraging prices between exchanges and

103. *Id.* at 19.
104. Brogaard, Hendershott, and Riordan note that they have no evidence as to whether HFT incorporates information that slower humans would have incorporated anyway. *Id.*
105. *Id.*
106. Brogaard, *supra* note 80, at 11–16.
107. CFTC-SEC FINDINGS, *supra* note 5, at 16–18.
108. *Id.*
109. *Id.* at 16.
110. Haldane, *supra* note 14, at 14.

bringing liquidity supplies into alignment.[111] Consistency across exchanges may be particularly important in Europe in light of the market fragmentation caused by MiFID,[112] as discussed in Section III.A.1. Regulators must weigh the benefits of cross-market consistency against the possible harms of propagating erroneous or panic-induced price movements across markets before circuit breakers, or cooler heads, have a chance to engage.[113] Greater systemic risk is a high price to pay for miniscule increases in consistency between markets.

E. *Manipulation and Market Integrity*

Due to the speed of the trades and the complexity of the algorithms, it is difficult for regulators to detect when HFTs engage in manipulative or illegal behavior. Officials have openly admitted that they lack the tools to effectively monitor HFT.[114] Anecdotal accounts of HFTs engaging in price manipulation abound,[115] and FINRA has sanctioned at least one HFT firm for a blatantly manipulative strategy.[116] Whether justified or not, the fear of manipulative HFT has driven some retail investors out of the market.[117] Regulators are accordingly concerned about rooting out market abuse and reassuring market participants that they are safe from exploitation by HFT.

HFTs can use their superior speed profitably to deceive other market participants. Three established abusive strategies carry the nicknames "stuffing," "smoking," and "spoofing."[118] "Stuffing" involves submitting huge numbers of orders—most of which will be cancelled prior to execution—so that the exchange becomes congested and slow traders' information becomes unreliable. HFTs then trade against misinformed orders they

111. Gomber et al., *supra* note 21, at 6.

112. *Id.* at 11.

113. *See* INT'L ORG. FOR SEC. COMM'NS, *supra* note 37, at 29–30.

114. For example, commenting on the need for a Consolidated Audit Trail system to monitor HFT, FINRA's VP for market regulation noted that "there's an expectation gap between what market participants expect and what we actually have." James Armstrong, *Officials Call CAT 'Long Overdue'*, TRADERS MAG. (Sept. 21 2011), http://www.tradersmagazine.com/news/cat-sec-finra-109439-1.html. SEC Chairman Mary Schapiro similarly told Congress in March 2011 that "the SEC's ability to collect trading data is 'wholly inadequate to the task of overseeing the largest equity markets in the world.' " Scott Patterson, *SEC Pushes Plan for Audit System*, WALL ST. J. (Sept. 21, 2011), http://online.wsj.com/article/SB10001424053111904491704576574883908453622.html.

115. *See, e.g.*, *HFT Quote Stuffing Market Manipulation Caught in the Act*, ZEROHEDGE.COM (Aug. 25, 2011), http://www.zerohedge.com/news/hft-quote-stuffing-market-manipulation-caught-act (market observers purporting to find evidence of quote stuffing).

116. Press Release, Fin. Indus. Reg. Auth., FINRA Sanctions Trillium Brokerage Services, LLC, Director of Trading, Chief Compliance Officer, and Nine Traders $2.26 Million for Illicit Equities Trading Strategy (Sept. 13, 2010), *available at* http://www.finra.org/Newsroom/NewsReleases/2010/P121951

117. INT'L ORG. FOR SEC. COMM'NS, *supra* note 37.

118. Biais & Woolley, *supra* note 4, at 8–9.

induce.[119] In "smoking," HFTs post generously priced limit orders with the intention of inducing a flow of slow marketable orders. The HFTs then cancel their generously priced limit orders before they execute and trade with the incoming marketable orders on more advantageous terms.[120] In "spoofing," HFTs place large limit orders to sell that are above the best asking price, with the intention of quickly cancelling them if the price moves upwards so that they will not be executed. The HFTs hope during spoofing that the size of the sell orders will scare other traders into selling at a low price, thus allowing the HFTs to scoop up a bargain.[121] This list of deceptive strategies is not exhaustive, but it provides insight into HFTs' ability to use speed to illegally hoodwink slower investors.[122]

III. Regulatory Responses

Responding to the concerns outlined above, regulators and exchanges have taken a range of measures to control HFT. Yet many promising ideas have not yet been implemented, and consensus on some points remains elusive. Regulators have taken serious steps to avoid other flash crashes, but a comprehensive regulatory approach capable of addressing all of HFT's issues has yet to emerge. A lack of conclusive evidence on certain questions is no doubt partially responsible,[123] as is financial regulators' preoccupation with other pressing issues during the last few years. These factors aside, we now know enough about HFT that global regulators should feel comfortable acting aggressively. Regulators must move beyond the limited paradigm of protecting against flash crashes, and instead acknowledge that the benefits of widespread, unmonitored HFT do not justify the costs and risks it imposes.

