

# THE NEW FINANCIAL INDUSTRY

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*Modern finance is undergoing a fundamental transformation. Artificial intelligence, mathematical models, and supercomputers have replaced human intelligence, human deliberation, and human execution. A financial industry once dominated by humans has evolved into one where humans and machines share power. Modern finance is becoming cyborg finance—an industry that is faster, larger, more complex, more global, more interconnected, and less human.*

*This Article offers an early systemic examination of this ongoing financial transformation, and presents an original set of regulatory principles for governing the emerging, new financial industry. This Article provides a normative and descriptive cartography of this changing financial landscape. It identifies particular perils, systemic risks, and regulatory shortcomings emanating from this financial transformation. It then proposes new guiding principles for the future of financial regulation in response to this sea-change. Drawing from a rich literature of past financial crises and transformations, this Article explores the next big movement in finance and financial regulation. And it offers fresh insights for better addressing the perils and promises emerging from the new financial industry.*

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## INTRODUCTION

Machines are taking over Wall Street.<sup>1</sup> Artificial intelligence, mathematical models, and supercomputers have replaced human intelligence, human deliberation, and human execution.<sup>2</sup> The modern financial industry is becoming faster, larger, more complex, more global,

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1. See, e.g., DAVID J. LEINWEBER, *NERDS ON WALL STREET: MATH, MACHINES, AND WIRED MARKETS* 31–64 (2009) (chronicling the rise of new, electronic financial markets); Jonathan R. Macey & Maureen O’Hara, *From Markets to Venues: Securities Regulation in an Evolving World*, 58 STAN. L. REV. 563, 563 (2005) (“Advances in technology, combined with the dramatic decrease in the cost of information processing, have conspired to change the way that securities transactions occur.”); Saule T. Omarova, *Wall Street as Community of Fate: Toward Financial Industry Self-Regulation*, 159 U. PA. L. REV. 411, 430 (2011) (describing finance as “[a]n increasingly complex marketplace, [with] dependence on fast-changing technology”); Felix Salmon & Jon Stokes, *Bull vs. Bear vs. Bot*, WIRED, Jan. 2011, at 93 (“It’s the machines’ market now; we just trade in it.”).

2. See Frank J. Fabozzi et al., *High-Frequency Trading: Methodologies and Market Impact*, 19 REV. FUTURES MKTS. 7, 9–10 (2011) (describing the essential role of computerization in financial trading); Jonathan Keats, *Thought Experiment: Neuroscientist Henry Markram Says He Can Build a Supercomputer Replica of the Human Brain. Now He Has \$1.3 Billion to Prove It*, WIRED, June 2013, at 171 (reporting on plans to build a computerized replication of the human brain); Salmon & Stokes, *supra* note 1 (“Algorithms have become so ingrained in our financial system that the markets could not operate without them.”).

more interconnected, and less human.<sup>3</sup> An industry once dominated by humans has evolved into one where humans and machines share dominion.

This Article is about that transformation and the regulatory principles that should govern it. This Article offers one of the first systemic examinations of this ongoing financial transformation and presents an original set of regulatory tenets for governing the emerging, new financial industry.<sup>4</sup> This Article normatively and descriptively traces the journey of this financial transformation, highlights promising and perilous paths, explains current regulatory shortcomings, and proposes new guiding principles for the road ahead.

While policymakers, commentators, and scholars continue to look back and study the last financial crisis,<sup>5</sup> this Article looks forward to what is emerging in finance and financial regulation. Drawing on a rich literature of past financial crises and transformations,<sup>6</sup> this Article examines the next big movement in finance and financial regulation.

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3. See SCOTT PATTERSON, DARK POOLS: HIGH-SPEED TRADERS, A.I. BANDITS, AND THE THREAT TO THE GLOBAL FINANCIAL SYSTEM 233–78 (2012); Andrew G. Haldane, Exec. Dir. Fin. Stability, Bank of Eng., The Race to Zero: Speech at the International Economic Association Sixteenth World Congress 3 (July 8, 2011) (transcript available at <http://www.bankofengland.co.uk/publications/speeches/2011/speech509.pdf>) (commenting on fundamental changes in the financial industry over the last century).

4. In a previous article, the author examined the rise of machines in finance and its impact on legal conceptions of the investor. The present Article builds upon the normative and descriptive examination of that publication and extends it to the financial industry and financial regulation at large. See Tom C.W. Lin, *The New Investor*, 60 UCLA L. REV. 678, 699–703 (2013).

5. See, e.g., CONG. OVERSIGHT PANEL, SPECIAL REPORT ON REGULATORY REFORM: MODERNIZING THE AMERICAN FINANCIAL REGULATORY SYSTEM: RECOMMENDATIONS FOR IMPROVING OVERSIGHT, PROTECTING CONSUMERS, AND ENSURING STABILITY 3–4 (2009) (suggesting reforms to improve oversight, transparency, and fairness); DEP’T OF THE TREASURY, BLUEPRINT FOR A MODERNIZED FINANCIAL REGULATORY STRUCTURE (2008), available at <http://www.treasury.gov/press-center/press-releases/Documents/Blueprint.pdf>; FIN. CRISIS INQUIRY COMM’N, THE FINANCIAL CRISIS INQUIRY REPORT: FINAL REPORT OF THE NATIONAL COMMISSION ON THE CAUSES OF THE FINANCIAL AND ECONOMIC CRISIS IN THE UNITED STATES (2011), available at <http://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf>; S. PERMANENT SUBCOMM. ON INVESTIGATIONS, WALL STREET AND THE FINANCIAL CRISIS: ANATOMY OF A FINANCIAL COLLAPSE (2011), available at [http://www.hsgac.senate.gov/public/\\_files/Financial\\_Crisis/FinancialCrisisReport.pdf](http://www.hsgac.senate.gov/public/_files/Financial_Crisis/FinancialCrisisReport.pdf); DAVID SKEEL, THE NEW FINANCIAL DEAL (2011); Jeffrey N. Gordon & Christopher Muller, *Confronting Financial Crisis: Dodd-Frank’s Dangers and the Case for a Systemic Emergency Insurance Fund*, 28 YALE J. ON REG. 151 (2011); Henry T. C. Hu, *Too Complex to Depict? Innovation, “Pure Information,” and the SEC Disclosure Paradigm*, 90 TEX. L. REV. 1601 (2012); Adam J. Levitin, *In Defense of Bailouts*, 99 GEO. L.J. 435 (2011); Andrew W. Lo, *Regulatory Reform in the Wake of the Financial Crisis of 2007–2008*, 1 J. FIN. ECON. POL’Y 4 (2009); Steven L. Schwarcz, *Protecting Financial Markets: Lessons from the Subprime Mortgage Meltdown*, 93 MINN. L. REV. 373 (2008); Frederick Tung, *Pay for Banker Performance: Structuring Executive Compensation for Risk Regulation*, 105 NW. U. L. REV. 1205 (2011); Charles K. Whitehead, *Reframing Financial Regulation*, 90 B.U. L. REV. 1 (2010).

6. See, e.g., RAGHURAM G. RAJAN, FAULT LINES: HOW HIDDEN FRACTURES STILL THREATEN THE WORLD ECONOMY (2010); CARMEN M. REINHART & KENNETH S. ROGOFF, THIS TIME IS DIFFERENT: EIGHT CENTURIES OF FINANCIAL FOLLY xxxix (2009); Lucian A. Bebchuk & Holger Spamann, *Regulating Bankers’ Pay*, 98 GEO. L.J. 247 (2010); Chris Brummer, *Stock Exchanges and the*

The objective of this Article is not to perfectly forecast the future of finance, nor is it to present an elegant, quixotic regulatory framework with specific rules to prevent all financial flaws and failures.<sup>7</sup> Rather, the objectives of this Article are more sensible and practical: First, this Article seeks to offer a new and better understanding of the rise of computerization and artificial intelligence in the financial industry and its wide-ranging effects on financial regulation. Second, this Article aims to present a preliminary set of guiding principles for thinking anew about regulatory design in this changing financial landscape. Collectively, this Article attempts to map the path of modern finance and financial regulation, from the recent past to the ongoing present, so as to provide an early guide for the emerging future. Inevitably, such an effort to chart the continuing, complex metamorphosis of modern finance and its regulation will be preliminary, unfinished, and dated. Yet, it is a shift that must be sketched and studied, for the effects of the ongoing financial transformation have become too consequential to ignore or wait.<sup>8</sup>

This Article endeavors this dynamic cartography of modern finance and financial regulation in five parts. Part I charts the road traveled and the road ahead. It offers a retrospective on how technological advances and financial innovations have transformed the financial industry into a new industry that is faster, larger, more complex, more global, more interconnected, and less human. It then previews key attributes of the emerging, new financial industry relating to technological progress,

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*New Markets for Securities Laws*, 75 U. CHI. L. REV. 1435 (2008); Charles W. Calomiris, *The Subprime Turmoil: What's Old, What's New, and What's Next*, 15 J. STRUCTURED FIN. 6 (2009); Stephen J. Choi & Andrew T. Guzman, *Portable Reciprocity: Rethinking the International Reach of Securities Regulation*, 71 S. CAL. L. REV. 903 (1998); John C. Coffee, Jr. & Hillary A. Sale, *Redesigning the SEC: Does the Treasury Have a Better Idea?*, 95 VA. L. REV. 707 (2009); Joseph A. Grundfest, *Punctuated Equilibria in the Evolution of United States Securities Regulation*, 8 STAN. J.L. BUS. & FIN. 1 (2002); Henry T.C. Hu, *Swaps, the Modern Process of Financial Innovation and the Vulnerability of a Regulatory Paradigm*, 138 U. PA. L. REV. 333 (1989); Howell E. Jackson, *Regulation in a Multisectoral Financial Services Industry: An Exploration Essay*, 77 WASH. U. L.Q. 319 (1999); Kathryn Judge, *Fragmentation Nodes: A Study in Financial Innovation, Complexity, and Systemic Risk*, 64 STAN. L. REV. 657, 701 (2012); Donald C. Langevoort, *Chasing the Greased Pig Down Wall Street: A Gatekeeper's Guide to the Psychology, Culture, and Ethics of Financial Risk Taking*, 96 CORNELL L. REV. 1209 (2011); Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193, 200 (2008); Jill E. Fisch, *Top Cop or Regulatory Flop? The SEC at 75*, 95 VA. L. REV. 785 (2009); James D. Cox, *Coping In A Global Marketplace: Survival Strategies For A 75-Year-Old SEC*, 95 VA. L. REV. 941 (2009).

7. Financial failures and crises will inevitably occur again. No financial regulatory framework will ever be fail-safe. See REINHART & ROGOFF, *supra* note 6, at xxvi (“Of course, financial crises are nothing new. They have been around since the development of money and financial markets.”).

8. Charles Reich in his seminal work, *The New Property*, makes a similar concession in his commentary about the then-transforming and transformative role of government on property, wealth, and individualism. See Charles A. Reich, *The New Property*, 73 YALE L.J. 733, 733 (1964) (“Inevitably, such an effort must be incomplete and tentative. But it is long past time that we began looking at the transformation taking place around us.”).

traditional financial structures, the growth of “shadow banking,”<sup>9</sup> and the role of humans in the future of finance.

Part II highlights threats along the way. It reviews the Flash Crash of May 6, 2010, which, in minutes, destroyed nearly \$1 trillion in market capitalization.<sup>10</sup> It forewarns of similar crashes in the future given the increasing reliance of finance on computerized systems. Part II then discusses new crimes and perils as the new financial industry migrates into cyberspace on a grand scale. It warns of threats posed by hackers, spies, criminals, competitors, and other nation-states.

Part III foreshadows new systemic dangers. It asserts that the enhanced speed and interconnectedness of the new financial industry presents two underappreciated systemic risks of speed and connectivity. The risk relating to speed is termed “too fast to save,” and the risk relating to connectivity is termed “too linked to fail.” Part III argues that these new systemic risks will be at least as challenging and pressing as the widely recognized systemic risk of “too big to fail.”<sup>11</sup>

Part IV contends with structural pitfalls. It identifies fundamental shortcomings in the current regulatory framework that render law and regulation unsuitable for better monitoring finance under the prevailing governance model. Part IV explains why core matters relating to jurisdiction, origination, and resource prevent regulators from effectively governing the emerging, new financial industry.

Part V offers a new way forward. Mindful of the perils and pitfalls articulated in the previous Parts, it proposes an original set of regulatory, first principles to better harness the potential and promise of the changing financial landscape. These proposed tenets address issues fundamental to financial regulation including effectiveness, transparency, speed, coordination, bailouts, costs, and accountability. Part V concludes with a reminder that the proposed tenets should serve as principles of regulatory

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9. See Lo, *supra* note 5, at 13–18 (discussing the emergence of shadow banking in the modern financial infrastructure); Steven L. Schwarcz, *Regulating Shadow Banking: Inaugural Address for the Inaugural Symposium of the Review of Banking & Financial Law*, 31 REV. BANKING & FIN. L. 619, 620–26 (2012) (defining shadow banking).

10. See generally U.S. COMMODITY FUTURES TRADING COMM’N & U.S. SECS. AND EXCH. COMM’N, FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010 1–6 (2010) [hereinafter CFTC & SEC FINDINGS], available at <http://www.sec.gov/news/studies/2010/marketevents-report.pdf> (summarizing the Flash Crash).

11. For an overview of the too-big-to-fail systemic risk, see S. PERMANENT SUBCOMM. ON INVESTIGATIONS, *supra* note 5, at 15–17 (reporting on the rise of too-big-to-fail financial institutions); ANDREW ROSS SORKIN, TOO BIG TO FAIL: THE INSIDE STORY OF HOW WALL STREET AND WASHINGTON FOUGHT TO SAVE THE FINANCIAL SYSTEM FROM CRISIS—AND THEMSELVES 538–39 (2009) (discussing the policy challenges presented by “too big to fail” institutions); and Tom C. Frost, *The Big Danger with Big Banks*, WALL ST. J., May 16, 2012, at A12.

design for policymakers as they re-imagine a better, workable framework for the emerging, new financial industry.

## I. CYBORG FINANCE

The dramatic and continuing rise of computerization and artificial intelligence over the last three decades has had a profound impact on the financial industry. It has transformed an industry once dominated by humans into one where machines play a significantly larger and more inextricable role. Modern finance is becoming an industry where the main players are no longer entirely human. Rather, the main financial players today are cyborgs: part human and part machine. Modern finance is becoming “cyborg finance,” or “cy-fi.”<sup>12</sup>

### A. *A Brief Retrospective*

Modern finance evolved into cyborg finance as a result of complimentary advances in technology and financial regulation. New technological advances and financial innovation encouraged regulatory reforms, which in turn spurred more innovation and advances within the financial industry.<sup>13</sup>

Beginning in the 1990s, technological advances made electronic trading a viable alternative to traditional intermediary-based platforms. Electronic communication networks led to direct market access, allowing firms to execute trades on exchanges without going through financial intermediaries.<sup>14</sup> Around the same time, the Securities and Exchange

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12. See Lin, *supra* note 4, at 682 (introducing the term “cyborg finance”); Salmon & Stokes, *supra* note 1 (reporting on the rise of automated, computerized systems in finance); see also SHERRY TURKLE, *ALONE TOGETHER: WHY WE EXPECT MORE FROM TECHNOLOGY AND LESS FROM EACH OTHER* 152 (2012) (“We are all cyborgs now.”); Donna J. Haraway, *A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century*, in *READINGS IN THE PHILOSOPHY OF TECHNOLOGY* 161, 161 (David M. Kaplan ed., 2004) (“A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction.”); David J. Hess, *On Low-Tech Cyborgs*, in *THE CYBORG HANDBOOK* 371, 373 (Chris Hables Gray ed., 1995) (“[A]most everyone in urban societies could be seen as a low-tech cyborg, because they spend large parts of the day connected to machines . . .”).

13. For a general discussion about the evolution of modern finance, see Robert DeYoung, *Safety, Soundness, and the Evolution of the U.S. Banking Industry*, 92 FED. RES. BANK OF ATLANTA ECON. REV. 41 (2007); Loretta J. Mester, *Commentary: Some Thoughts on the Evolution of the Banking System and the Process of Financial Intermediation*, 92 FED. RES. BANK OF ATLANTA ECON. REV. 67, 67–72 (2007); and Arthur E. Wilmarth, Jr., *The Transformation of the U.S. Financial Services Industry, 1975–2000: Competition, Consolidation, and Increased Risks*, 2002 U. ILL. L. REV. 215 (2002).