This discussion will first draw a distinction between three complementary, non-mutually exclusive regulatory perspectives on HFT. The first perspective, which emerged in response to the Flash Crash, sees HFT as a potential source of systemic risks. The second perspective approaches HFT as a potential location of illegal or deceptive activity. The third perspective looks at HFT as a potentially harmful influence on day-to-day market functioning. Each of these perspectives reflects distinct, non-mutually exclusive empirical conclusions about HFT's effects and urges different remedies.

Next, this Note will contend that all three of these perspectives deserve a place in the U.S. and European regulatory schemes. It will also catalog the implications of the current state of affairs, in which regulators lack adequate

119. *Id.*
120. *Id.*
121. *Id.*
122. *See infra* Part III.A.2 (discussing the legal implications of HFT market manipulation).
123. For example, compare Zhang, *supra* note 54, with Brogaard et al., *supra* note 91, for a discussion on price discovery.

visibility into HFT activity.[124] If regulators cannot monitor and understand HFT activity in detail, they cannot enforce targeted rules that exclusively affect "bad apple" HFT strategies.[125] To the extent that detailed oversight is impracticable, broad-brush (and occasionally overinclusive) rules on HFT may be appropriate. Finally, since the existing evidence does not demonstrate that a slowdown in HFT would substantially harm the markets, regulators should not shy away from aggressive measures.

A. *Three Complementary Perspectives for Regulators*

In the previous Section, this Note discussed five aspects of market functioning that may be impacted by HFT: liquidity, volatility, price discovery, market resiliency, and market integrity. These aspects of market functioning interact in complex ways. For example, if HFT removes liquidity during times of market unpredictability, it may exacerbate volatility.[126] On the other hand, if it provides liquidity under normal circumstances, it may facilitate price discovery—yet this effect may be mitigated if it provides liquidity selectively to uninformed counterparties.[127] This makes for an extremely knotty and nuanced range of possible views on HFT. However, this tangled range of views can be rendered manageable. We can summarize regulators' views on HFT by examining how they answer the following three questions:

1. Is HFT a systemic risk? Regulators on both sides of the Atlantic largely answer affirmatively in light of the Flash Crash and have taken precautionary measures.[128]

2. Is HFT a likely locus of illegal market manipulation? Regulators on both sides of the Atlantic acknowledge that this is a potentially large problem, and they currently lack the tools and resources to deal with it effectively.[129]

3. Does HFT harm market quality (i.e., liquidity, volatility, and price discovery) on a day-to-day basis, regularly imposing

124. *See* Brogaard et al., *supra* note 91.

125. "Targeted rules" refers to those rules that target subsets of HFT, i.e., rules aimed specifically at market manipulators or at HFT algorithms engaging in particular statistical arbitrage strategies. "Broad-brush regulation" means measures that do not depend on the ability to distinguish between different HFT strategies, like circuit breakers or across-the-board transaction taxes.

126. CFTC-SEC FINDINGS, *supra* note 5 (finding that when HFT removes liquidity during times of market unpredictability, it may exacerbate volatility and could potentially lead to a flash crash).

127. *See supra* note 91.

128. *See generally* BANK FOR INT'L SETTLEMENTS, *supra* note 25; INT'L ORG. FOR SEC. COMM'NS, *supra* note 37.

129. *See, e.g.*, Haldane, *supra* note 14.

serious negative externalities? This is a more controversial proposition, with many regulators apparently undecided.[130]

The regulatory perspectives that flow from affirmative answers to these questions are not mutually exclusive. In other words, there is no contradiction in seeing HFT as a potential systemic risk, a likely locus of illegality, and a detriment to everyday market quality. In general, regulators give a stronger affirmative answer to the first question than to the second two. This is understandable given that the Flash Crash armed regulators with tangible evidence of HFT's contribution to systemic risk. On the other hand, the evidence also compels a strongly affirmative answer to the second question and a weakly affirmative or neutral answer to the third question. Adopting all three of these perspectives simultaneously is key to developing an efficient and comprehensive policy on HFT, as illustrated by Figure 1 below.

FIGURE 1

	1. Systemic Risk	**2. Illegality**	**3. Harm to Day-to-Day Market Quality**
Regulatory remedy urged	• Circuit breakers • Enforceable market-making obligations • Naked-access ban	• Consolidated Audit Trail • Increased securities law enforcement • Regulatory review of algorithms	• Pigovian tax schemes • Limit up/limit down rules • Resting rules
Regulatory remedies urged by the three perspectives on HFT risk, when taken together	If HFT imposes systemic risks, hides illegal activity, and has a negative or neutral effect on market quality, its harms likely outweigh its benefits. The three propositions taken together therefore suggest that more restrictive regulatory measures—like resting rules[131] and cancellation or transaction taxes—are probably justified.		

As a whole, U.S. and European regulators have taken the threat of systemic events like the Flash Crash seriously, placing them on the right track regarding HFT policy. Some abusive HFT methodologies—most notably naked or unfiltered access—have been eliminated.[132] In November 2010, the SEC approved rules banning stub quotes—posted orders at grossly implausible prices that can exacerbate price swings.[133] Furthermore, in June 2012, the SEC announced its approval of limit up/limit down rules.[134] U.S. ex-

130 *See, e.g.*, BANK OF INT'L SETTLEMENTS, *supra* note 25; INT'L ORG. OF SEC. COMM'NS, *supra* note 37.