14. SAL ARNUK & JOSEPH SALUZZI, *BROKEN MARKETS: HOW HIGH FREQUENCY TRADING AND PREDATORY PRACTICES ON WALL STREET ARE DESTROYING INVESTOR CONFIDENCE AND YOUR PORTFOLIO* 68–78 (2012).

Commission (SEC) introduced reforms like Regulation Alternative Trading System (Reg ATS) to promote alternative trading platforms and electronic communication networks.<sup>15</sup> During this period, regulators also introduced decimalization to securities pricing, which made electronic trading more profitable as smaller pricing spreads increased trading opportunities.<sup>16</sup> By the end of the 1990s, computers were key players in finance, serving as critical components in financial trading and investment management.<sup>17</sup>

Over the course of the decade that followed, information technology continued to innovate and evolve. Advances in computer science and digitized information spurred more computerization and artificial intelligence in financial trading and investment management. Decreases in the cost of technology also spawned the growth of discount brokerages and other intermediaries that gave more investors greater access to more classes of assets. In response to these advances, the SEC passed Regulation National Market System (Reg NMS) in 2005.<sup>18</sup> Reg NMS was designed to connect disparate electronic marketplaces into one linked national market platform to increase competition and access in finance.<sup>19</sup> Additionally, Reg NMS, coupled with globalization, helped to internationalize financial markets by connecting electronic marketplaces across the globe.

In the years since the implementation of Reg NMS, the use of computerization and artificial intelligence in finance has dramatically accelerated. It has transformed modern finance into cy-fi. A key feature of cyborg finance is the use of supercomputers to analyze risk, manage assets,

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15. See Regulation ATS, 17 C.F.R. § 242.300(a) (2009); ARNUK & SALUZZI, *supra* note 14; BRIAN R. BROWN, CHASING THE SAME SIGNALS: HOW BLACK-BOX TRADING INFLUENCES STOCK MARKETS FROM WALL STREET TO SHANGHAI 2 (2010); LEINWEBER, *supra* note 1.

16. See STAFF OF THE SEC, REPORT TO CONGRESS ON DECIMALIZATION 4 (2012), available at <http://www.sec.gov/news/studies/2012/decimalization-072012.pdf> (“Prior to implementing decimal pricing in April 2001, the U.S. equity market used fractions as pricing increments, and had done so for hundreds of years.”); CHRISTOPHER STEINER, AUTOMATE THIS 185 (2012) (discussing how decimalization bolsters electronic trading volumes and profits).

17. See, e.g., RAY KURZWEIL, THE AGE OF SPIRITUAL MACHINES: WHEN COMPUTERS EXCEED HUMAN INTELLIGENCE 70 (2000) (“Not only were the stock, bond, currency, commodity, and other markets managed and maintained by computerized networks, but the majority of buy-and-sell decisions were initiated by software programs . . . .”); Markku Malkamäki & Jukka Topi, *Future Challenges for Securities and Derivative Markets*, in 3 RESEARCH IN BANKING AND FINANCE 359, 382 (Iftekhar Hasan & William C. Hunter eds., 2003) (“At the end of [the] 1990s, between 30% and 40% of all U.S. securities were channeled through the Internet and about 15% of all the U.S. equity trades were done on-line.”); William M. Bulkeley, *Computers Take on New Role as Experts in Financial Affairs*, WALL ST. J., Feb. 7, 1986.

18. 17 C.F.R. § 242.601 (2005).

19. See Regulation NMS, 69 Fed. Reg. 11126-01, at 11161 (proposed Mar. 9, 2004) (codified at 17 C.F.R. §§ 200, 230, 240, 242, 249); see also PATTERSON, *supra* note 3, at 49; Laura Nyantung Beny, *U.S. Secondary Stock Markets: A Survey of Current Regulatory and Structural Issues and a Reform Proposal to Enhance Competition*, 2002 COLUM. BUS. L. REV. 399, 426 (“[T]he express purpose of the NMS [is] to promote efficiency and competition across secondary markets.”).

and execute trades based on complex algorithmic programs operating at super-speeds.<sup>20</sup> Many of these programs, once successfully installed, can operate completely devoid of human intervention with great profitability.<sup>21</sup>

In terms of risk analysis and asset management, almost every significant financial participant today uses computers with artificial intelligence to assess risk and manage investments.<sup>22</sup> For instance, BlackRock, the world's largest asset management firm, uses its proprietary artificial intelligence program, dubbed Aladdin, to help clients manage risk and capital relating to stocks, bonds, derivatives, and other complex financial instruments.<sup>23</sup> During the financial crisis of 2008 ("the Financial Crisis"), Aladdin even aided the federal government with its critical decisions concerning Bear Stearns, AIG, Citigroup, Fannie Mae, and Freddie Mac.<sup>24</sup>

In terms of trading, the emergence of computerization and artificial intelligence has led to the rise of black-box or algorithmic trading, which refers to the use of incredibly powerful computers to analyze and execute trading opportunities based on complex mathematical models.<sup>25</sup> In the age of cy-fi, almost every financial institution with significant capital employs some form of algorithmic trading.<sup>26</sup> These programs frequently operate exclusively on artificial intelligence, devoid of human input after initial installation.<sup>27</sup> These programs can process massive amounts of information, spot trends, and allocate capital accordingly within seconds.<sup>28</sup> In fact, some programs are so advanced that within fractions of seconds of a securities

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20. See PATTERSON, *supra* note 3, at 36–38 (describing the rise of powerful, high-speed computers in finance); see also FIN. CRISIS INQUIRY COMM'N, *supra* note 5, at 44.

21. See PATTERSON, *supra* note 3, at 128–30; David M. Serritella, *High Speed Trading Begets High Speed Regulation: SEC Response To Flash Crash, Rash*, 2010 U. ILL. J.L. TECH. & POL'Y 433, 436 (discussing the automated nature of financial algorithmic programs); Brody Mullins, et al., *Traders Pay for an Early Peek at Key Data*, WALL ST. J., June 13, 2013, at A1 (discussing the value of seconds to traders using computerized programs).

22. For a general discussion of computerized risk models, see Erik F. Gerding, *Code, Crash, and Open Source: The Outsourcing of Financial Regulation to Risk Models and the Global Financial Crisis*, 84 WASH. L. REV. 127, 130–35 (2009).

23. See Sheelah Kolhatkar & Sree Vidya Bhaktavatsalam, *The Colossus of Wall Street*, BUS. WK., Dec. 13, 2010, at 62, 66.

24. *Id.*

25. See BROWN, *supra* note 15, at 8; ROBERT A. G. MONKS & ALEXANDRA REED LAJOUX, CORPORATE VALUATION FOR PORTFOLIO INVESTMENT: ANALYZING ASSETS, EARNINGS, CASH FLOW, STOCK PRICE, GOVERNANCE, AND SPECIAL SITUATIONS 229 (2011).

26. See BROWN, *supra* note 15, at 11.

27. See CFTC & SEC FINDINGS, *supra* note 10, at 13–16 (discussing automation in high-frequency trading); PATTERSON, *supra* note 3, at 128–30; Serritella, *supra* note 21, at 436 ("Automation is a crucial element in HFT [high-frequency trading].").

28. See Fabozzi et al., *supra* note 2, at 8; Charles Duhigg, *Stock Traders Find Speed Pays, in Milliseconds*, N.Y. TIMES, July 24, 2009, at A17 ("[Algorithmic computer programs] can spot trends before other investors can blink, changing orders and strategies within milliseconds.").

filing or news report, the programs can “read” them and execute trades based on the new information without any human assistance.<sup>29</sup> In the new financial industry, decisions that previously took hours or minutes to analyze and execute by numerous teams of individuals now take only seconds by a single computer.

A prominent form of algorithmic trading is high-frequency trading. High-frequency trading refers to computerized trading that generates positive returns by executing deluges of trades at super speeds.<sup>30</sup> This form of trading normally occurs at rates measured in seconds and milliseconds,<sup>31</sup> with daily volumes measured in the range of billions of units, and valued in the billions of dollars.<sup>32</sup> By 2010, high-frequency trading constituted approximately 30% of all foreign-exchange transactions.<sup>33</sup> In 2011, high-frequency trading made up about 60% of U.S. equity trading<sup>34</sup> and 35 to 40% of European equity trading,<sup>35</sup> with signs of more potential growth in the years to come.

This emphasis on speed in finance has given considerable advantages to market participants who can afford better technology and better real estate so as to reduce the latency of their trade executions through the process of colocation.<sup>36</sup> Latency refers to the period between an order submission and the receipt of an order acknowledgement.<sup>37</sup> If an institution’s server is located closer to the server of an exchange or other relevant intermediary, then that institution can lower their latency period and increase their execution speed.<sup>38</sup> As such, market participants with

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29. See ARNUK & SALUZZI, *supra* note 14, at 121 (“Machine-readable news data feeds enable HFT [high-frequency trading] computers to react within microseconds to news events, beating out traditional institutional and retail investors.”); LEINWEBER, *supra* note 1, at 31–88, 109–34; Helen Coster, *Search and Disrupt*, FORBES, Sept. 26, 2011, at 60 (reporting on software that summarizes federal securities filings in seconds).

30. See Concept Release on Equity Market Structure, 75 Fed. Reg. 3594, 3598 (Jan. 21, 2010) (codified at 17 C.F.R. pt. 242); IRENE ALDRIDGE, HIGH-FREQUENCY TRADING: A PRACTICAL GUIDE TO ALGORITHMIC STRATEGIES AND TRADING SYSTEMS 1 (2010).

31. Fabozzi et al., *supra* note 2, at 8.

32. See Eric Dash & Christine Hauser, *As Dizzying Week Ends on Wall St., Dangers Linger*, N.Y. TIMES, Aug. 13, 2011, at A1.

33. Neil Shah, *High-Speed Traders Dive into Forex Despite Doubts*, WALL ST. J., Apr. 25, 2011, <http://online.wsj.com/article/SB10001424052748704677404576284921020282968.html>.

34. Graham Bowley, *Fast Traders, In Spotlight, Battle Rules*, N.Y. TIMES, July 18, 2011, at A1.

35. Fabozzi et al., *supra* note 2, at 8.

36. See BROWN, *supra* note 15, at 63; PATTERSON, *supra* note 3, at 230 (“The new hierarchy would be all about who owned the most powerful computers, the fastest links between markets, the most sophisticated algorithms—and the inside knowledge of how the market’s plumbing was put together.”).

37. See BROWN, *supra* note 15, at 64.

38. See Fabozzi et al., *supra* note 2, at 10 (“It is estimated that for each 100 miles the server is located away from the matching engine, 1 millisecond of delay is added to [the transmittal and execution time] . . .”).

more resources can arguably outperform other participants on a regular basis, even if all participants receive actionable information simultaneously.<sup>39</sup> While market participants with better resources have always had some advantages in execution over other participants,<sup>40</sup> the differences this time may be differences in kind rather than degrees.

In retrospect, over the last few decades, advances in technology and artificial intelligence accompanied by complementary regulatory reforms have fundamentally transformed modern finance into cyborg finance. It has turned an industry once based primarily on human interactions into one that is drastically less human, faster, larger, more global, more complex, and more interconnected.<sup>41</sup>

### B. A Modest Preview

Previewing the future of cyborg finance is difficult given the dynamism of modern finance and technology. Yet, past developments and contemporary changes offer glimpses of the emerging future. Four potential characteristics of the emerging new financial industry are particularly noteworthy.

First, the use of computers and artificial intelligence will likely persistently rise in finance with lower cost barriers to entry. In 1965, Gordon Moore, the founder of Intel, coined what would later be termed “Moore’s Law,” which predicted that components on integrated circuits would increase exponentially about every two years and costs would fall correspondingly, leading to incredible technological progressions.<sup>42</sup> Since the 1960s, computing power and capacity have only grown increasingly better, faster, smaller, and cheaper.<sup>43</sup> A single iPhone today possesses more computing power than all of NASA during the first lunar mission.<sup>44</sup> In addition to being stronger, computer power has also become smarter. Through computerized data aggregation and analyses, colloquially known

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39. See, e.g., James B. Stewart, *Fair Play Measured in Slivers of a Second*, N.Y. TIMES, Jul. 13, 2013, at B1.

40. STEINER, *supra* note 16, at 121.

41. See, e.g., PATTERSON, *supra* note 3, at 281–322; Salmon & Stokes, *supra* note 1, at 90.

42. See NICHOLAS CARR, *THE BIG SWITCH: REWIRING THE WORLD, FROM EDISON TO GOOGLE* 58 (2008); Gordon E. Moore, *Cramming More Components Onto Integrated Circuits*, 86 PROCEEDINGS OF THE IEEE 82, 82–83 (1998).

43. See NICHOLAS CARR, *THE SHALLOWS: WHAT THE INTERNET IS DOING TO OUR BRAINS* 83 (2011) (“[T]he price of a typical computing task has dropped by 99.9 percent since the 1960s.”); ORG. FOR ECON. CO-OPERATION AND DEV., 255 21<sup>ST</sup> CENTURY TECHNOLOGIES: PROMISES AND PERILS OF A DYNAMIC FUTURE 9 (1998) (stating that “[f]aster, cheaper, [and] smaller” are the key objectives of the technology sector); Chip Walter, *Kryder’s Law*, SCIENTIFIC AM., Aug. 2005, at 32.

44. MICHIO KAKU, *PHYSICS OF THE FUTURE: HOW SCIENCE WILL SHAPE HUMAN DESTINY AND OUR DAILY LIVES BY THE YEAR 2100* 21 (2011).

as Big Data, information technology is constantly providing new insights into the world.<sup>45</sup> As technology continues to progress in capacity and capability, finance—like other industries—will continue to adopt computers and artificial intelligence as key operational inputs.<sup>46</sup> The future intellectual and physical infrastructure of finance and other industries will likely be one based more and more on computerization and artificial intelligence, creating an omni-computing existence where the workings and manifestations of computerized data analyses become like oxygen—necessary but unnoticed.

Second, technological advances and corresponding market changes will make traditional financial frameworks, like public stock exchanges and human brokers, less relevant.<sup>47</sup> For instance, algorithmic trading has already advanced so much that exchange floors manned by human traders have been rendered relics of a bygone era.<sup>48</sup> Today, most equities are traded in private electronic markets using fully computerized systems rather than in public exchanges like the New York Stock Exchange (NYSE) or the NASDAQ.<sup>49</sup> In recent years, more than half of the trading of equities listed on the NYSE takes place in electronic exchanges.<sup>50</sup> In fact, in 2013, two

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45. See, e.g., VIKTOR MAYER-SCHONBERGER & KENNETH CUKIER, *BIG DATA: A REVOLUTION THAT WILL TRANSFORM HOW WE LIVE, WORK, AND THINK* 6–10 (2013); NATE SILVER, *THE SIGNAL AND THE NOISE: WHY SO MANY PREDICTIONS FAIL—BUT SOME DON'T* 9–10 (2012); Andrew McAfee & Erik Brynjolfsson, *Big Data: The Management Revolution*, HARV. BUS. REV., Oct. 2012, at 60–68; Ashlee Vance, *The Data Knows*, BUS. WK., Sept. 12, 2011, at 71.

46. See ERIK BRYNJOLFSSON & ANDREW MCAFEE, *THE SECOND MACHINE AGE: WORK, PROGRESS AND PROSPERITY IN A TIME OF BRILLIANT TECHNOLOGIES* 13–39 (2014); CARR, *supra* note 42, at 45–46 (reporting on the proliferation of computers in society); David H. Autor et al., *The Skill Content of Recent Technological Change: An Empirical Exploration*, 118 Q.J. ECON. 1279, 1322 (2003) (studying how computerization increases the substitution of machinery for human labor in certain situations); W. Brian Arthur, *The Second Economy*, MCKINSEY Q., Oct. 2011, at 92 (discussing how computerization and artificial intelligence have replaced human labor in many industries); Mary Childs, *Computers Elbow Traders Aside*, BUS. WK., Nov. 19, 2012, at 48; Bill Wasik, *Welcome to the Programmable World*, WIRED, June 2013, at 140.