131. Haldane, *supra* note 14, at 17–18.

132. Press Release, SEC, SEC to Publish for Public Comment Updated Market-Wide Circuit Breaker Proposals to Address Extraordinary Market Volatility (Sept. 27, 2011), *available at* http://www.sec.gov/news/press/2011/2011-190.htm.

133. Press Release, SEC, SEC Approves New Rules Prohibiting Market Maker Stub Quotes (Nov. 8, 2010), *available at* http://www.sec.gov/news/press/2010/2010-216.htm.

134. Press Release, SEC, SEC Approves Proposals to Address Extraordinary Volatility in Individual Stocks and Broader Stock Market (June 1, 2012), *available at* http://www.sec.gov/news/press/2012/2012-107.htm; *see also* JOINT CFTC-SEC ADVISORY

change rules are also moving in the right direction: most recently, Nasdaq and Direct Edge implemented fees, albeit on fairly lenient terms, for very large order cancellations.[135] European regulators, too, are discussing serious changes in HFT regulation for MiFID II, which could take effect around 2015.[136] But risks remain, and far too little has been done to root out HFT market manipulation. Although regulators have discussed good ideas, change has been tentative and incremental.

While caution regarding unintended consequences is warranted,[137] deference to the questionable evidence of HFT's market benefits is not. The empirical research does not demonstrate that HFT has enough clear social utility to justify its clear risks. Below, this Note explains and evaluates recent regulatory actions within the three perspectives of systemic risk, illegality, and market quality. It builds toward the conclusion that regulators should move forward confidently with measures like resting rules or cancellation taxes that would broadly alter the practice of HFT.

1. High-Frequency Trading as a Systemic Risk

The Flash Crash served as a wake-up call that alerted many regulators to the threat of HFT-related systemic crashes.[138] Consequently, regulators have taken a proactive stance on this aspect of HFT. In 2011, the CFTC and SEC proposed a basket of rational safeguards against other flash crashes, and pursued regulations implementing them.[139] These included updated circuit breakers, limit up/limit down mechanisms,[140] stub quote bans, and naked-access bans.[141] The SEC has put some of these proposals into law, updating

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COMM. ON EMERGING REGULATORY ISSUES, RECOMMENDATIONS REGARDING REGULATORY RESPONSES TO THE MARKET EVENTS OF MAY 6, 2010 (2011), *available at* http://www.cftc.gov/ucm/groups/public/@aboutcftc/documents/file/jacreport_021811.pdf [Hereinafter JOINT ADVISORY RECOMMENDATIONS].

135. Telis Demos, *U.S. Bourses to Fine HFT Data-Cloggers*, FIN. TIMES (Mar. 7, 2012, 11:55 PM), http://www.ft.com/intl/cms/s/0/8d3aead4-689b-11e1-b803-00144feabdc0.html#axzz1q4odaTL6.

136. *See generally* Oliver Linton, Maureen O'Hara & Jean-Pierre Zigrand, Economic Impact Assessments on MiFID II Policy Measures Related to Computer Trading in Financial Markets (U.K. Gov't Office of Sci., Foresight Project Working Paper, Aug. 2012).

137. The main worry is diminishing market liquidity, discussed in Section II.A. Another worry is that overzealous regulation of algorithms' content may cause a proliferation of similar algorithms that will fail to offset one another in the market, thus creating systemic risks. *See* Gomber et. al, *supra* note 21, at 60–61. This concern seems primarily directed at detailed regulation of algorithms' content (as opposed to broad-brush measures like mandatory resting periods), but more research is warranted.

138. *See, e.g.*, CFTC-SEC FINDINGS, *supra* note 5, at 6–8; BANK OF INT'L SETTLEMENTS, *supra* note 25, at 15–17; INT'L ORG. FOR SEC. COMM'NS, *supra* note 37, at 11–12.

139. *See* JOINT ADVISORY RECOMMENDATIONS, *supra* note 134.

140. Limit up/limit down mechanisms restrict the speed at which the price of an exchange-traded security can fluctuate. *See id.* at 5; *see also* Haldane, *supra* note 14, at 17–19 (discussing the proposed regulations in the U.S. and Europe).

141. *See* JOINT ADVISORY RECOMMENDATIONS, *supra* note 134, at 4.

the circuit-breaking rules several times, and most recently supplementing them with a limit up/limit down regime.[142] Additional regulatory achievements include eliminating stub quotes and naked access in U.S. markets.[143] SEC Chairman Mary Schapiro has also claimed that the updated circuit-breaking rules prevented Knight Capital's rogue algorithm from causing greater damage.[144] Still tighter SEC circuit-breaking rules will go into effect in February 2013, at the same time as the limit up/limit down regime.[145] Regulators have further discussed imposing market-making guidelines on HFTs, but continue to allow exchanges to manage these obligations.[146] Together, these measures should reduce the risk of a Flash Crash repeat. But how do they work?

Circuit breakers are mechanisms designed to prevent or correct anomalous trades or halt trading when there is evidence of dangerous volatility.[147] SEC-mandated circuit breakers have been in place since 1988, but prior to 2012, they were only triggered once, in 1997.[148] Unhappily, they failed to trigger during the Flash Crash because "the downturn was not broad enough."[149] Accordingly, the SEC implemented a new, more sensitive system in September 2010.[150] These new circuit breakers do not require a broad downturn to trigger; rather, they temporarily stop trading in systemically important individual stocks and ETFs if their prices move rapidly within a five-minute period.[151] This should reduce the severity of irrational, non-

142. Notice of Filing of a National Market System Plan to Address Extraordinary Market Volatility, 76 Fed. Reg. 31647-01 (June 1, 2011); Press Release, SEC, SEC Announces Filing of Limit Up-Limit Down Proposal to Address Extraordinary Market Volatility (Apr. 5, 2011), *available at* http://www.sec.gov/news/press/2011/2011-84.htm.

143. Press Release, SEC, SEC to Publish for Public Comment Updated Market-Wide Circuit Breaker Proposals to Address Extraordinary Market Volatility (Sept. 27, 2011), *available at* http://www.sec.gov/news/press/2011/2011-190.htm.

144. Press Release, SEC, Chairman Schapiro Statement on Knight Capital Group Trading Issue (Aug. 3, 2012), *available at* http://www.sec.gov/news/press/2012/2012-151.htm.

145. *Investor Bulletin: New Measures to Address Market Volatility,* SEC (July 23, 2012), http://www.sec.gov/investor/alerts/circuitbreakersbulletin.htm.

146. Market-making guidelines are obligations designed to prevent liquidity providers from fleeing the market in times of stress. These would mirror the liquidity-providing obligations of exchange "specialists"—analog market makers who have largely been supplanted by HFT. JOINT ADVISORY RECOMMENDATIONS, *supra* note 134, at 10.

147. CFTC-SEC FINDINGS, *supra* note 5, at 7.

148. Press Release, SEC, *supra* note 143.

149. *Investor Bulletin: New Stock-by-Stock Circuit Breakers*, SEC (Aug. 9, 2011), *available at* http://www.sec.gov/investor/alerts/circuitbreakers.htm.

150. Press Release, SEC, SEC Approves Rules Expanding Stock-by-Stock Circuit Breakers and Clarifying Process for Breaking Erroneous Trades (Sept. 10, 2010), *available at* http://www.sec.gov/news/press/2010/2010-167.htm.

151. *Investor Bulletin*, *supra* note 149; SEC Press Release, *supra* note 150, at 2 ("For stocks priced $25 or less, trades will be broken if the trades are at least 10 percent away from the circuit breaker trigger price. For stocks priced more than $25 to $50, trades will be broken if they are 5 percent away from the circuit breaker trigger price. For stocks priced more than $50, the trades will be broken if they are 3 percent away from the circuit breaker trigger price.").

fundamental shocks. The 2011 "stock-specific" circuit breakers have indeed mitigated (though not prevented) harm by stopping trading in stocks affected by Knight Capital's rogue algorithm on August 1, 2012.[152] In addition to these stock-specific circuit breakers, the SEC has approved measures making market-wide circuit breakers easier to trigger, which will go into effect on February 4, 2013.[153]

The SEC goes beyond circuit breakers in its attempt to control HFT-related systemic risk. It also restricts stub quotes in equity markets.[154] Stub quotes, once again, are offers to buy or sell at prices unrealistically far from the current market price.[155] Stub quotes played a key role in the Flash Crash because when other liquidity providers fled the market, HFTs actually consummated transactions at wildly low prices, causing the market to plunge.[156] The stub quote ban is a prudent measure that should reduce the risk of a Flash Crash recurrence. Furthermore, the SEC has adopted measures clarifying the rules on erroneous trade nullification, requiring broker dealers to control risk within private trading pools, and prohibiting brokers from giving clients naked access to public exchanges.[157] The naked access ban closes a dangerous loophole that allowed HFTs to get direct access to exchanges by trading on their broker's account, thus avoiding risk checks and capital requirements.[158] Naked access therefore compounded HFT's other problems by adding counterparty risk.

These rules are not perfect and do not reach all non-equity markets where HFT is also abundant (e.g., FX markets). Intermarket cross-linkages remain extremely tight due to rapid HFT arbitrage, so that volatility in one market sector could threaten wider markets. Overall, however, the SEC has been fairly proactive and may deserve credit for the fact that the Knight Capital algorithm did not cause disastrous cross-market propagation.

Additional important safeguards, including a limit up/limit down mechanism restricting single-stock short-term volatility, will take effect in 2013, further protecting U.S. markets.[159] By preventing the most disruptive and irrational trades from occurring in the first place (rather than stopping trading after they occur), this measure will likely improve markets' resiliency.[160]

152. Press Release, SEC, *supra* note 144.

153. *Investor Bulletin: New Measures to Address Market Volatility*, SEC (July 23, 2012), http://www.sec.gov/investor/alerts/circuitbreakersbulletin.htm.

154. Quotation Standards for Market Makers, Exchange Act Release No. 34-63255, 2010 WL 4466998 (Nov. 5, 2010), *available at* http://www.sec.gov/rules/sro/bats/2010/34-63255.pdf.

155. *Id*.