47. See Donald C. Langevoort & Robert B. Thompson, “Publicness” in *Contemporary Securities Regulation After the JOBS Act*, 101 GEO. L.J. 337, 347 (2013) (“Today, liquidity is now much more possible outside of traditional exchanges. In the new millennium, cheap information and low communication costs have expanded markets . . .”); Ben Paynter, *The Exchange Blew Up*, BUS. WK., March 18, 2013, at 58; Jacob Bunge, *BATS, Direct Edge in Talks to Merge*, WALL ST. J., Aug. 24, 2013, at B1 (reporting on the merger of two large electronic exchanges).

48. See, e.g., Jerry W. Markham & Daniel J. Harty, *For Whom the Bell Tolls: The Demise of Exchange Trading Floors and the Growth of ECNs*, 33 J. CORP. L. 865, 866 (2008) (“Exchange trading floors are fast fading into history as the trading of stocks and derivative instruments moves to electronic communications networks (ECNs) that simply match trades by computers through algorithms.”).

49. Nathaniel Popper, *Public Exchanges Duel with Newcomers over Trade Transparency*, N.Y. TIMES, June 27, 2012, at B1.

50. Nelson D. Schwartz & Louise Story, *Surge of Computer Selling After Apparent Trading Glitch Sends Stocks Plunging*, N.Y. TIMES, May 7, 2010, at B7.

leading electronic trading exchanges merged;<sup>51</sup> and the IntercontinentalExchange, an electronic derivatives and commodities exchange, announced a takeover of the NYSE.<sup>52</sup> That same year, the NYSE made preparations to operate without human traders in the event of a major disaster.<sup>53</sup> It is probably safe to predict that in the near future, human traders will no longer work the NYSE's famed trading floor in their traditional roles; the exchange will become like a façade on a movie set. Additionally, these changes in financial technology will likely allow more individuals to invest in a wider array of assets.<sup>54</sup> Online brokers, like Charles Schwab, already offer investment options that were not available to investors in eras past without well-connected financial intermediaries.<sup>55</sup>

Third, cyborg finance will likely expand the "shadow banking" system as it grows darker, more complex, more global, but not necessarily more profitable.<sup>56</sup> While significant volumes of trading still take place on public exchanges, a growing volume of trades are taking place in less-regulated private exchanges and "dark pools."<sup>57</sup> A dark pool is an electronic trading network that facilitates anonymous trading and is hidden from the general marketplace.<sup>58</sup> Private exchanges and dark pools are particularly attractive to investors, many of whom prefer to trade securities without losing informational advantages to competitors that may mimic their trades.<sup>59</sup> These opaque financial forums also facilitate innovative and complex transactions and strategies because they are less regulated.<sup>60</sup> Moreover,

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51. Michael J. De La Merced and Nathaniel Popper, *Two Exchanges to Merge, Taking On Larger Rivals*, N.Y. TIMES, Aug. 27, 2013, at B1.

52. Ben Protess & Nathaniel Popper, *Exchange Sale Reflects New Realities of Trading*, N.Y. TIMES, Dec. 21, 2012, at A1.

53. Jacob Bunge, *NYSE Revamps Disaster Plan*, WALL ST. J., Mar. 9, 2013, at B1.

54. See, e.g., Nathaniel Popper, *Complex Investments Prove Risky as Savers Chase Bigger Payoff*, N.Y. TIMES, Feb. 11, 2013, at A1.

55. CHARLES SCHWAB INVESTMENT PRODUCTS, [http://www.schwab.com/public/schwab/investing/accounts\\_products/investment](http://www.schwab.com/public/schwab/investing/accounts_products/investment) (last visited Feb. 1, 2014).

56. See, e.g., GARY B. GORTON, *SLAPPED BY THE INVISIBLE HAND: THE PANIC OF 2007 6–9* (2010) (noting the growing importance of the shadow banking system); SKEEL, *supra* note 5 (discussing deregulation and financial innovation in connection to shadow banking); Lo, *supra* note 5, at 13–18 (describing the expansive shadow banking system); Schwarcz, *supra* note 9, at 619–42.

57. See Regulation of Non-Public Trading Interest, Exchange Act Release No. 34-60997 (Nov. 13, 2009); Mary L. Schapiro, Chairman, SEC, Statement on Dark Pool Regulation Before the Commission Open Meeting (Oct. 21, 2009) (transcript available at <http://www.sec.gov/news/speech/2009/spch102109mls.htm>); ARNUK & SALUZZI, *supra* note 14; LEINWEBER, *supra* note 1, at 79 (discussing the growth of dark pools and alternative trading systems in recent years); PATTERSON, *supra* note 3, at 61–62; Matthew Philips, *Where Has All the Trading Gone?*, BUS. WK., May 14, 2012, at 49 (reporting on the migration of trading from public exchanges to dark pools).

58. BROWN, *supra* note 15, at 116.

59. See *id.*

60. See Schwarcz, *supra* note 9, at 619–42.

unlike traditional exchanges, which are partially constrained by spatial and geographic limitations, private exchanges and dark pools exist in cyberspace, a frontier without such limitations.<sup>61</sup> In the past few years, rather than defend the benefits of well-regulated, transparent trading, traditional exchanges have begun to create opaque electronic networks to capture the growing computerized trading market.<sup>62</sup> Increased participation in shadow banking coupled with lower costs of technology will likely lead to greater competition and lower profit margins.<sup>63</sup>

Fourth, humans will likely remain critical players in the future of cyborg finance. Advances in the speed, precision, and convenience of computerized systems have led many in finance to view such systems as the antidotes to the follies of human thought and human action.<sup>64</sup> After all, computers process deluges of data faster and better than humans, computers do not suffer from emotional fits or irrational impulses, and computers do not fatigue the way humans do. As a result of these advantages, there exists an understandable enchantment with advanced technologies in finance and beyond.<sup>65</sup> And at the same time, there also exists an equally understandable lamentation of the fall of humans in the face of rising technology.<sup>66</sup> Yet, such easy sentiments about the demise of humans are misplaced. Humans, after all, possess arguably the most powerful and complex of computing machineries, the human brain, which contains billions of neurons and trillions of synaptic connections.<sup>67</sup> And lest we forget, the Financial Crisis occurred partially because many prevalent,

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61. See, e.g., David R. Johnson & David Post, *Law and Borders—The Rise of Law in Cyberspace*, 48 STAN. L. REV. 1367, 1367 (1996); Lawrence Lessig, *The Law of the Horse: What Cyberlaw Might Teach*, 113 HARV. L. REV. 501, 514–22 (1999).

62. Popper, *supra* note 49.

63. See Matthew Philips, *How the Robots Lost*, BUS. WK., June 10, 2013, at 64, 66 (discussing the decrease in profits of high-frequency traders due to competition).

64. EMANUEL DERMAN, MODELS.BEHAVING.BADLY.: WHY CONFUSING ILLUSION WITH REALITY CAN LEAD TO DISASTER, ON WALL STREET AND IN LIFE 143–87 (2011).

65. Computers today excel over humans in tasks beyond the mechanical and rote to the subjective and judgmental. Computers with artificial intelligence can grade essays, select movie scripts, predict court decisions, review legal documents, and spot out lies. See CARR, *supra* note 43, at 223 (discussing computerized review of essays); Joe Dysart, *A New View of Review: Predictive Coding Vows to Cut E-Discovery Drudgery*, A.B.A. J., Oct. 1, 2011, at 26; Theodore W. Ruger et al., *The Supreme Court Forecasting Project: Legal and Political Science Approaches to Predicting Supreme Court Decisionmaking*, 104 COLUM. L. REV. 1150, 1150 (2004); Anne Eisenberg, *Software that Listens for Lies*, N.Y. TIMES, Dec. 4, 2011, at BU5; Malcolm Gladwell, *The Formula*, NEW YORKER, Oct. 16, 2006, at 139 (reporting on software that predicts the potential success of screenplays based on their narrative elements).

66. See JARON LANIER, YOU ARE NOT A GADGET: A MANIFESTO 24–30 (2010) (lamenting the self-subordination of humans to technology).

67. ELLEN E. PASTORINO & SUSANN M. DOYLE-PORTILLO, WHAT IS PSYCHOLOGY? 355 (2011).

“smart” computerized risk models failed to properly account for the collapse of the U.S. housing market and its deleterious economic effects.<sup>68</sup>

With the ascension of artificially intelligent machines driven by data, humans are actually needed more than ever.<sup>69</sup> Humans are needed to gather and create the data that is the lifeblood of artificial intelligence.<sup>70</sup> Humans are needed to design and create the algorithms and programs for the computers.<sup>71</sup> Humans are needed to attest to the veracity and utility of the computerized systems.<sup>72</sup> Artificially intelligent machines, despite their advances, are still devoid of the awareness, sophistication, and judgment of human intelligence.<sup>73</sup> Computerized modeling of a financial world populated by humans will remain flawed and limited.<sup>74</sup> Data about the past can only give so much insight about the future. Thus, humans will likely remain key players in the future of cyborg finance.

## II. CRASHES AND CRIMES

While the new financial industry presents many great opportunities for investors and financial institutions, it also presents grave perils. The enhanced speed and linkage of finance can make industry participants more vulnerable to volatile crashes and cybercrimes.

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68. See, e.g., ANTHONY SAUNDERS & LINDA ALLEN, CREDIT RISK MANAGEMENT IN AND OUT OF THE FINANCIAL CRISIS: NEW APPROACHES TO VALUE AT RISK AND OTHER PARADIGMS 31 (3d ed. 2010); Amir E. Khandani & Andrew W. Lo, *What Happened to the Quants in August 2007?: Evidence From Factors and Transactions Data*, 5 J. INV. MGMT. 5, 5–9 (2007); Paul Krugman, *How Did Economists Get It So Wrong?*, N.Y. TIMES MAG., Sept. 6, 2009, at 36 (“There was nothing in the prevailing models suggesting the possibility of the kind of collapse that happened last year.”).

69. RISHI K. NARANG, INSIDE THE BLACK BOX: THE SIMPLE TRUTH ABOUT QUANTITATIVE TRADING xi (2009).

70. See IAN AYRES, SUPER CRUNCHERS: WHY THINKING-BY-NUMBERS IS THE NEW WAY TO BE SMART 124–26 (2007); Steve Lohr, *Google Schools Its Algorithm*, N.Y. TIMES, Mar. 6, 2011, at WK 4 (“Computers are only as smart as their algorithms—man-made software recipes for calculation . . .”).

71. NARANG, *supra* note 69, at xi.

72. Shvetank Shah et al., *Good Data Won't Guarantee Good Decisions*, HARV. BUS. REV., Apr. 2012, at 23.

73. See STEPHEN BAKER, FINAL JEOPARDY: MAN VS. MACHINE AND THE QUEST TO KNOW EVERYTHING 148–69 (2011) (discussing the limitations of artificial intelligence). *But see* JAMES BARRAT, OUR FINAL INVENTION: ARTIFICIAL INTELLIGENCE AND THE END OF THE HUMAN ERA 7–8 (2013).

74. See CLAYTON M. CHRISTENSEN ET AL., HOW WILL YOU MEASURE YOUR LIFE? 14 (2012) (“People often think that the best way to predict the future is by collecting as much data as possible . . . . But this is like driving a car looking only at the rearview mirror—because data is only available about the past.”); Jón Danielsson, *The Emperor Has No Clothes: Limits to Risk Modeling*, 26 J. BANKING & FIN. 1273, 1274 (2002); Krugman, *supra* note 68 (“[E]conomists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth.”).

*A. Flash Crashes*

The accelerated speed of cyborg finance means faster executions, faster market-making, and faster profits. But the accelerated speed also means faster ascents and faster crashes at speeds previously unattainable, posing challenges previously unimaginable.

On May 6, 2010, the world witnessed a stock market crash of incredible volatility and velocity.<sup>75</sup> In less than thirty minutes, approximately \$1 trillion in market value vanished from the U.S. stock market.<sup>76</sup> That episode in financial history is now simply referred to as the Flash Crash.<sup>77</sup>

An SEC and Commodity Futures Trading Commission (CFTC) joint investigation following the crash revealed that the Flash Crash was initiated by a futures order from a Kansas mutual fund company.<sup>78</sup> With a high-speed, automated computer program, the mutual fund company, Waddell & Reed, created an order to sell \$4.1 billion of E-Mini S&P futures contracts at approximately 2:32 p.m.<sup>79</sup> The program executed the order “without regard to price or time,”<sup>80</sup> and completed it in about twenty minutes.<sup>81</sup> In years past, an order of this size would have taken several hours or days to complete.<sup>82</sup>

Within minutes of the fulfillment of Waddell & Reed’s order, other computerized programs executed corresponding high-speed trades in the futures and equity markets that caused significant volatility in the Dow Jones Industrial Average (Dow), S&P futures, other futures contracts, and domestic equities.<sup>83</sup> Within the span of twenty minutes after Waddell & Reed’s initial trade, S&P futures experienced a 3% drop,<sup>84</sup> and the Dow experienced a 9.16% drop.<sup>85</sup> During the Dow’s rapid free fall, share prices in blue-chip stocks like 3M and Proctor & Gamble suffered losses nearing or exceeding 20%, or billions of dollars in market capitalization.<sup>86</sup> Other stocks also experienced severe volatility during this brief period.

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75. CFTC & SEC FINDINGS, *supra* note 10, at 1.

76. Haldane, *supra* note 3, at 2.

77. Graham Bowley, *Lone Sale of \$4.1 Billion in Contracts Led to ‘Flash Crash’ in May*, N.Y. TIMES, Oct. 2, 2010, at B1.

78. CFTC & SEC FINDINGS, *supra* note 10, at 2; Bowley, *supra* note 77.

79. *Id.*

80. Bowley, *supra* note 77 (quoting CFTC & SEC FINDINGS, *supra* note 10, at 2).

81. CFTC & SEC FINDINGS, *supra* note 10, at 2.

82. *See id.*

83. *Id.* at 1–4.

84. *Id.* at 3.

85. *See* Serittella, *supra* note 21, at 435.

86. CFTC & SEC FINDINGS, *supra* note 10, at 84–85.

Accenture, a leading consulting company, saw its shares fall by over 99%, from \$40 to \$0.01.<sup>87</sup> Shares of the famed auction house, Sotheby's, increased three thousand-fold, from \$34 to \$99,999.99.<sup>88</sup> At the end of the rollercoaster trading day, the major futures and equity indexes closed with losses of about 3% relative to the previous day.<sup>89</sup>

In the aftermath, the SEC and CFTC joint inquiry did not blame black-box traders and automated computerized programs entirely for causing the Flash Crash. Instead, the investigation noted that such traders and programs played a critical role in eroding liquidity and exacerbating volatility on the day of the Flash Crash.<sup>90</sup>

While another crash matching the velocity and magnitude of the Flash Crash has yet to materialize, there have been many smaller and more isolated lightning crashes,<sup>91</sup> including one in 2013 that caused the NASDAQ to suspend trading of its securities for three hours during a normal trading day.<sup>92</sup> Nevertheless, some experts and policymakers speculate that as finance accelerates and automates, it will only be a matter of time before another major crash like the Flash Crash occurs again.<sup>93</sup>

### B. Cy-Fi Crimes

Threats of new financial crimes accompany the emergence of cyborg finance. Cy-fi's heavy reliance on computerized systems to store

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87. *Id.* at 83; Haldane, *supra* note 3, at 2.

88. Haldane, *supra* note 3, at 2.

89. CFTC & SEC FINDINGS, *supra* note 10, at 1.

90. *Id.* at 6.