156. CFTC-SEC FINDINGS, *supra* note 5, at 38–39.

157. *Id.*

158. Gomber et al., *supra* note 21, at 41.

159. *Investor Bulletin*, *supra* note 153.

160. *Id.* ("Because single-stock circuit breakers are triggered after a trade occurs at or outside of the applicable percentage threshold, circuit breakers have been triggered by erroneous trades. In contrast, the new limit up-limit down mechanism is intended to prevent trades in

In sum, U.S. regulators have probably reduced the likelihood of a systemic, Flash Crash–like recurrence, but risks remain.

European authorities have been relatively slow to implement similar measures,[161] although European exchanges have long had stock-specific circuit breakers.[162] Nevertheless, European lawmakers are currently debating a range of aggressive proposals for the new iteration of the MiFID. Proposed versions of the legislation would mirror many actions taken by U.S. regulators, and in some cases go much further in restricting HFT.

In a July 2011 speech, the Bank of England's Executive Director of Financial Stability argued for three aggressive measures dealing with HFT-related crashes: stricter market-making guidelines, strict circuit breakers, and resting rules.[163] Market-making guidelines would obligate HFTs to continue providing liquidity under adverse market conditions.[164] Many criticize this idea because under stressful market circumstances, market makers may prefer to incur fees than to risk disastrous trades;[165] but if implemented sensitively, it has the potential to mitigate the effect of HFTs withdrawing liquidity, as they did in the Flash Crash. Resting rules, explained further below, would impose a minimum trading speed and thus reduce the speed at which market makers could withdraw liquidity.[166]

Other voices in Europe disagree with these aggressive proposals. In a paper commissioned by the Deutsche Börse Group, Gomber et al. argue that the Flash Crash was exclusively a U.S. problem, rooted largely in the absence of stock-specific circuit breakers on May 6, 2010.[167] They further argue that HFT has an intermarket arbitrage role that is more important in the U.S. than in Europe.[168] This argument relies on the fact that while both jurisdictions have recently seen the proliferation of smaller exchanges and trading venues, Europe lacks the equivalent of Regulation NMS. Regulation NMS requires U.S. orders to be routed to the exchange offering the "national best bid or offer."[169] Therefore, the argument goes, U.S. traders can trust that they will get the best price available, but European traders need tighter HFT arbitrage to be confident that an order executed on any given exchange

individual securities from occurring outside of a specified price band. These price limit bands will be 5%, 10% or 20%, or the lesser of $0.15 or 75%, depending on the price of the stock. Additionally, these price bands will double during the opening and closing periods of the trading day. If the stock's price does not naturally move back within the price bands within 15 seconds, there will be a five-minute trading pause.")

161. Haldane, *supra* note 14, at 17.

162. Gomber et al., *supra* note 21, at 48.

163. Haldane, *supra* note 14, at 17–19.

164. *See supra* note 122.

165. *See* Gomber et al., *supra* note 21, at 53.

166. *See* Haldane, *supra* note 14.

167. Regulation NMS requires brokers to execute market orders on the market with the best available price, thus increasing intermarket linkages. Gomber et al., *supra* note 21, at 1.

168. *Id.* at 11–12.

169. *See* Gomber et al., *supra* note 21.

will get the best possible price. This argument stakes too much on the efficacy of stock-specific circuit breakers, and likely overestimates the importance of extremely short-term price arbitrage.

While the legislative process continues, the draft version of MiFID II includes changes that will affect HFT. If it is adopted, HFTs will no longer be able to escape the Directive's requirements through an exemption in MiFID Article 2.[170] That exemption, intended for "persons who do not provide any investment services or activities other than dealing on their own account," will no longer apply to HFTs.[171] Thus, HFTs will need to comply with basic reporting requirements and rules on internal risk controls.[172] Furthermore, changes to MiFID Article 17 may require HFTs to disclose details of their algorithms to regulators, to ensure that they provide liquidity irrespective of market conditions.[173] It is not yet clear how this potentially sweeping provision would be enforced or whether it would apply to all HFTs.[174]

Amidst industry opposition, a few aggressive proposals discussed in the MiFID review process—such as amendments to MiFID Articles 14 and 39 that would have imposed liquidity provision obligations and limited the speed at which HFTs could cancel orders[175]—did not make it into the October 2011 draft of the proposed directive.[176] However, a September 26, 2012 vote by the European Parliament's economic affairs committee officially revived the idea of a speed limit or "resting period," which would require traders to let limit orders remain open for a half-second before cancellation.[177] Such a "resting rule," which may become law when MiFID II goes into effect in 2014 or 2015, could mitigate liquidity droughts like the Flash Crash and also address a range of other concerns about HFT. Perhaps most importantly, resting rules could reduce illegal or deceptive trading, as discussed below.

2. High-Frequency Trading as a Locus of Illegality or Deceptive Practices

Regulators currently lack the ability to effectively monitor and analyze HFT activity. If regulators had better information, HFT market manipulation would likely be prosecutable in both the U.S. and Europe. Indeed, tactics such as stuffing, smoking, and spoofing fall within the commonplace understanding of market manipulation. Because these techniques aim to induce

170. *Proposed Directive*, *supra* note 43, at art. 2.
171. *Id.* at 7.
172. *Id.* at 7–8.
173. *See* Linton, O'Hara & Zigrand, *supra* note 136, at 17–19.
174. *See id.*
175. *See* Gomber et al., *supra* note 21, at 50.
176. *See Proposed Directive*, *supra* note 43.
177. Huw Jones, *EU Lawmakers Vote for Sweeping Market Reforms*, REUTERS (Sept. 26, 2012), http://www.reuters.com/assets/print?aid=USBRE88P0BJ20120926.

misinformed trading by counterparties, they most likely count as "deceptive devices" under Rule 10b-5 of the Exchange Act.[178] Under new rulemaking powers given to it by the Dodd-Frank Act, the CFTC in 2011 promulgated an analogous rule, 17 C.F.R. § 180.1, banning deceptive practices in the trading of swaps, commodities, and futures.[179] Manipulative HFT strategies are also unlawful under current European law. Under Article 43 of MiFID, exchanges must be required by Member States to identify and report "market abuse."[180] Comments in a new draft of the Market Abuse Directive ("MAD") specify that the definition of market abuse in the current version of MAD probably already encompasses "some . . . [HFT] strategies such as quote stuffing, layering, and spoofing" and that the new draft should prohibit these strategies even more clearly.[181]

Thus, regulators largely have the legal ability to prosecute market abuse by HFTs if they can conclusively discover it; however, scienter requirements complicate matters. For example, if an HFT submits and then cancels a large number of limit orders, it is hard to know whether they intended to deceive counterparties, or whether they revised their order legitimately based on new information.[182] Rule 10b-5 requires only "strong circumstantial evidence of conscious misbehavior or recklessness,"[183] and 17 C.F.R. § 180.1 similarly prohibits deceptive behavior that is either "intentional or reckless."[184] The recklessness standard will probably render it challenging, but not impossible, for regulators to prove HFT market abuse if they have detailed and well-analyzed market data.

As a prerequisite to prosecuting abuse, regulators need more sophisticated systems to sift through enormous amounts of trading information. One commentator illustrated the situation colorfully: "The traders are driving Ferraris, and the market policemen—the regulators—are riding bicycles."[185] Accordingly, the SEC is moving forward with the development of a Consolidated Audit Trail, a comprehensive system for merging data between different markets and different participants.[186] The SEC estimates the cost of developing the system at $4 billion, which would be recouped through fees

178. 17 C.F.R. § 240.10b–5 (2012).

179. 17 C.F.R. § 180.1 (2012).

180. Eur. Sec. & Mkt. Auth, *supra* note 85, at 44.

181. *Proposal for a Regulation of the European Parliament and of the Council on Insider Dealing and Market Manipulation (Market Abuse)*, at 8, COM (2011) 651 final (Oct. 20, 2011), *available at* http://ec.europa.eu/internal_market/securities/abuse/index_en.htm.

182. *See, e.g.*, Jeremy Grant, *European MP Calls for Holding Period in HFT*, FIN. TIMES (Mar. 23, 2012), http://www.ft.com/cms/s/0/5024ede6-74f5-11e1-ab8b-00144feab49a.html#axzz1q4odaTL6.

183. Novak v. Kasaks, 216 F.3d 300, 308 (2d Cir. 2006).

184. 17 C.F.R. § 180.1(a) (2012).

185. Bonnie Kavoussi, *SEC May Monitor High-Frequency Trading With Consolidated Audit Trail*, HUFFINGTON POST (Oct. 10, 2011), http://www.huffingtonpost.com/2011/10/10/sec-high-frequency-trading_n_987378.html; *see also supra* note 99.

186. CFTC-SEC FINDINGS, *supra* note 5, at 14.

to FINRA and the exchanges; these entities may decide to pass the cost on to HFTs.[187] MIT economist Andrew Lo comments that this system would be a bargain if spread out over the course of several years and if it helped regulators manage turmoil and restore confidence to retail investors.[188] Yet it would be a waste if, after enormous investment, regulators remained a step behind the curve.

In September 2010, the SEC took the aggressive step of asking some HFT firms to disclose their algorithms to the agency in order to aid in the scrutiny of possible market manipulation.[189] Although this signals seriousness about stopping manipulation, it is questionable whether the SEC can usefully interpret the algorithms.[190] The Office of Financial Research, a creation of the Dodd-Frank Act meant to support the data analysis capability of the Financial Stability Oversight Board,[191] may have the capability to perform the needed analyses. Therefore, if algorithm monitoring is to become an ongoing part of the regulatory scheme, intensive and continuous interagency cooperation might prove necessary. European regulators face similar workability questions regarding the proposed algorithm disclosure requirements in MiFID II.[192]

An exception to the apparent unenforceability of HFT market abuse came in the case of Trillium Brokerage Services in September 2010.[193] FINRA levied a $2.26 million fine against Trillium and nine of its traders for engaging in high-frequency trades aimed at deceiving counterparties.[194] However, this fine reflects an industry self-regulatory action, not a legal sanction. FINRA's report on the incident leaves it unclear how the violation was detected.[195] Furthermore, FINRA has taken no comparable action against an HFT firm since Trillium.