91. See Graham Bowley, *The Flash Crash, in Miniature*, N.Y. TIMES, Nov. 9, 2010, at B1 (reporting on the occurrence of smaller flash crashes); Jacob Bunge, et al., *Goldman's Misfire Rattles Options*, WALL ST. J., Aug. 21, 2013, at C1; Amy Chozick & Nicole Perloth, *Twitter Speaks, Markets Listen, and Fears Rise*, N.Y. TIMES, April 29, 2013, at A1 (describing the stock market crash caused by a false tweet); Shen Hong, *Everbright Securities Fiasco Casting a Shadow*, WALL ST. J., Aug. 21, 2013, at C3; Edward E. Kaufman, Jr. & Carl M. Levin, Op-Ed, *Preventing the Next Flash Crash*, N.Y. TIMES, May 6, 2011, at A27 (discussing mini-crashes since the Flash Crash); Matt Krantz, *Mini Flash Crashes Worry Traders*, USA TODAY, May 17, 2011, available at [http://www.usatoday.com/money/markets/2011-05-16-mini-flash-crashes-market-worry\\_n.htm](http://www.usatoday.com/money/markets/2011-05-16-mini-flash-crashes-market-worry_n.htm); Nathaniel Popper, *Wave of Runaway Trades Spread Turmoil Across Wall St.*, N.Y. TIMES, Aug. 2, 2012, at A1 (discussing market instability caused by computerized trading relating to Facebook's initial public offering and a rogue computer program related to Knight Trading); Nathaniel Popper, *BATS Flaw Not So Rare, Data Shows*, N.Y. TIMES, Mar. 29, 2012, at B1 (reporting on the volatility surrounding the initial public offering of BATS Global Markets, an electronic stock exchange pioneer).

92. See E.S. Browning and Scott Patterson, *Complex Systems Get Blame*, WALL ST. J., Aug. 23, 2013, at C1; Nathaniel Popper, *Pricing Problem Suspends NASDAQ for Three Hours*, N.Y. TIMES, Aug. 23, 2013, at A1.

93. See Kaufman, Jr. & Levin, *supra* note 91 ("[A]lgorithmic trading has caused mini-flash crashes since, and surveys suggest that most investors and analysts believe it's only a matter of time before the Big One.").

information, analyze data, and manage capital renders it particularly vulnerable to cybercrimes.<sup>94</sup> The new financial industry is essentially a high-tech industry where software codes, computerized systems, intellectual property, and technological infrastructure represent some of the industry's most valuable assets.<sup>95</sup> Many serious crimes against financial institutions now involve computers as the weapons of choice and cyberspace as the preferred setting.<sup>96</sup> For instance, with the proliferation of automated trading platforms, simply by injecting bad data and false trades into the system, cyber criminals can cause significant financial damage without guns and from the comforts of a remote location.<sup>97</sup> General Keith Alexander, the head of the National Security Agency and the U.S. Cyber Command in 2013, called the loss of American business secrets and intellectual property to cyber criminals "the greatest transfer of wealth in history."<sup>98</sup>

With the emergence of crimes in cyborg finance, a new lineup of criminal suspects is also emerging. Episodes from recent history suggest that financial firms must protect their interests from various, elusive antagonists including employees, competitors, hackers, and other nation-states.<sup>99</sup> In 2009, a former Goldman Sachs programmer was arrested for allegedly stealing the firm's algorithmic trading codes.<sup>100</sup> In 2011, hackers

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94. See Duncan B. Hollis, *Why States Need an International Law for Information Operations*, 11 LEWIS & CLARK L. REV. 1023, 1042 (2007) (speculating about computer viruses that incapacitate stock markets); Scott Patterson, *CME Was the Victim of 'Cyberintrusion' in July*, WALL ST. J., Nov. 16, 2013, at B5; Michael Riley & Ashlee Vance, *The Code War*, BUS. WK., July 25, 2011, at 52.

95. See BROWN, *supra* note 15, at 49 (discussing the urgent need for black-box firms to safeguard successful strategies for as long as possible); David Barboza & Kevin Drew, *Security Firm Sees Global Cyberspying*, N.Y. TIMES, Aug. 4, 2011, at A11 ("Cybersecurity is now a major international concern, with hackers gaining access to sensitive corporate and military secrets, including intellectual property."); Alex Berenson, *Arrest over Trading Software Illuminates a Secret of Wall St.*, N.Y. TIMES, Aug. 24, 2009, at A1 (noting the importance of computer programs to financial institutions).

96. Riley & Vance, *supra* note 94.

97. *Id.* at 56.

98. John Seabrook, *Network Insecurity*, NEW YORKER, May 20, 2013, at 64 (quoting Gen. Keith Alexander).

99. See SEC v. Dorozhko, 574 F.3d 42, 44–46 (2d Cir. 2009) (opining on a case involving hackers who traded on illicitly-acquired, material, nonpublic information); MARK BOWDEN, WORM: THE FIRST DIGITAL WORLD WAR 48 (2011) ("Today the most serious computer predators are funded by rich criminal syndicates and even nation-states, and their goals are far more ambitious."); INTELLIGENCE & NAT'L SEC. ALLIANCE, CYBER INTELLIGENCE: SETTING THE LANDSCAPE FOR AN EMERGING DISCIPLINE 7–9 (2011); SCOTT PATTERSON, THE QUANTS: HOW A NEW BREED OF MATH WHIZZES CONQUERED WALL STREET AND NEARLY DESTROYED IT 107–16 (2010) (discussing the theft of trade secrets from hedge funds); Michael Joseph Gross, *Silent War*, VANITY FAIR, July 2013, at 98; Nicole Perloth, *Hunting for Syrian Hackers' Chain of Command*, N.Y. TIMES, May 18, 2013, at B1 (reporting on the difficulties of tracing hackers); Nathaniel Popper, *Wall Street's Exposure to Hacking Laid Bare*, N.Y. TIMES, July 26, 2013, at B1.

100. See Azam Ahmed, *Ex-Programmer Is Sentenced to 8 years for Stealing Code from Goldman*, N.Y. TIMES, Mar. 19, 2011, at B2; Reed Albergotti, *Questions Linger in Goldman Code*

threatened Bank of America with stolen, corporate information.<sup>101</sup> In 2012, large, coordinated attacks, some attributable to Iran, dubbed “Operation High Roller,” targeted American and international financial institutions.<sup>102</sup> In 2013, hackers infiltrated the Associated Press’s Twitter account to falsely broadcast an attack on the White House that temporarily erased \$136 billion in market value.<sup>103</sup> Furthermore, in recent years, China has been suspected of serious cybercrimes against American business interests.<sup>104</sup>

Due to the amorphous and anonymous nature of cybercrimes, and the unwillingness of corporate victims to come forward, they can be difficult to prevent, trace, and prosecute.<sup>105</sup> Recognizing the seriousness of cybercrimes against the financial system and other American interests,<sup>106</sup> the federal government has responded to this emerging threat with more intense, strategic cyberspace studies<sup>107</sup> and aggressive cyber-defense

Case, WALL ST. J., June 14, 2013, at C1. *But see* Michael Lewis, *Goldman’s Greek Tragedy*, VANITY FAIR, Sept. 2013, at 312.

101. Nelson D. Schwartz, *Facing a New Type of Threat From WikiLeaks, a Bank Plays Defense*, N.Y. TIMES, Jan. 3, 2011, at B1.

102. DAVE MARCUS & RYAN SHERSTOBITOFF, MCAFEE/GUARDIAN ANALYTICS, DISSECTING OPERATION HIGH ROLLER 3 (2012), available at <http://www.mcafee.com/us/resources/reports/rp-operation-high-roller.pdf>; Nicole Perlroth, *Attacks on 6 Banks Frustrate Customers*, N.Y. TIMES, Oct. 1, 2012, at B1; Nicole Perlroth & Quentin Hardy, *Bank Hacks Were Work Of Iranians, Officials Say*, N.Y. TIMES, Jan. 9, 2013, at B1.

103. Chozick and Perlroth, *supra* note 91.

104. *See* Barboza & Drew, *supra* note 95; Sanger et al., *China’s Army Seen as Tied to Hacking Against U.S.*, N.Y. TIMES, Feb. 19, 2013, at A1; David E. Sanger and Mark Landler, *U.S. and China Will Hold Talks About Hacking*, N.Y. TIMES, June 2, 2013, at A1.

105. *See, e.g.*, BOWDEN, *supra* note 99, at 48–53 (describing challenges in creating a cybersecurity defense system); 2 ROCCI LUPPICINI, HANDBOOK OF RESEARCH ON TECHNOETHICS 542 (2009) (acknowledging difficulties in tracing the origins of cyberattacks); Sarah Gordon & Richard Ford, *On the Definition and Classification of Cybercrime*, 2 J. COMPUTER VIROLOGY 13, 13 (2006) (“Despite the fact that the word ‘Cybercrime’ has entered into common usage, many people would find it hard to define the term precisely.”); Oona A. Hathaway et al., *The Law of Cyber-Attack*, 100 CALIF. L. REV. 817, 874–77 (2012) (opining on legal challenges to addressing cyberattacks); Michael Joseph Gross, *Enter the Cyber-Dragon*, VANITY FAIR, Sept. 2011, at 220 (“Because virtual attacks can be routed through computer servers anywhere in the world, it is almost impossible to attribute any hack with total certainty.”); Christopher Matthews, *Cybertheft Victims Itchy to Retaliate*, WALL ST. J., June 3, 2013, at B6; Chris Strohm et al., *Cyber Attack? What Cyber Attack?*, BUS. WK., Apr. 15, 2013, at 40 (reporting on the reluctance of companies to disclose cyber attacks).

106. *See* TERRORNOMICS 117 (Sean S. Costigan & David Gold, eds. 2007) (noting the FBI estimated that cybercrime costs the U.S. \$400 billion annually).

107. *See, e.g.*, DEP’T OF DEF., CYBERSPACE POLICY REPORT (Nov. 2011), available at [http://www.defense.gov/home/features/2011/0411\\_cyberstrategy/docs/NDAA%20Section%20934%20Report\\_For%20webpage.pdf](http://www.defense.gov/home/features/2011/0411_cyberstrategy/docs/NDAA%20Section%20934%20Report_For%20webpage.pdf); SEC DIV. OF CORP. FIN., CF DISCLOSURE GUIDANCE: TOPIC NO. 2: CYBERSECURITY (Oct. 13, 2011), available at [http://sec.gov/divisions/corpfin/guidance/cfguidance-topic2.htm#\\_ednref1](http://sec.gov/divisions/corpfin/guidance/cfguidance-topic2.htm#_ednref1); THE WHITE HOUSE, INTERNATIONAL STRATEGY FOR CYBERSPACE: PROSPERITY, SECURITY, AND OPENNESS IN A NETWORKED WORLD (May 2011), available at [http://www.whitehouse.gov/sites/default/files/rss\\_viewer/international\\_strategy\\_for\\_cyberspace.pdf](http://www.whitehouse.gov/sites/default/files/rss_viewer/international_strategy_for_cyberspace.pdf).

programs.<sup>108</sup> In 2012 alone, the Air Force spent about \$4 billion on its cyber programs,<sup>109</sup> and the Labor Department, in response to cyber threats, improved the computer security of its valuable economic data.<sup>110</sup> In 2013, it was revealed that President Obama possessed broad powers relating to cyberstrikes against our enemies.<sup>111</sup> That same year, President Obama also issued an executive order aimed at enhancing cybersecurity.<sup>112</sup> Despite these efforts, as cyborg finance grows and evolves, industry and government sentinels must remain vigilant of the growing and evolving criminal threats against the new financial industry. It should not be surprising if most significant financial crimes of the future are cybercrimes.

### III. EMERGING SYSTEMIC RISKS

As the financial system evolves and grows, so do its systemic risks.<sup>113</sup> In recent years, the systemic risk of “too big to fail” has garnered much attention.<sup>114</sup> “Too big to fail” refers to the systemic risk where large financial intuitions become too critical to the economy, so much so that government has to bail out any of such faltering private firms with public funds.<sup>115</sup> The emergence of cyborg finance has borne two new systemic risks: one related to connectivity that the author terms “too linked to fail” and the other related to speed that the author terms “too fast to save.”<sup>116</sup>

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108. James Bamford, *The Silent War*, WIRED, July 2013, at 90.

109. See Julian E. Barnes, *Pentagon Digs in on Cyberwar Front*, WALL ST. J., July 6, 2012, at A4 (stating that “[o]verall the Air Force spends about \$4 billion a year on its cyber programs”).

110. John H. Cushman Jr., *Guarding the Numbers*, N.Y. TIMES, July 17, 2012, at B1.

111. David E. Sanger & Thom Shanker, *Broad Powers Seen for Obama in Cyberstrikes*, N.Y. TIMES, Feb. 4, 2013, at A1.

112. Exec. Order No. 13636, 78 Fed. Reg. 11739 (Feb. 12, 2013), available at <http://www.whitehouse.gov/the-press-office/2013/02/12/executive-order-improving-critical-infrastructure-cybersecurity>.

113. See Hal S. Scott, *The Reduction of Systemic Risk in the United States Financial System*, 33 HARV. J.L. & PUB. POL’Y 671, 673 (2010) (“Going forward, the central problem for financial regulation . . . is to reduce systemic risk.”).

114. See, e.g., S. PERMANENT SUBCOMM. ON INVESTIGATIONS, *supra* note 5, at 15–17 (reporting on the rise of too-big-to-fail financial institutions); SORKIN, *supra* note 11 (discussing the policy challenges presented by “too big to fail” institutions); Frost, *supra* note 11.

115. See, e.g., 12 C.F.R. § 1320.1 (2011); Amir E. Khandani, Andrew W. Lo & Robert C. Merton, *Systemic Risk and the Refinancing Ratchet Effect* 38 (Harv. Bus. Sch. Fin., Working Paper No. 147892, 2012), available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1472892](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1472892) (“[S]ystemic risk . . . arises when large financial losses affect important economic entities that are unprepared for and unable to withstand such losses, causing a cascade of failures and widespread loss of confidence.”).

116. The author previously introduced these terms in a prior publication. See Lin, *supra* note 4, at 711–17.

*A. Too Linked to Fail*

In the age of cyborg finance, numerous financial participants and products coexist in an expansive, global financial web that crosses institutions, industries, instruments, and states, creating a systemic risk of “too linked to fail.” Today, commercial banks, investment banks, hedge funds, sovereign funds, mutual funds, and other financial participants are all involved, intermediated, and interconnected like never before, operating in a single financial network with numerous intertwined products and transactions.<sup>117</sup> JPMorgan Chase, for instance, is linked to a host of counterparties through a wide-range of services and products including investment banking, commercial banking, lending, market-making, trading, clearing, custodial servicing, and prime brokering.<sup>118</sup> Moreover, these modern, hi-tech financial links can be difficult to break cleanly and be inherently prone to accidents, as described by Charles Perrow in his seminal study of the risks of technology, *Normal Accidents*.<sup>119</sup>

In eras past, the failures of one nation-state, one financial institution, or one financial instrument could have been more readily isolated by geography. In the new financial industry, geographic borders matter little as financial participants and products have grown more linked than ever. For instance, the collateralized debt obligations (CDOs) and mortgage-backed securities (MBSs) that played such critical roles in the Financial Crisis frequently linked thousands of mortgages, hundreds of CDOs, and hundreds of payment tranches across multiple financial institutions.<sup>120</sup> Like never before, the failings of one nation-state, one financial institution, or one financial instrument can affect all nation-states, all institutions, and all instruments.<sup>121</sup>

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117. See Markus K. Brunnermeier, *Deciphering the Liquidity and Credit Crunch 2007–2008*, 23 J. ECON. PERSPS. 77, 96 (2009) (discussing the financial system’s “interwoven network of financial obligations”); Robin Greenwood & David S. Scharfstein, *How to Make Finance Work*, at 107; HAL S. SCOTT, COMM. ON CAPITAL MKTS. REGULATION, INTERCONNECTEDNESS AND CONTAGION (2012), available at [http://www.aei.org/files/2013/01/08/-interconnectedness-and-contagion-by-hal-scott\\_153927406281.pdf](http://www.aei.org/files/2013/01/08/-interconnectedness-and-contagion-by-hal-scott_153927406281.pdf).

118. JPMorgan Chase & Co., Annual Report (Form 10-K) (Feb. 29, 2012), available at <http://www.sec.gov/Archives/edgar/data/19617/000001961713000221/corp10k2012.htm>.

119. See CHARLES PERROW, *NORMAL ACCIDENTS: LIVING WITH HIGH-RISK TECHNOLOGIES* 4–5 (1999); see also Anna Gelpern & Adam J. Levitin, *Rewriting Frankenstein Contracts: Workout Prohibitions in Residential Mortgage-Backed Securities*, 82 S. CAL. L. REV. 1075, 1076 (2009); Judge, *supra* note 6, at 701–11 (commenting on the “stickiness” of modern financial products); Adam J. Levitin & Tara Twomey, *Mortgage Servicing*, 28 YALE J. ON REG. 1, 58 (2011).

120. Kenneth E. Scott & John B. Taylor, Op-Ed., *Why Toxic Assets Are So Hard to Clean Up*, WALL ST. J., July 20, 2009, at A13.

121. See LESSONS FROM THE FINANCIAL CRISIS: CAUSES, CONSEQUENCES, AND OUR ECONOMIC FUTURE 128 (Robert W. Kolb ed., 2010) (“The failure of just one large financial institution might lead to the failure of one or more other institutions that would then spread to yet more financial institutions

Distinct from “too big to fail,” this emerging systemic risk of “too linked to fail” includes smaller participants and products, whose failures may ripple across the system because of their linkages regardless of their value or size despite not being classified as systemically important financial institutions.<sup>122</sup> In 1998, the Federal Reserve initiated a \$3.6 billion industry-led bailout for Long-Term Capital Management, a hedge fund with less than two hundred employees, because its failure would have created significant losses for many investment banks and caused widespread panic on Wall Street.<sup>123</sup> Since then, hedge funds and other financial intermediaries have only grown larger in size and number, further exacerbating the risks of “too linked to fail.”<sup>124</sup> More recent events involving individual institutions and individual nation-states also signal the emergence of “too linked to fail.” Between 2008 and 2013, the failings of Bear Stearns and Lehman Brothers,<sup>125</sup> along with the sovereign debt crises of Greece, Italy, and Spain all individually, and collectively, created serious strains on the global financial system.<sup>126</sup>

Further complicating the risks of “too linked to fail” is the fact that many financial participants engage in similar and interdependent strategies.<sup>127</sup> As such, many of these strategies may be similarly flawed due

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in a contagion that was feared might end in the collapse of the entire financial system.”); Judge, *supra* note 6, at 659 (arguing that new linked products in the modern financial system generate new sources of systemic risk); Serritella, *supra* note 21, at 437 (noting the potential perils emanating from “the interconnectivity of financial markets and their participants, as well as increased interconnections between securities and their derivatives”).

122. See Schwarcz, *supra* note 6, at 200 (discussing the systemic risks caused by financial intermediation and disintermediation); Hong, *supra* note 91 (reporting on the impact of a trading glitch at a medium-sized Chinese brokerage); FINANCIAL STABILITY BOARD, ASSESSMENT METHODOLOGIES FOR IDENTIFYING NON-BANK NON-INSURER GLOBAL SYSTEMICALLY IMPORTANT FINANCIAL INSTITUTIONS, Jan. 8, 2014, available at: [http://www.financialstabilityboard.org/publications/r\\_140108.pdf](http://www.financialstabilityboard.org/publications/r_140108.pdf).

123. See ROGER LOWENSTEIN, WHEN GENIUS FAILED: THE RISE AND FALL OF LONG-TERM CAPITAL MANAGEMENT xviii–xx (2000); FRANK PARTNOY, INFECTIOUS GREED: HOW DECEIT AND RISK CORRUPTED THE FINANCIAL MARKETS 261 (2003).

124. See Whitehead, *supra* note 5, at 5 (“Although hedge funds grew by 260% between 1999 and 2004 to become a one trillion dollar business, they were largely exempt from regulation under the federal securities and investment advisory laws.”).

125. See Bryan Burrough, *Bringing Down Bear Stearns*, VANITY FAIR, Aug. 2008, at 106; Carrick Mollenkamp et al., *Lehman’s Demise Triggered Cash Crunch Around Globe*, WALL ST. J., Sept. 29, 2008, at A1; Andrew Ross Sorkin, *Bids to Halt Financial Crisis Reshape Landscape of Wall St.*, N.Y. TIMES, Sept. 15, 2008, at A1.

126. See Clive Crook, *Who Lost the Euro?*, BUS. WK., May 24, 2012, at 12. euro; Peter Coy, *Greece: Why the Beast is Back*, BUS. WK., May 30, 2011, at 11; Carol Matlack & Jeff Black, *Exit the Euro Zone? Think Before You Leap*, BUS. WK., Sept. 19, 2011, at 15.

127. See Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3611 (proposed Jan. 21, 2010) (codified at 17 C.F.R. pt. 242) (“[M]any proprietary firms potentially could engage in similar or connected trading strategies that, if such strategies generated significant losses at the same time, could cause many proprietary firms to become financially

to shared conceptual biases.<sup>128</sup> As a result, the failing of one participant or one product could not only adversely impact others, but could also create vicious cycles of volatility for the entire global financial system as trades cascade and generate feedback loops and spillover effects of serious consequences.<sup>129</sup>

As cyborg finance expands, the systemic perils posed by “too linked to fail” will only grow more challenging and more pressing in the coming years as the complexity and multiplicity of linkages create greater risks and opportunities for error.<sup>130</sup>

### B. *Too Fast to Save*

In the new financial industry of cyborg finance, financial transactions operate at incredible velocities. Billions of transactions worth trillions of dollars move through cables and spectra across seas and states at the speed of milliseconds.<sup>131</sup> The accelerated velocity has resulted in faster executions and also faster investment turnover. “At the end of World War II, the average holding period for a stock was four years. By 2000, it was eight months. By 2008, it was two months. And by 2011 it was *twenty-two seconds . . .*”<sup>132</sup> And the future of cy-fi only appears to be accelerating as financial engineers chase the speed of light with new technology like quantum computing.<sup>133</sup> Such velocity and acceleration give rise to a new systemic risk of “too fast to save.”

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distressed and lead to large fluctuations in market prices.”); Bernard S. Donefer, *Algos Gone Wild: Risk in the World of Automated Trading Strategies*, 5 J. TRADING 31, 32 (2010).

128. Geoffrey P. Miller & Gerald Rosenfeld, *Intellectual Hazard: How Conceptual Biases in Complex Organizations Contributed to the Crisis of 2008*, 33 HARV. J.L. & PUB. POL’Y 807, 810 (2010).

129. See BROWN, *supra* note 15, at 7; PATTERSON, *supra* note 3, at 9–10 (discussing the financial dangers of “a vicious self-reinforcing feedback loop”); Louise Story & Graham Bowley, *Market Swings Are Becoming New Standard*, N.Y. TIMES, Sept. 12, 2011, at A1.

130. See Henry T.C. Hu & Bernard Black, *Debt, Equity and Hybrid Decoupling: Governance and Systemic Risk Implications*, 14 EUR. FIN. MGMT. 663, 691 (2008) (“The longer the ownership chain . . . the greater the potential for agency costs and valuation errors to creep in.”); Judge, *supra* note 6, at 685; see also Steven L. Schwarcz, *Regulating Complexity in Financial Markets*, 87 WASH. U. L. REV. 211, 215 (2009).

131. See Fabozzi et al., *supra* note 2, at 8.

132. PATTERSON, *supra* note 3, at 46.

133. See, e.g., Concept Release on Equity Market Structure, Exchange Act Release No. 34-61358, 75 Fed. Reg. 3594, 3610 (proposed Jan. 21, 2010) (codified at 17 C.F.R. pt. 242) (acknowledging the accelerating speed of modern financial markets); A. D. Wissner-Gross & C. E. Freer, *Relativistic Statistical Arbitrage*, 82 PHYSICAL REV. E 056104 (2010) (studying arbitrage opportunities for trading near the speed of light); Graham Bowley, *The New Speed of Money*, N.Y. TIMES, Jan. 2, 2011, at BU1 (“Almost each week, it seems, one exchange or another claims a new record: Nasdaq, for example, says its time for an average order ‘round trip’ is 98 microseconds—a mind-numbing speed equal to 98 millionths of a second.”); Quentin Hardy, *Testing a New Class of*

While the accelerated speed of finance can be beneficial in terms of efficiencies, the accelerated speed also increases risks of error, volatility, market fragmentation, and malfeasance before anyone can stop it.<sup>134</sup> A single misinformed or rogue trader can cause material damage to a financial institution or the entire system in a very short amount of time. In 2008, a trader at Société Générale, the storied French investment bank, nearly destroyed the firm with \$69 billion in unauthorized positions over a period of several months.<sup>135</sup> In 2011, another rogue trader at UBS, a leading Swiss investment bank, caused losses of \$2.3 billion.<sup>136</sup>

Beyond human traders, automated programs pose even more serious systemic perils related to speed. Automated programs responding to bad data or nefarious stimuli can cause catastrophic harm to financial institutions before remedial or rescue measures can be implemented.<sup>137</sup> Automated programs operating at warp speeds can exacerbate volatility and reduce liquidity during periods of tumult by eliminating trading positions in the marketplace.<sup>138</sup> The Flash Crash serves as a prime example of the problems of “too fast to save”:

For the first time in financial history, machines can execute trades far faster than humans can intervene. That gap is set to widen. In some respects the 2010 Flash Crash and the 1987 stock market crash have common genes – algorithmic amplification of stress. But they differ in one critical respect. Regulatory intervention could feasibly have forestalled the 1987 crash. By the time of the Flash Crash, regulators might have blinked—literally, blinked—and missed their chance.<sup>139</sup>

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*Speedy Computer*, N.Y. TIMES, Mar. 22, 2013, at B1; Matthew Philips, *Trading at the Speed of Light*, BUS. WK., April 2, 2012, at 46.

134. See FRANK PARTNOY, WAIT: THE ART AND SCIENCE OF DELAY 43 (2012); PERROW, *supra* note 119, at 71 (discussing the tendency for failures or “accidents” to compound upon one another); Haldane, *supra* note 3, at 15; see also Fabozzi et al., *supra* note 2, at 29 (discussing how emphasis on speed and technology fragments the financial industry); Matthew Baron et al., *The Trading Profits of High Frequency Traders* (Nov. 2012) (unpublished manuscript) (available at [http://conference.nber.org/confer//2012/MMf12/Baron\\_Brogaard\\_Kirilenko.pdf](http://conference.nber.org/confer//2012/MMf12/Baron_Brogaard_Kirilenko.pdf)) (finding that high-frequency traders profit at the expense of ordinary investors); Floyd Norris, *In Markets’ Tuned-Up Machinery, Stubborn Ghosts Remain*, N.Y. TIMES, Aug. 23, 2013, at B1.

135. Nicola Clark, *Ex-Trader Gets 3 Years*, N.Y. TIMES, Oct. 6, 2010, at B1.

136. Julia Werdigier, *Revealing Details of Rouge Trades, UBS Raises Loss Estimate to \$2.3 Billion*, N.Y. TIMES, Sept. 19, 2011, at B3.

137. See THOMAS NEAL FALKENBERRY, HIGH FREQUENCY DATA FILTERING: A REVIEW OF THE ISSUES ASSOCIATED WITH MAINTAINING AND CLEANING A HIGH FREQUENCY FINANCIAL DATABASE (2002), available at [http://www.tickdata.com/pdf/Tick\\_Data\\_Filtering\\_White\\_Paper.pdf](http://www.tickdata.com/pdf/Tick_Data_Filtering_White_Paper.pdf); Fabozzi et al., *supra* note 2, at 11.

138. PARTNOY, *supra* note 134.

139. Haldane, *supra* note 3, at 15.

Additionally, cyborg finance's emphasis on speed has also meant that traditional, institutional safeguards have been sacrificed for velocity and efficiency, making it more difficult to prevent such calamitous episodes. While such episodes may have occurred in eras past, they would have taken longer to execute and, therefore, allowed more time for intervention.

As cyborg finance accelerates, the systemic perils posed by "too fast to save" will only grow more apparent and more difficult in the coming years.

#### IV. CURRENT REGULATORY SHORTCOMINGS

Legal change frequently trails technological change.<sup>140</sup> Old laws and old regulations become blunt in the face of sharp, new financial developments.<sup>141</sup> As technological advances transform modern finance into cyborg finance, law's lagging performance has grown more apparent and more consequential.<sup>142</sup> The current regulatory framework's shortcomings can be partially traced to matters of jurisdiction, origination, and resource.

##### A. Matters of Jurisdiction

Sovereign and regulatory boundaries frequently bound law and regulation.<sup>143</sup> Yet cyborg finance is unencumbered by such quaint boundaries as it operates in a global marketplace, crosscutting states and regulators.<sup>144</sup> This jurisdictional dissonance helps to explain part of the

140. Lyria Bennett Moses, *Recurring Dilemmas: The Law's Race to Keep up with Technological Change*, 2007 U. ILL. J.L. TECH. & POL'Y 239, 239 (2007).

141. See Tara Bhupathi, *Technology's Latest Market Manipulator? High Frequency Trading: The Strategies, Tools, Risks, and Responses*, 11 N.C. J.L. & TECH. 377, 377–78 (2010) ("Rapid technological advances have . . . caus[ed] the legal world to either choose to judicially adapt old laws and policies to the new digital situations or to legislatively create new doctrines to deal with unforeseen challenges."); Stephen J. Choi & Andrew T. Guzman, *National Laws, International Money: Regulation in a Global Capital Market*, 65 FORDHAM L. REV. 1855, 1856–57 (1997); Whitehead, *supra* note 5, at 2–5 (noting the lack of regulatory innovation in response to financial innovation).

142. See REINHART & ROGOFF, *supra* note 6, at 224–25 (discussing the high costs of financial crises and failures).

143. See *Morrison v. Nat'l Austl. Bank Ltd.*, 130 S. Ct. 2869, 2885 (2010) ("Like the United States, foreign countries regulate their domestic securities exchanges and securities transactions occurring within their territorial jurisdiction."); *EEOC v. Arabian Am. Oil Co.*, 499 U.S. 244, 248 (1991) ("It is a longstanding principle of American law 'that legislation of Congress, unless a contrary intent appears, is meant to apply only within the territorial jurisdiction of the United States.'") (quoting *Foley Bros. v. Filardo*, 336 U.S. 281, 285 (1949)).

144. See BROWN, *supra* note 15, at 149 ("Advancements in electronic trading technology have rapidly accelerated the globalization of equity markets . . ."); Johnson & Post, *supra* note 61, at 1367 (discussing the need for new conceptions of jurisdiction with the emergence of the Internet); Lawrence Lessig, *The Path of Cyberlaw*, 104 YALE L.J. 1743, 1743–45 (1995); Cox, *supra* note 6, at 945 ("As technology has made national borders seamless, it challenges the territorial orientation of securities regulations."); see also JACK GOLDSMITH & TIM WU, *WHO CONTROLS THE INTERNET?: ILLUSIONS OF A BORDERLESS WORLD* vii–viii (2006) (finding that the Internet is "becoming bordered");

current regulatory framework's shortcomings in governing financial innovation.

Because of the jurisdictional dissonance between government regulators and the regulated, financial industry participants and products exist in spaces with varying degrees of governance. In some spaces, multiple competing regulators govern participants and products across various territories and agencies with rules that overlap and conflict.<sup>145</sup> For instance, a complex multiplicity of regulators in the United States and the United Kingdom govern investment banks with intercontinental presence.<sup>146</sup> In other spaces, financial participants and products exist in regulatory penumbras with little oversight.<sup>147</sup> As an example, the credit default swap markets operated with few regulations and little oversight for many years prior to the Financial Crisis.<sup>148</sup>

The jurisdictional dissonance between the regulators and the regulated has encouraged financial players to engage in games of regulatory arbitrage within and across nations, by skirting and leaping ahead of existing law, and by moving between shadow finance and regulated finance.<sup>149</sup> The jurisdictional gaps and gulfs among regulators often serve as fertile ground for financial innovation and malfeasance.<sup>150</sup> As cy-fi continues to push and

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145. See Fisch, *supra* note 6, at 787 (discussing jurisdictional conflict among regulators).

146. See Jack Ewing, *Global Rules for Banks Draw Near*, N.Y. TIMES, Sept. 11, 2010, at B1 (discussing the complexities in creating and standardizing banking rules internationally).

147. See, e.g., ALEXANDER DAVIDSON, HOW THE GLOBAL FINANCIAL MARKETS REALLY WORK: THE DEFINITIVE GUIDE TO UNDERSTANDING INTERNATIONAL INVESTMENT AND MONEY FLOWS 17 (2009) (discussing shadow banking and financial regulation); Robert A. Eisenbeis, *Agency Problems and Goal Conflicts in Achieving Financial Stability: The Case of the EMU*, in THE STRUCTURE OF FINANCIAL REGULATION 232, 235 (David G. Mayes & Geoffrey E. Wood eds., 2007) (explicating on state and federal financial regulation conflicts); James J. Park, *The Competing Paradigms of Securities Regulation*, 57 DUKE L.J. 625, 665 (2007) (suggesting that regulatory competition creates regulatory gamesmanship opportunities).