In short, regulators worldwide lack the ability to effectively monitor markets for HFT abuse and reassure investors of market integrity. Better monitoring tools like the SEC's Consolidated Audit Trail (or the more recently announced "Midas" system) may help,[196] but it is far from clear that

187. Scott Patterson, *SEC Pushes Plan for Audit System*, WALL ST. J. (Sept. 21, 2011), http://online.wsj.com/article/SB10001424053111904491704576574883908453622.html.

188. *See* Kavoussi, *supra* note 185.

189. *See* Lynch & Spicer, *supra* note 95.

190. *Id.*

191. *See* U.S. DEP'T OF THE TREASURY, OFFICE OF FIN. RESEARCH, STRATEGIC FRAMEWORK 2 (Mar. 2012), *available at* http://www.treasury.gov/initiatives/wsr/ofr/Documents/OFRStrategicFramework.pdf.

192. *See* Linton, O'Hara & Zigrand, *supra* note 136, at 17–19.

193. Press Release, Fin. Indus. Reg. Auth, *supra* note 116.

194. *Id.*

195. Letter from Trillium Brokerage Servs., LLC, et al., to FINRA, Letter of Acceptance, Waiver and Consent (Aug. 5, 2010), *available at* http://www.finra.org/web/groups/industry/@ip/@enf/@ad/documents/industry/p122044.pdf.

196. *See* Nathaniel Popper and Ben Protess, *To Regulate Rapid Traders, S.E.C. Turns To One Of Them*, N.Y. TIMES (Oct. 7, 2012), http://www.nytimes.com/2012/10/08/business/sec-regulators-turn-to-high-speed-trading-firm.html?pagewanted=all.

such tools will yield enough information to prove scienter in market manipulation crimes. By contrast, comprehensive measures curtailing HFT order cancellation could greatly diminish HFTs' ability to use misdirection to deceive other market participants. If such measures work as intended, they would stop abuse before it happened, rather than scouring complex data to find it after the fact.

European regulators have been more aggressive in this area. Markus Ferber, German member of the European Parliament and a leader in the MiFID review process, has advocated for a resting rule in stocks and derivatives.[197] On September 26, 2012, the European Parliament's economic affairs committee approved a measure requiring limit orders to remain valid for at least five hundred milliseconds, placing the measure on the road to becoming law.[198] If structured carefully, this could make it difficult or impossible for HFTs to post limit orders that they have no intention to fulfill.[199] That, in turn, could undermine strategies like stuffing, smoking, and spoofing, and reduce the problem of illusory liquidity.

Andrew Haldane of the Bank of England has strongly argued for resting rules.[200] He explains the key distinction between this regulatory proposal and others, like market-making guidelines and circuit breakers: "Minimum resting periods are an ex-ante, non-state contingent intervention rule. They tackle the arms race at the source by imposing a speed limit on trading."[201] A well-designed resting rule could mitigate many of HFT's problems, from flash crashes to market abuse. Indeed, the most problematic HFT market strategies require the ability to cancel orders quickly. A resting rule would limit that possibility, forcing HFTs to assume a risk familiar to analog traders: namely, if conditions change fractions of a second after you place a limit order, a counterparty may trade with you before you can retract. The potential downside is that if HFT benefits market quality, minimum resting or holding periods would reduce those benefits by increasing the cost of HFT market making.

Therefore, regulators seeking to eliminate market abuse should closely scrutinize the question of whether HFT's market quality benefits substantially outweigh accompanying harms. The clear evidence of HFT's potential for market abuse should shift the burden to HFTs to prove overriding benefits to market quality. If unambiguous evidence of substantial benefit to market quality cannot be found—and the research largely suggests it cannot—regulators ought not shy away from major rule changes like resting periods or order cancellation taxes (described below). These measures could greatly increase both the actual and perceived fairness of markets.

197. *See* Grant, *supra* note 182.
198. *See* Jones, *supra* note 177.
199. *See supra* notes 89, 90.
200. Haldane, *supra* note 14, at 18–19.
201. *Id.*

3. High-Frequency Trading as a Detriment to Day-to-Day Market Quality

Few regulators have fully embraced the position that HFT harms market quality on a day-to-day basis. To be sure, some regulators have acknowledged concerns that HFT may "adversely affect the quality of markets, for instance, through the decrease of trade size and by pushing up indirect trading costs for retail and institutional investors."[202] It is also widely accepted that HFT's liquidity provision is not as beneficial as it appears because "[t]he operational model of HFT requires trading in markets that are already liquid enough to be able to quickly enter and exit from the market. This is a critical requirement for limiting their exposure to market risk."[203] But these observations have not been taken to their logical conclusion: that HFT's benefit to market quality is more doubtful than it appears.

Regulatory output has relied heavily on work by Hendershott and Riordan, which seems to indicate that HFT benefits market quality.[204] Yet in their 2011 study, these researchers admit a failure to establish that HFT's contribution to price discovery is either lasting or reflective of information that would not have been quickly traded on by other market participants anyway.[205] Nonetheless, regulators tend to lean toward concluding that the effect of HFT on market quality is "neutral to beneficial."[206]

This overreliance on limited and imperfect research goes some way toward explaining the fact that regulators on both sides of the Atlantic have not yet implemented stringent measures such as resting rules or steep cancellation fees. Resting rules would simultaneously address many concerns about HFT, from rapid liquidity taking to market manipulation. They would also reduce socially inefficient investments in ever-faster trading infrastructures and mitigate the disadvantage to slower traders trying to impound valid information into stock prices.[207]

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202. Eur. Sec. & Mkt. Auth, *supra* note 85, at 10.