148. See James E. Kelly, *Transparency and Bank Supervision*, 73 ALB. L. REV. 421, 424 (2010) (noting regulatory gaps relating to "hedge funds; derivatives markets; off balance sheet entities; the credit ratings agencies; firms' disclosure of risk, valuation, and compensation policies; securitized and structured products"); Whitehead, *supra* note 5, at 34 ("[Credit default swaps] were also exempt from regulation under the Securities Act of 1933 and the Securities Exchange Act of 1934, and were preempted from state gaming or bucketshop laws under the Commodity Exchange Act.") (footnote omitted); Gretchen Morgenson, *First Comes the Swap. Then It's the Knives.*, N.Y. TIMES, June 1, 2008, at BU1; Interview by Michael Kirk with Brooksley Born, Chair 1996–1999, Commodity Futures Trading Comm'n (Aug. 28, 2009), available at <http://www.pbs.org/wgbh/pages/frontline/warning/interviews/born.html> ("When I was chair of the Commodity Futures Trading Commission [CFTC], I became aware of how quickly the over-the-counter derivatives market was growing, how little any of the federal regulators knew about it.").

149. See Victor Fleischer, *Regulatory Arbitrage*, 89 TEX. L. REV. 227, 229 (2010); Edward F. Greene & Elizabeth L. Broomfield, *Promoting Risk Mitigation, Not Migration: A Comparative Analysis of Shadow Banking Reforms by the FSB, USA and EU*, 8 CAP. MKTS. L.J. 6, 14–15 (2013); Robin Greenwood and David S. Scharfstein, *How to Make Finance Work*, at 107.

150. See, e.g., GILLIAN TETT, FOOL'S GOLD: HOW THE BOLD DREAM OF A SMALL TRIBE AT J.P. MORGAN WAS CORRUPTED BY WALL STREET GREED AND UNLEASHED A CATASTROPHE 39–47 (2009)

break traditional regulatory boundaries based on jurisdiction, law must seek new paradigms to better address this shortcoming.<sup>151</sup>

### B. Matters of Origination

Law is built on reaction, precedent, and predictability,<sup>152</sup> but cyborg finance is built on initiative, innovation, and change.<sup>153</sup> Financial regulations often do not originate organically; instead, they are the children of busts and scandals and become orphans in boom times.<sup>154</sup> The aftermath of the Great Depression led to the creation of the SEC and the modern federal securities regulatory framework.<sup>155</sup> The Enron and WorldCom scandals served as catalysts for the Sarbanes Oxley Act.<sup>156</sup> The Financial Crisis sowed the seeds of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank).<sup>157</sup> In response to the Flash Crash, regulators implemented new rules to address high-frequency trading.<sup>158</sup> Finance innovation, in contrast, originates organically as market participants create and change in the dynamic pursuit of profit.

(discussing how the derivatives market originated from regulatory evasion); Charles W. Calomiris, *Financial Innovation, Regulation, and Reform*, 29 CATO J. 65, 65 (2009) (explaining how financial innovation is often borne out of “sidestepping regulatory restrictions”).

151. See, e.g., Choi & Guzman, *supra* note 6, at 904–08; Merritt B. Fox, *Securities Disclosure in a Globalizing Market: Who Should Regulate Whom*, 95 MICH. L. REV. 2498, 2501–03 (1997).

152. See, e.g., Frederick G. Kempin, Jr., *Precedent and Stare Decisis: The Critical Years, 1800 to 1850*, 3 AM. J. LEGAL HIST. 28, 28 (1959) (“The modern doctrine of stare decisis as applied in the United States is a general policy of all courts to adhere to the ratio decidendi of prior cases decided by the highest court in a given jurisdiction . . .”).

153. See, e.g., Henry T.C. Hu, *Misunderstood Derivatives: The Causes of Informational Failure and the Promise of Regulatory Incrementalism*, 102 YALE L.J. 1457, 1479 (1993) (“To stay competitive, banks constantly introduce new financial products because margins on products decline quickly.”); Eamonn K. Moran, *Wall Street Meets Main Street: Understanding the Financial Crisis*, 13 N.C. BANKING INST. 5, 33 (2009) (discussing the financial innovation behind mortgage-backed securities and collateralized debt obligations).

154. See ERIK F. GERDING, *LAW, BUBBLES, AND FINANCIAL REGULATION* 2–3 (2013) Stuart Banner, *What Causes New Securities Regulation? 300 Years of Evidence*, 75 WASH. U. L.Q. 849, 850 (1997) (“[M]ost of the major instances of new securities regulation in the past three hundred years of English and American history have come right after crashes.”); John C. Coffee, Jr., *The Political Economy of Dodd-Frank: Why Financial Reform Tends To Be Frustrated and Systemic Risk Perpetuated*, 97 CORNELL L. REV. 1019, 1020 (2012) (“[O]nly after a catastrophic market collapse can legislators and regulators overcome the resistance of the financial community and adopt comprehensive ‘reform’ legislation.”); Grundfest, *supra* note 6, at 1 (“[E]very dramatic change in the structure of our securities laws has been provoked by a perceived failure in the capital markets that stimulated a regulatory response.”).

155. JACK E. KIGER ET AL., *ACCOUNTING PRINCIPLES* 409 (1984).

156. Larry E. Ribstein, *Bubble Laws*, 40 HOUS. L. REV. 77, 83 (2004).

157. SKEEL, *supra* note 5, at 43–59.

158. See Troy A. Paredes, Comm’r, SEC, *Speech by SEC Commissioner: Remarks at the Symposium on “Hedge Fund Regulation and Current Developments”* (June 8, 2011) (transcript available at <http://www.sec.gov/news/speech/2011/spch060811tap.htm>) (remarking on new regulatory proposals following the Flash Crash).

Because of this dissonance in origination, law frequently lags behind finance. New financial products and problems frequently lack elegant legal guidance and remedies. In some cases, the swiftness of financial innovation simply laps the slowness of rulemaking.<sup>159</sup> In other cases, mistimed, mismatched, and misinformed regulations create the bases for future financial problems.<sup>160</sup> This reactionary approach to rulemaking has led some leading corporate law scholars to call such an approach to financial regulation, “quack corporate governance.”<sup>161</sup>

Because of this dissonance in origination, law has fallen gravely short in effectively governing financial markets. As cy-fi continues to innovate and evolve, law must re-examine its sources of origination in order to be more effective.<sup>162</sup>

### C. Matters of Resource

There exists a significant resource asymmetry between participants in cyborg finance and the government regulators that oversee them. While the pursuit of profits drives financial firms to invest in technology and expertise, regulatory funding lacks a similar driving force and is often constrained by politics.<sup>163</sup>

159. See, SEQUENCING?: FINANCIAL STRATEGIES FOR DEVELOPING COUNTRIES 133 (Alison Harwood & Bruce L. R. Smith eds., 1997); Ben Protess & Jessica Silver-Greenberg, *Senate Report Said to Fault JPMorgan on Loss*, N.Y. TIMES, March 5, 2013, at B1 (reporting on huge losses from risky trading while regulators have spent years trying to finalize and implement the Volcker Rule to curb such trading activities).

160. See, e.g., Calomiris, *supra* note 150, at 67 (“Risk-taking was driven by government policies; government’s actions were the root problem, not government inaction.”).

161. See Stephen M. Bainbridge, *Dodd-Frank: Quack Federal Corporate Governance Round II*, 95 MINN. L. REV. 1779, 1821 (2011); Roberta Romano, *The Sarbanes-Oxley Act and the Making of Quack Corporate Governance*, 114 YALE L. J. 1521 (2005).

162. See, e.g., Evan J. Criddle, *Fiduciary Administration: Rethinking Popular Representation in Agency Rulemaking*, 88 TEX. L. REV. 441, 448–49 (2010) (proposing a new regulatory model based on fiduciary duties); Randy J. Kozel & Jeffrey A. Pojanowski, *Administrative Change*, 59 UCLA L. REV. 112, 115 (2011) (suggesting a regulatory model based on “prescriptive reasoning”).

163. See *Testimony on Budget and Management of the U.S. Securities Exchange Commission: Hearing Before the H. Comm. on Fin. Servs., & the Subcomm. on Capital Mkts., Ins., and Gov’t-Sponsored Enters. of the H. Comm. on Fin. Servs.*, 112th Cong. (2011) (statement of Robert Khuzami et al., Dirs., Secs. Exch. Comm’n), available at <http://www.sec.gov/news/testimony/2011/ts031011directors.htm> (“Over the past decade, the SEC has faced significant challenges in maintaining a staffing level and budget sufficient to carry out its core mission. The SEC experienced three years of frozen or reduced budgets . . . that forced a reduction of 10 percent of the agency’s staff. Similarly, the agency’s investments in new or enhanced IT systems declined about 50 percent . . .”); Arthur Levitt Jr., Op-Ed, *Don’t Gut the S.E.C.*, N.Y. TIMES, Aug. 8, 2011, at A19 (opining on the funding and political constraints on the SEC); Mark Maremont & Deborah Solomon, *Missed Chances: Behind SEC’s Failings: Caution, Tight Budget, ‘90s Exuberance*, WALL ST. J., Dec. 24, 2003, at A1; Richard Rubin, *House Panel Endorses Budget Cuts at IRS, Consumer Bureau*, BLOOMBERG, June 16, 2011, available at <http://www.bloomberg.com/news/2011-06-16/house-panel-endorses-budget-cuts-at-irs-consumer-bureau-1-.html> (“[Because of budget cuts], the SEC wouldn’t be able to carry out the new

Resource limitations can directly impact regulators on important matters of technology and expertise. In terms of technology, industry participants invest millions of dollars into the technology that is at the heart of cy-fi, while regulators lack similar resources to keep pace.<sup>164</sup> For instance, while the financial industry pushes into the new frontiers of technology, the federal government still has agencies that use floppy disks to submit information to the Federal Register in the year 2013.<sup>165</sup> In terms of expertise, private cy-fi participants can earn millions of dollars and continue to deepen their expertise.<sup>166</sup> Government regulators generally earn a fraction of that income with fewer opportunities for expertise development.<sup>167</sup> These significant compensation disparities have made it difficult for regulators to attract and retain talent.<sup>168</sup> Given the technology and complexity behind cyborg finance, effective regulation requires regulators that have sufficient technological capacity and financial comprehension to understand the industry that they seek to regulate.<sup>169</sup>

Moreover, regulated firms also expend significant influence to lobby policymakers, while regulators lack a similar influence.<sup>170</sup> A deleterious

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responsibilities it received in the Dodd-Frank law.”); James B. Stewart, *As a Watchdog Starves, Wall St. Is Tossed a Bone*, N.Y. TIMES, July 16, 2011, at A1 (discussing the small budgets of financial regulators like the SEC).

164. Nathaniel Popper & Ben Protess, *To Regulate High-Speed Traders, S.E.C. Turns to One of Them*, N.Y. TIMES, Oct. 8, 2012, at B1.

165. Jada F. Smith, *Slowly They Modernize: A Federal Agency that Still Uses Floppy Disks*, N.Y. TIMES, Dec. 7, 2013, at A14.

166. See, e.g., U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-11-654, SEC: EXISTING POST-EMPLOYMENT CONTROLS COULD BE FURTHER STRENGTHENED (2011), available at <http://www.gao.gov/new.items/d11654.pdf> (studying the revolving door between the SEC and the private sector); MICHAEL SMALLBERG, PROJECT ON GOV'T OVERSIGHT, DANGEROUS LIAISONS: REVOLVING DOOR AT SEC CREATES RISK OF REGULATORY CAPTURE (2013), available at <http://pogoarchives.org/ebooks/20130211-dangerous-liaisons-sec-revolving-door.pdf>; JAMES Q. WILSON ET AL., AMERICAN GOVERNMENT: INSTITUTIONS & POLICIES 279 (11th ed. 2008) (“Every year, hundreds of people leave important jobs in the federal government to take more lucrative positions in private industry.”).

167. See, e.g., U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 166; WILSON, *supra* note 166, at 279. While this has traditionally been the case, in the last few decades, the compensation gap between those in the industry and those in government regulating the industry has grown exponentially. Admittedly, better compensated financial regulators and monitors do exist, namely private industry and intra-institution regulators like stock exchange officials, in-house attorneys, and compliance officers. Nevertheless, the commentary herein focuses on external, governmental regulators, who arguably serve as the most prominent and consequential financial regulators.

168. See U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 166; Edward Wyatt, *Study Questions Risk of S.E.C. Revolving Door*, N.Y. TIMES, Aug. 6, 2012, at B2.

169. See, e.g., PATTERSON, *supra* note 3, at 230 (“The new hierarchy would be all about who owned the most powerful computers, the fastest links between markets, the most sophisticated algorithms—and the inside knowledge of how the market’s plumbing was put together.”); Hu, *supra* note 6, at 412; Fisch, *supra* note 6, at 820.

170. See Roberta S. Karmel, *IOSCO’s Response to the Financial Crisis*, 37 J. CORP. L. 849, 853 (2012) (“Where regulated industries have so much power and influence over lawmakers, there is a lack of political will to engage in vigorous regulation even when regulators perceive the dangers of

consequence of this influence is that financial regulators can become “captured” by the industry.<sup>171</sup> Prior to the Financial Crisis, partially due to industry lobbying, credit default swaps<sup>172</sup> and hedge funds<sup>173</sup> were left largely unregulated under existing rules. Following the Financial Crisis, industry lobbyists were (and are) at the forefront of helping to draft financial reform rules and regulations.<sup>174</sup>

As a result of the resource disparities between the regulators and the regulated, it has been challenging for regulators to meaningfully police financial industry participants.<sup>175</sup> The net effect is a marketplace where large segments are poorly regulated or regulated only on paper.<sup>176</sup> As cy-fi continues to advance, policymakers must examine ways to narrow the resource disparities between the regulators and the regulated with new funding sources and new paradigms of financial governance.<sup>177</sup>

## V. REGULATORY PRINCIPLES FOR THE NEW FINANCIAL INDUSTRY

Regulating the new financial industry of cyborg finance will be one of the most important endeavors for government and industry policymakers in the coming years. While actual and potential challenges presented by cy-fi are many, serious, and real,<sup>178</sup> so are its actual and potential benefits. Thus, regulatory efforts to govern it must be sensible and thoughtful, and they

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insufficient market place standards.”); Rebecca M. Kysar, *The Sun Also Rises: The Political Economy of Sunset Provisions in the Tax Code*, 40 GA. L. REV. 335, 392 (2006) (“Through campaign contributions and lobbyists, these [interest] groups seek legislative votes favorable to their interests from politicians.”); see also MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* 33–36 (2d ed. 1971).

171. See, e.g., Saule T. Omarova, *The Quiet Metamorphosis: How Derivatives Changed the “Business of Banking,”* 63 U. MIAMI L. REV. 1041, 1077 (2009) (analyzing industry “capture” of the Office of the Comptroller of Currency).

172. See 7 U.S.C. § 16(e)(2) (2006); Frank Partnoy & David A. Skeel, Jr., *The Promise and Perils of Credit Derivatives*, 75 U. CIN. L. REV. 1019, 1046–47 (2007); Whitehead, *supra* note 5, at 34.

173. Troy A. Paredes, *On the Decision to Regulate Hedge Funds: The SEC’s Regulatory Philosophy, Style, and Mission*, 2006 U. ILL. L. REV. 975, 976–1001.

174. See JEFF CONNAUGHTON, *THE PAYOFF: WHY WALL STREET ALWAYS WINS* (2012); ROBERT G. KAISER, *ACT OF CONGRESS: HOW AMERICA’S ESSENTIAL INSTITUTION WORKS, AND HOW IT DOESN’T* 127–41 (2013); Eric Lipton & Ben Protess, *Banks’ Lobbyists Help in Drafting Bills on Finance*, N.Y. TIMES, May 24, 2013, at A1.

175. It should be noted that despite asymmetric resources, the SEC has recently had some high profile victories against better-resourced participants in the financial industry. See Devin Leonard, *Outmanned, Outgunned, And On a Roll*, BUS. WK., April 23, 2012, at 60–66.