203. INT'L ORG. FOR SEC. COMM'NS, *supra* note 37, at 25.

204. Eur. Sec. & Mkt. Auth., *supra* note 85, at 64; BANK OF INT'L SETTLEMENTS, *supra* note 25, at 28; INT'L ORG. FOR SEC. COMM'NS, *supra* note 37, at 25.

205. *See supra* notes 103–104 and accompanying text.

206. The following quote concisely illustrates how many regulators have interpreted the empirical work on HFT: "Overall, the empirical literature suggests that algorithmic trading and HFT are neutral to beneficial for market quality, in that volatility has declined and quoted spreads have narrowed. The findings on liquidity provision are mixed. Generally, algorithmic liquidity appears to be more strategic than non-algorithmic liquidity and tends to decline when volatility rises. Regarding price discovery, contrary conclusions have been drawn for FX and for equities. Taken as a whole, the literature consistently shows that information in orders has become more relevant than information in trades." BANK OF INT'L SETTLEMENTS, *supra* note 25, at 13; *see also* INT'L ORG. FOR SEC. COMM'NS, *supra* note 37, at 26–27 ("The available evidence fails to find a consistent and significant negative effect of HFT on liquidity . . . . [T]he limited empirical evidence available so far has not clearly identified negative effects of HFT on the efficiency of the price discovery process.").

207. *See* Biais, Foucault, & Moinas, *supra* note 36, at 27–28.

Order cancellation fees or taxes would also address many concerns at once, perhaps even more efficiently than a resting rule. Like a "sin" tax, such fees would discourage traders from posting orders they do not intend to execute. Imposing costs on cancelled orders may also diminish manipulative HFT strategies that involve massive order cancellation—like stuffing and spoofing—by rendering them uneconomical.[208] In fact, the SEC has called for cancellation fees,[209] but they have been only incompletely self-imposed by a couple of U.S. exchanges.[210] These current fee structures aim primarily at preventing overload in the exchange computer systems, and discourage only the most blatantly excessive cancellations.[211]

Even if we accept the view that HFT's contribution to market quality is "neutral to beneficial,"[212] these benefits are probably minor and equivocal. In light of the clear evidence of HFT's harms—namely, added systemic risk and reduced market integrity—more aggressive regulation appears justified. Yet the right structure and combination of rules on resting periods and cancellation or transaction fees remains a complex open question.

CONCLUSION

Academic analysis of HFT's effect on markets is difficult, and further study would help point the way forward; however, existing evidence suggests a handful of general conclusions. HFT adds to systemic risk by tightly interlinking markets and creating the possibility of Flash Crash–type events. HFT also provides opportunities for illegal market manipulation that are difficult and expensive to detect. On the positive side, HFT provides liquidity and narrows spreads under normal trading conditions, and its marketable orders tend to move prices in the right direction. But empirical research has not demonstrated that these benefits are substantial, for several reasons. First, HFT stops providing liquidity—and even reduces it—when volatility is high and liquidity is most in demand. Second, HFT's apparent contributions to price discovery could be: A) an artifact of HFT's ability to identify and front-run informed traders, or B) the result of millisecond price arbitrage strategies, impounding information that the market would soon have incorporated anyway.[213]

International and domestic regulators have by and large accepted these conclusions. However, their actions until now have focused largely on avoiding Flash Crash–like events by beefing up circuit breakers, closing regulatory loopholes like naked access and the exemption in MiFID Article

208. *See* Biais & Woolley, *supra* note 4, at 8–9.
209. JOINT ADVISORY RECOMMENDATIONS, *supra* note 134.
210. Demos, *supra* note 135.
211. *See id.*
212. BANK OF INT'L SETTLEMENTS, supra note 25, at 13.
213. *See supra* notes 103–104 and accompanying text.

2, and encouraging more industry self-regulation. These are steps in the right direction, but the facts suggest that regulators should do more to ensure market integrity. Strict order cancellation taxes or resting rules would likely reduce systemic risk and diminish opportunities for market abuse. These benefits would come at only a questionable cost to market liquidity and price efficiency. Andrew Haldane, Executive Director of Financial Stability for the Bank of England, states the current predicament articulately:

> "In calibrating [the] trade-off, a judgment would need to be made on the social value of split-second trading and liquidity provision and whether this more than counterbalances the greater market uncertainty it potentially engenders. At times, the efficiency of financial markets and their systemic resilience need to be traded off. This may be one such moment. Historically, the regulatory skew has been heavily towards the efficiency objective. Given today's trading topology, it may be time for that to change."[214]

Superfast trading on public exchanges is not an inevitable feature of modernity, and the fact that resting rules or cancellation fees could dramatically alter the practice of HFT does not in itself make them unreasonable. Regulators should lose less sleep over diminishing the benefits of HFT, and do more to ensure that it cannot threaten the stability and integrity of the markets.

214. Haldane, *supra* note 14, at 18–19.