176. Serritella, *supra* note 21, at 441–42.

177. See Omarova, *supra* note 1, at 427 (advocating for more private regulation as a form of new governance); see also Orly Lobel, *The Renew Deal: The Fall of Regulation and the Rise of Governance in Contemporary Legal Thought*, 89 MINN. L. REV. 342, 343–44 (2004) (describing a new governance model based on de-centralization, localization, and collaboration).

178. See Derek E. Bambauer, *Conundrum*, 96 MINN. L. REV. 584, 598–603 (2011) (describing the challenges of regulating cyberspace issues).

must not inhibit the promise and “generativity” of cy-fi.<sup>179</sup> Toward that end, this Part of the Article proposes a preliminary set of first principles for cyborg finance that should be considered by policymakers in creating a better regulatory framework for the emerging, new financial industry.

### A. Embrace Reality

Policymakers should embrace the functional realities of the new financial industry in terms of its individual and institutional participants when designing regulations for cyborg finance.<sup>180</sup> Policymakers may need to update antiquated paradigms of reasonable individual investors and elegantly compartmentalized institutions in order to better regulate the financial industry.

In terms of individuals, financial regulators have long operated under the assumption that individual participants in the financial industry are rational actors of neo-classical economic theory who invest for the long term.<sup>181</sup> Financial regulation for the mythical rational actor is fairly simple: equip him with the requisite information, and he would then perfectly process that information and make the utility-maximizing decision.<sup>182</sup> Thus, transparency and disclosure have been longtime hallmarks of financial regulation.<sup>183</sup>

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179. See LAWRENCE LESSIG, *THE FUTURE OF IDEAS: THE FATE OF THE COMMONS IN A CONNECTED WORLD* 8–16 (2002) (arguing that misguided regulations can inhibit the potential of new technology); Jonathan L. Zittrain, *The Generative Internet*, 119 HARV. L. REV. 1974, 1980–81 (2006).

180. See, e.g., Ronald Coase, *Saving Economics from the Economists*, HARV. BUS. REV., Dec. 2012, at 36 (arguing that policymakers need to focus on the realities of the world in order to remain effective and relevant).

181. See Regulation NMS, Exchange Act Release No. 34-51808, 70 Fed. Reg. 37,496, 37,500 (June 29, 2005) (“Indeed, the core concern for the welfare of long-term investors . . . was first expressed in the foundation documents of the Exchange Act itself.”); Joan MacLeod Heminway, *Female Investors and Securities Fraud: Is the Reasonable Investor a Woman?*, 15 WM. & MARY J. WOMEN & L. 291, 297 (2009); David A. Hoffman, *The “Duty” to Be a Rational Shareholder*, 90 MINN. L. REV. 537, 537–39 (2006); Margaret V. Sachs, *Materiality and Social Change: The Case for Replacing “the Reasonable Investor” with “the Least Sophisticated Investor” in Inefficient Markets*, 81 TUL. L. REV. 473, 475 (2006).

182. See GARY S. BECKER, *THE ECONOMIC APPROACH TO HUMAN BEHAVIOR* 14 (1976) (advocating use of the economic approach for understanding human behavior); JOEL SELIGMAN, *THE TRANSFORMATION OF WALL STREET: A HISTORY OF THE SECURITIES AND EXCHANGE COMMISSION AND MODERN CORPORATE FINANCE* 39–40 (3d ed. 2003); Troy A. Paredes, *Blinded by the Light: Information Overload and Its Consequences for Securities Regulation*, 81 WASH. U. L.Q. 417, 418 (2003).

183. See, e.g., SELIGMAN, *supra* note 182; Tom C.W. Lin, *A Behavioral Framework for Securities Risk*, 34 SEATTLE U. L. REV. 325, 336 (2011) (“In practice, this assumption has produced a regulatory framework that emphasizes more information over less information, more disclosure over better disclosure, quantity over quality.”).

In order to remain effective, financial regulators need to better embrace the reality that actual individuals and investors are not rational actors.<sup>184</sup> A voluminous body of behavioral law and economics literature suggests that actual investors suffer from cognitive quirks, such as overconfidence and status quo bias, which affect their ability to process information perfectly and make optimal decisions consistently.<sup>185</sup> Admittedly, following the Financial Crisis, there has been greater awareness of the fallacies of the rational actor as the reasonable investor assumption.<sup>186</sup>

Beyond the imperfect assumption of investor rationality, with the emergence of cyborg finance, regulators also need to be more mindful that new investors have capabilities unmatched by previous paradigms of investors.<sup>187</sup> Given the inextricable technology that is at the heart of modern finance, new investors are essentially cyborgs—part human, part machine. New investors are faster, smarter, more global, and less human; they should be regulated accordingly.<sup>188</sup>

In terms of institutions, for too long financial regulation has been organized on elegantly compartmentalized institutional categories.<sup>189</sup> Distinct regulators oversaw commercial banks, thrifts, broker-dealers, and investment banks, respectively, for much of the last seven decades.<sup>190</sup> But

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184. See Stephen J. Choi & A.C. Pritchard, *Behavioral Economics and the SEC*, 56 STAN. L. REV. 1, 2 (2003); Christine Jolls et al., *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1473–76 (1998); Richard A. Posner, *Rational Choice, Behavioral Economics, and the Law*, 50 STAN. L. REV. 1551, 1552–56 (1998).

185. See DANIEL KAHNEMAN, THINKING, FAST AND SLOW 377–85 (2011); Robert B. Ahdieh, *The Visible Hand: Coordination Functions of the Regulatory State*, 95 MINN. L. REV. 578, 625 (2010) (“Over the last twenty years, psychologists and experimental economists have collected significant evidence that the rationality assumption of neoclassical economics fares poorly in the real world.”); Ehud Guttel & Alon Harel, *Matching Probabilities: The Behavioral Law and Economics of Repeated Behavior*, 72 U. CHI. L. REV. 1197, 1197–200 (2005); Robert J. Shiller, *Measuring Bubble Expectations and Investor Confidence*, 1 J. PSYCHOL. & FIN. MKTS. 49, 50–52 (2000) (studying investor overconfidence); Herbert A. Simon, *A Behavioral Model of Rational Choice*, 69 Q.J. ECON. 99 (1955).

186. See, e.g., *The Financial Crisis and the Role of Federal Regulators: Hearing Before the H. Comm. on Oversight and Gov’t Reform*, 110th Cong. 46 (2008) (statement of Alan Greenspan, Former Chairman of the Fed. Reserve Bd.) (acknowledging that he “found a flaw in the [neoclassical] model that . . . defines how the world works”); Richard A. Posner, *How I Became a Keynesian*, NEW REPUBLIC, Sept. 23, 2009, at 34.

187. See Lin, *supra* note 4, at 699–703 (discussing a new investor paradigm in cyborg finance).

188. See, e.g., CLIVE THOMPSON, SMARTER THAN YOU THINK: HOW TECHNOLOGY IS CHANGING OUR MINDS FOR THE BETTER 6 (2013) (“At their best, today’s digital tools help us see more, retain more, communicate more.”)

189. See Anita K. Krug, *Escaping Entity-Centrism In Financial Services Regulation*, 113 COLUM. L. REV. 2039, 2049 (2013) (“Financial services regulation embodies entity-centrism, in that it is largely premised on the notion that the entity is the appropriate unit of regulation.”); U.S. GOV’T ACCOUNTABILITY OFFICE, GAO-08-32, FINANCIAL REGULATION: INDUSTRY TRENDS CONTINUE TO CHALLENGE THE FEDERAL REGULATORY STRUCTURE 4–5 (2007); Jackson, *supra* note 6, at 332–39; Whitehead, *supra* note 5, at 2–3.

190. See, e.g., Michael S. Barr, *The Financial Crisis and the Path of Reform*, 29 YALE J. ON REG. 91, 97 (2012) (“Before Dodd-Frank, major financial firms were regulated according to their formal

in recent years, financial institutions operate and penetrate across old categories, rendering such categorizations quaint and arbitrary.<sup>191</sup> Sophisticated financial industry participants today frequently exist less as singular entities and more as a collection of entities. JPMorgan Chase, for example, through subsidiary companies and limited partnerships, has significant operations in commercial banking, investment banking, consumer finance, financial processing, and private equity.<sup>192</sup> Smaller entities, like hedge funds and private equity groups, also work across multiple segments of the financial industry. As a result of this financial evolution, the old categorical approach to financial regulation does not match the functional realities of the new marketplace.

This mismatched categorical approach to regulation can have significant consequences on the effectiveness of regulation. The categorical approach, for instance, largely presumes that if individual categories and individual institutions were safeguarded and stabilized, then the entire financial system would be safeguarded and stabilized.<sup>193</sup> While elegant, this syllogism is false. Efforts targeted at protecting individual institutions or select categories of institutions by industry players and regulators can result in actions and consequences that harm the entire system given the crosscutting, linked realities of the new financial industry.<sup>194</sup> Borrowing lessons and language from property law, attempts at imposing categorical regulation to cross-categorical industry participants can lead to financial tragedies of the commons, where due to misguided regulations, firms

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labels—as banks, thrifts, investment banks, insurance companies, and the like—rather than according to what they actually did.”); Gary Gorton, *Bank Regulation When “Banks” and “Banking” Are Not the Same*, 10 OXFORD REV. ECON. POL’Y 106, 107 (1994); Heidi Mandanis Schooner & Michael Taylor, *United Kingdom and United States Responses to the Regulatory Challenges of Modern Financial Markets*, 38 TEX. INT’L L.J. 317, 328–29 (2003) (noting that financial regulatory mandates are largely categorically-driven); see generally MARK JICKLING & EDWARD V. MURPHY, CONG. RESEARCH SERV., R40249, WHO REGULATES WHOM? AN OVERVIEW OF U.S. FINANCIAL SUPERVISION (2010).

191. See Howell E. Jackson, *The Expanding Obligations of Financial Holding Companies*, 107 HARV. L. REV. 507, 509 (1994) (“[T]oday’s financial giants . . . now operate in multiple sectors of the industry, typically through a network of subsidiaries specializing in deposit-taking, insurance underwriting, securities activities, and various other financial services.”); Robert C. Merton, *Financial Innovation and the Management and Regulation of Financial Institutions*, 19 J. BANKING & FIN. 461, 466–70 (1995); Schwarcz, *supra* note 5, at 374–75.

192. See JPMorgan Chase & Co., Annual Report (Form 10-K) 1 (Feb. 29, 2012) (“[JPMorgan Chase] is a leader in investment banking, financial services for consumers and small businesses, commercial banking, financial transaction processing, asset management and private equity.”).

193. MARKUS KONRAD BRUNNERMEIER ET AL., THE FUNDAMENTAL PRINCIPLES OF FINANCIAL REGULATION xv (2009).

194. See *Id.* (“It is perhaps banal by now to point out that the reason why we try to prevent banking crises is that the costs to society are invariably enormous and exceed the private cost to individual financial institutions.”); Beverly J. Hirtle et al., *Macropprudential Supervision of Financial Institutions: Lessons from the SCAP 1* (Fed. Reserve Bank of N.Y., Staff Report No. 409, 2009), available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1515800](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1515800).

undertake self-serving, aggressive actions, such as overcapitalizing their reserves, which may harm the entire system in the long run.<sup>195</sup> Alternatively, such attempts could also lead to financial tragedies of the anticommons, where regulatory restrictions cause industry participants to underutilize available capital to the detriment of the financial system and the economy.<sup>196</sup>

Following the Financial Crisis, there have been greater regulatory efforts to recognize the cross-categorical nature of financial participants.<sup>197</sup> Many of the provisions in Dodd-Frank were intended to better regulate large financial institutions with cross-categorical presence.<sup>198</sup> With the emergence of cyborg finance, those efforts should be redoubled as cy-fi has made it possible for more institutional participants to operate across more traditional categories at higher speeds and greater magnitudes. In the new financial industry, one institution can perform functions that in eras past would have required multiple investment banks, commercial banks, and brokerages to act in concert. The fact of the matter is that many financial industry participants work across traditional categories of regulation. And thus, they should be regulated in modes that break away from stale, isolated categories.<sup>199</sup>

In sum, in order to effectively regulate cyborg finance, as a matter of first principles, policymakers should embrace the emerging individual and institutional realities of finance, and should be mindful of the fact that old paradigms of governance may be ill-suited and inadequate for the new financial industry.

### B. Enhance Disclosure

When thinking about regulating cyborg finance, policymakers should enhance the old financial regulatory tool of disclosure.<sup>200</sup> By thoughtfully building upon existing disclosure rules and practices, policymakers can create a familiar, yet smarter framework for cy-fi.<sup>201</sup>

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195. See Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243, 1244–45 (1968) (explaining the tragedy of commons concept).

196. See Michael A. Heller, *The Tragedy of Anticommons: Property in the Transition From Marx to Markets*, 111 HARV. L. REV. 621, 624 (1998) (introducing the tragedy of anticommons concept).

197. See CONG. OVERSIGHT PANEL, *supra*, note 5, at 22–24, 29.

198. Judge, *supra* note 6, at 659.

199. See Schwarcz, *supra* note 5, at 374 (calling old modes of financial regulation focused on banks “anachronistic”); Whitehead, *supra* note 5, at 42 (advocating for a new “supra-functional approach” to financial regulation that is not limited by “function, categories, or intermediaries”).

200. See Hu & Black, *supra* note 130, at 693.

201. See, e.g., Jose A. Lopez, *Disclosure as a Supervisory Tool: Pillar 3 of Basel II 1* (Fed. Reserve Bank of S.F., Econ. Letter 2003-22, 2003), available at <http://www.frbsf.org/publications/economics/letter/2003/el2003-22.pdf> (“The principle underlying

The existing federal securities regime is largely based on the straightforward motivation to “substitute a philosophy of full disclosure for the philosophy of *caveat emptor*.”<sup>202</sup> Currently, publicly traded companies are required to make periodic and timely disclosures to the investing public. The working assumption is that with good disclosures, the financial market, like other efficient markets, would inform and govern itself and allocate capital accordingly.<sup>203</sup> Despite inherent flaws and notable setbacks, this disclosure-oriented framework has worked fairly well in terms of creating a growing economy and robust capital markets in America.<sup>204</sup> Nonetheless, in the aftermath of the Financial Crisis, many policymakers and commentators have suggested that prior to the crisis regulators allowed the financial industry participants to provide too little disclosure and operate in the shadows.<sup>205</sup>

With the emergence of cyborg finance, in order to maintain an efficient marketplace, policymakers should examine how they can adapt and update old disclosure practices to an industry that is more complex and more technologically driven than ever before.<sup>206</sup> The vast array of interlinked, complex instruments moving around the cyborg financial infrastructure is a departure from the relatively simple financial industry of the past where instruments like bonds and stocks dominated the marketplace.<sup>207</sup> The

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Pillar 3 is that improved public disclosure of relevant information should enhance market discipline and hence its potential usefulness to bank supervisors.”); Robert P. Bartlett, III, *Making Banks Transparent*, 65 VAND. L. REV. 293 (2012) (advocating for enhanced disclosure as a tool for better financial regulation); Hu, *supra* note 5, at 1607–12 (suggesting a new disclosure paradigm based on “pure information” and new technology); Steven L. Schwarcz, *Rethinking the Disclosure Paradigm in a World of Complexity*, 2004 U. ILL. L. REV. 1, 16–17.

202. SEC v. Capital Gains Research Bureau, Inc., 375 U.S. 180, 186 (1963).

203. See BECKER, *supra* note 182; Hu, *supra* note 5, at 1607; Arthur Fleischer, Jr., “*Federal Corporation Law*”: An Assessment, 78 HARV. L. REV. 1146, 1148–49 (1965) (“Because disclosure is designed to provide investors with the data necessary to make informed judgments, the information required may encompass all aspects of corporate life, and consequently all aspects of corporate life may be affected.” (footnote omitted)).

204. See, e.g., OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, BUDGET OF THE UNITED STATES GOVERNMENT, FISCAL YEAR 2006, 20–21 (2005), available at <http://www.gpo.gov/fdsys/pkg/BUDGET-2006-BUD/pdf/BUDGET-2006-BUD-7.pdf> (detailing the rise of the U.S. gross domestic product since 1940); Bengt Holmstrom & Steven N. Kaplan, *The State of U.S. Corporate Governance: What’s Right and What’s Wrong?*, 15 J. APPLIED CORP. FIN. 8, 8 (Spring 2003) (“Despite the alleged flaws in its governance system, the U.S. economy has performed very well, both on an absolute basis and particularly relative to other countries.”); see CHARLES ROXBURGH ET AL., MCKINSEY GLOBAL INST., GLOBAL CAPITAL MARKETS: ENTERING A NEW ERA 9 (2009) (depicting the growth of U.S. capital markets).

205. See CONG. OVERSIGHT PANEL, *supra*, note 5, at 13–15.

206. Accurate timely information has long been a hallmark of efficient capital markets. See, e.g., Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383, 404 (1970); Ronald J. Gilson & Reinier H. Kraakman, *The Mechanisms of Market Efficiency*, 70 VA. L. REV. 549, 550–66 (1984) (explaining that informed trading is a prerequisite for efficient markets).

207. Even in traditional financial markets, information asymmetry was a huge problem for market participants. See Bernard S. Black, *Information Asymmetry, the Internet, and Securities Offerings*, 2 J.

current paradigm is built on the disclosure of material information written in “plain English” by firms and issuers.<sup>208</sup> While informative, the current paradigm may be ill-suited and inadequate to depict the complex risks and realities of cyborg finance.<sup>209</sup> In a marketplace with vast complex links and linked products, investors and participants in the various lower chains of cy-fi may be seriously under-informed or misinformed by the current disclosure paradigm that cannot fully depict this complex financial web.<sup>210</sup> At best, firms and issuers are only capable of depicting one piece of a much larger mosaic. Therefore, more information in terms of volume and variety may need to be disclosed in order to better inform market participants.<sup>211</sup>

Mindful of new technological capabilities, policymakers should examine new ways to leverage technology towards creating a better, more workable disclosure framework. Policymakers should move beyond quaint beliefs that regulated disclosures are intended to be read by average, reasonable investors, so they must be written in “plain English.”<sup>212</sup> The reality is that most reasonable investors do not educate themselves through raw, regulated disclosures, which at times can amount to information overload for many average investors.<sup>213</sup> Rather, in the age of cy-fi, professionals using artificial intelligence programs process regulated disclosures in ways and at speeds previously unimaginable.<sup>214</sup> Investors in the new financial industry may need to depend less on the depicted

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SMALL & EMERGING BUS. L. 91, 92 (1998) (“[T]he single largest cost that stands between issuers and investors is the problem of asymmetric information.”).

208. See Presentation of Information in Prospectuses, 17 C.F.R. § 230.421(b) (2013) (“You must present the information in a prospectus in a clear, concise and understandable manner.”); Plain English Disclosure, Securities Act Release No. 7497, Exchange Act Release No. 39,593, Investment Company Act Release No. 23,011, 63 Fed. Reg. 6370 (Feb. 6, 1998); OFFICE OF INVESTOR EDUC. & ASSISTANCE, SEC, A PLAIN ENGLISH HANDBOOK: HOW TO CREATE CLEAR SEC DISCLOSURE DOCUMENTS 4 (1998).

209. See Hu, *supra* note 5, at 1608 (arguing that conventional disclosure methodologies “are especially limited in their ability to convey the pertinent quantitative aspects of financial innovations and of banks involved in such innovations”); Donald C. Langevoort, *Organized Illusions: A Behavioral Theory of Why Corporations Mislead Stock Market Investors (and Cause Other Social Harms)*, 146 U. PA. L. REV. 101, 135–46 (1997).

210. See, e.g., BD. OF GOVERNORS OF THE FED. RESERVE SYS., REPORT TO THE CONGRESS ON RISK RETENTION 41 (2010), available at <http://federalreserve.gov/boarddocs/rptcongress/securitization/riskretention.pdf> (“Participants in securitization markets—originators, securitizers, rating agencies, and investors—have come to recognize that investors may have less information than other members of the securitization chain, particularly about the credit quality of the underlying assets.”).

211. See Judge, *supra* note 6, at 690–96 (commenting on how financial complexity leads to information loss and dangerous consequences).

212. See *supra* note 208.

213. Paredes, *supra* note 182.

214. See Hu, *supra* note 5, at 1607 (suggesting that a new disclosure paradigm can be “facilitated by innovations in computer and Internet technologies”).

disclosures of firms and issuers.<sup>215</sup> Advances in information technology have made it possible for market participants to process information that is more voluminous, more complex, and more unfiltered at faster rates than ever before.<sup>216</sup> As such, policymakers can reform the volume and variety of information disclosed to include more unfiltered data so that all investors can benefit directly or indirectly from that information. Sophisticated investors can benefit from that information using their superior technical capacity and financial expertise to analyze it; and ordinary investors can benefit from repackaged presentations of that information from market entrepreneurs, in addition to more accurate prices in a market with better information.<sup>217</sup>

Following the Financial Crisis, policymakers have taken actions to better leverage technology to enhance disclosure. Dodd-Frank requires the disclosure of swap prices and volume data “as soon as technologically practicable.”<sup>218</sup> The SEC has also adopted a “consolidated audit trail” rule to make it easier for regulators to monitor and track the complex securities clearinghouse infrastructure.<sup>219</sup> At the end of 2013, pursuant to the Jumpstart Our Business Startups Act (the “JOBS Act”),<sup>220</sup> the SEC also issued a comprehensive study on how to modernize disclosure processes.<sup>221</sup>

In sum, as a matter of first principles, policymakers should aim to enhance the traditional regulatory tool of disclosure for cyborg finance. Through a fresh recognition of present financial complexities and technological capacities, policymakers may be able to upgrade an old tool for a new time.<sup>222</sup> While enhanced disclosure by itself will not cure all

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215. See *id.* at 1610 (arguing that “[i]f the investor is given the opportunity to see reality itself with his own eyes, he could come much closer to pure information, the objective truth in all of its quantitative and qualitative dimensions”).

216. See *id.* (“With advances in computer and Internet technologies, it is no longer essential for an investor to rely exclusively on intermediary depictions.”); *cf.* Schwarcz, *supra* note 130, at 221 (opining that regardless of disclosed information “[c]omplexity can deprive investors and other market participants of the understanding needed for markets to operate effectively”).

217. See Zohar Goshen & Gideon Parchomovsky, *The Essential Role of Securities Regulation*, 55 DUKE L.J. 711, 714–15 (2006) (discussing the important informational role of sophisticated investors).

218. Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act), Pub. L. No. 111-203, 124 Stat. 1376 (2010) (to be codified in scattered sections of the U.S. Code). In the years since the passage of Dodd-Frank, the CFTC has made progress towards enhancing transparency in the swaps market. See Interpretive Guidance and Policy Statement Regarding Compliance with Certain Swap Regulations, 78 Fed. Reg. 45,292 (July 26, 2013).

219. 17 C.F.R. § 242.613 (2013).

220. Pub. L. No. 112-106 (2012).

221. STAFF OF THE SEC, REPORT ON REVIEW OF DISCLOSURE REQUIREMENTS IN REGULATION S-K (2013), available at: <http://www.sec.gov/news/studies/2013/reg-sk-disclosure-requirements-review.pdf>.

222. See Hu, *supra* note 5, at 1608–10 (proposing a new disclosure paradigm based on new technology and “pure information”); Judge, *supra* note 6, at 712 (“Better disclosure, by its nature, should reduce information loss, and increased transparency could reduce the magnitude of the

potential financial flaws and failures arising from the complexity of cy-fi,<sup>223</sup> it will be a meaningful early step towards that elusive goal.

### C. Slow Down

In contemplating smarter regulations for cyborg finance, policymakers should consider ways to create safer speeds and smarter brakes for finance as a key principle of future regulation.<sup>224</sup> The velocity at which much of cy-fi currently operates, fractions of seconds, can create serious problems for the financial system and its participants.<sup>225</sup> This is not to suggest that policymakers should, as a matter of principle, favor a dilatory financial system. Rather, this suggests that policymakers should favor a more thoughtful, deliberative pace for finance. While high speeds contain significant benefits, they also contain high risks that can be catastrophic.

In the aftermath of the Flash Crash, domestic policymakers, regulators, and scholars have begun to pay greater attention to the effects of high velocities on finance.<sup>226</sup> Regulators at the national exchanges and the SEC proposed and implemented new rules aimed at sensibly slowing the speed of finance in the form of new circuit breakers designed to pause trading during periods of high volatility. Shortly after the Flash Crash, the national exchanges proposed more stringent circuit breakers in the event of dramatic

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coordination challenges that lead to stickiness.”); Saule T. Omarova, *Rethinking the Future of Self-Regulation in the Financial Industry*, 35 BROOK. J. INT’L L. 665, 684 (2010) (“[T]he key to managing an increasingly complex financial system is timely access to, and ability to process, relevant market information.”); Richard H. Thaler and Will Tucker, *Smarter Information, Smarter Consumers*, HARV. BUS. REV., Jan.–Feb. 2013, at 45–54.

223. See Robert P. Bartlett, III, *Inefficiencies in the Information Thicket: A Case Study of Derivative Disclosures During the Financial Crisis*, 36 J. CORP. L. 1, 7 (2010); Steven Davidoff & Claire Hill, *Limits of Disclosure*, 36 SEATTLE U. L. REV. 599, 604 (2013); Hu, *supra* note 5, at 1603–10 (discussing the various limits of disclosure).

224. See Frank Partnoy, *Don’t Blink: Snap Decisions and Securities Regulation*, 77 BROOK. L. REV. 151, 155 (2011) (espousing the virtues of slower speeds in financial markets).

225. See *infra* Part III.B (describing the dangers of the accelerating velocity of finance).

226. See, e.g., Charles K. Whitehead, *The Goldilocks Approach: Financial Risk and Staged Regulation*, 97 CORNELL L. REV. 1267, 1283–89 (2012) (explicating on risky, accelerated, and high-volume financial trading); Baron et al., *supra* note 134 (finding that high-frequency traders profit at the expense of ordinary investors). For general commentary on the effects of short-term, voluminous trading, see Fischer Black, *Noise*, 41 J. FIN. 529, 532–33 (1986); Robert Bloomfield et al., *How Noise Trading Affects Markets: An Experimental Analysis*, 22 REV. FIN. STUD. 2275, 2300 (2009); Robert Pollin et al., *Securities Transaction Taxes for U.S. Financial Markets*, 29 E. ECON. J. 527, 534–36 (2003); Joseph E. Stiglitz, *Using Tax Policy To Curb Speculative Short-Term Trading*, 3 J. FIN. SERVICES RES. 101, 102–05 (1989); Lawrence H. Summers & Victoria P. Summers, *When Financial Markets Work Too Well: A Cautious Case for a Securities Transactions Tax*, 3 J. FIN. SERVICES RES. 261, 264–69 (1989).

market decreases.<sup>227</sup> In the years since the Flash Crash, the SEC has also implemented a series of new circuit breakers for single stocks and entire markets to better manage the velocity of cyborg finance.<sup>228</sup> In addition to circuit breakers, policymakers should also consider kill switches for high speed systems,<sup>229</sup> and multi-location dissemination points for sensitive public information, like unemployment data, to minimize the significance of co-location and speed.

Policymakers abroad have similarly recognized the institutional and systemic risks of the accelerating velocity of finance. Internationally, regulators in Australia, Canada, France, Germany, and Hong Kong have utilized various mechanisms, including speed restrictions, volume limits, transaction fees, stress tests, and trading curbs to better manage the supersonic speed of finance.<sup>230</sup> For instance, in 2013, the Royal Bank of Canada, with the support of its regulators and some Canadian banks, purposely slowed customer trade orders to avoid the speed of high-frequency traders and dark pools so as to better fulfill such orders.<sup>231</sup>

While the accelerating speed has been quite beneficial to many market participants, as those speeds approach the speed of light they may contain more risks than rewards to the financial system. Thus, policymakers should adopt regulations aimed at moderating the velocities of finance as a designing principle for regulating cyborg finance.

#### D. *Mind the Gaps*

Policymakers should adhere to a principle of minding gaps in designing regulations for cyborg finance. Modern finance has frequently innovated and mutated at the regulatory breaks and market crevices of the financial system.<sup>232</sup> Every regulatory candle lit casts a new shadow within the system. Policymakers should be more aware of gaps created by regulations

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227. See, e.g., Notice of Filing of Proposed Rule Change to Update Rule 6121 and Amend Rule 6440, SEC Release No. 34-65430 (Sept. 28, 2011), available at <http://www.sec.gov/rules/sro/finra/2011/34-65430.pdf>.

228. CFTC & SEC FINDINGS, *supra* note 10, at 7; *Investor Bulletin: New Measures to Address Market Volatility*, SEC, Last Updated April 9, 2013, <http://www.sec.gov/investor/alerts/circuitbreakersbulletin.htm>.

229. Luis A. Aguilar, Comm'r, "Addressing Market Instability through Informed and Smart Regulation" at Practising Law Institute's SEC Speaks in 2013 Program, Washington, D.C. (Feb. 22, 2013) (transcript available at <http://www.sec.gov/News/Speech/Detail/Speech/1365171492386#.UthfBr9jRtK>) (discussing the concept of kill switches for financial markets).

230. Nathaniel Popper, *As U.S. Discusses Limits on High-Speed Trading, Other Nations Act*, N.Y. TIMES, Sept. 27, 2012, at B1.

231. Nathaniel Popper, *Bank Gains by Putting the Brakes on Traders*, N.Y. TIMES, June 26, 2013, at B1.

232. Judge, *supra* note 6, at 659.

and market operations given the accelerated pace and growing complexity of cy-fi.<sup>233</sup>

Market participants design new instruments and transactions to take advantage of apertures in the financial system.<sup>234</sup> In some cases, gaps in financial markets provided fertile ground for financial innovation and regulatory arbitrage.<sup>235</sup> For instance, mortgage-backed securities and new forms of securitized assets originated partially because the market then lacked more efficient mechanisms to manage liabilities related to mortgages.<sup>236</sup> In other related cases, gaps in financial regulations created rich openings for new financial products. Credit default swaps, for instance, were created to circumnavigate commodities and securities regulations.<sup>237</sup> In both cases, gaps in the financial markets created fertile penumbras for shadow banking to blossom.<sup>238</sup> Some scholars have already speculated that new post-crisis regulations such as increased capital reserve requirements and rules on futures and swaps will create new gaps and shadows for financial regulators and industry participants.<sup>239</sup>

Since the Financial Crisis, policymakers have made strides towards better minding the gaps in the financial system by broadening the mandates of existing regulators and also by creating new regulators. Before the Financial Crisis, “no regulator or supervisor had the authority to look across the full sweep of the financial system—including less-regulated segments—and take action when it perceived a threat.”<sup>240</sup> The post-crisis financial reform efforts led to the creation of the Financial Services Oversight Counsel, the National Bank Supervisor, the Consumer Financial Protection Bureau, and other government regulators geared towards filling

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233. See, e.g., Schwarcz, *supra* note 130, at 212–13 (discussing complexity “as the greatest financial-market challenge of the future”).

234. See Calomiris, *supra* note 150 (“Financial innovations often respond to regulation by sidestepping regulatory restrictions that would otherwise limit activities in which people wish to engage.”).

235. See Fleischer, *supra* note 149 (“Regulatory arbitrage exploits the gap between the economic substance of a transaction and its legal or regulatory treatment, taking advantage of the legal system’s intrinsically limited ability to attach formal labels that track the economics of transactions with sufficient precision.”); Frank Partnoy, *Financial Derivatives and the Costs of Regulatory Arbitrage*, 22 J. CORP. L. 211, 227 (1997) (“Regulatory arbitrage consists of those financial transactions designed specifically to reduce costs or capture profit opportunities created by differential regulations or laws.”).

236. See, e.g., Judge, *supra* note 6, at 670–73 (summarizing the origins of mortgaged-backed securities).

237. See Coffee, Jr. & Sale, *supra* note 6, at 727, 731–37 (mentioning Congress’s failure to give the SEC authority over credit default swap). See generally Partnoy & Skeel, Jr., *supra* note 172.

238. See RAJAN, *supra* note 6, at 16; Gary Gorton & Andrew Metrick, *Regulating the Shadow Banking System*, in BROOKINGS PAPERS ON ECON. ACTIVITY 261 (2010), available at [http://www.brookings.edu/~media/projects/bpea/fall%202010/2010b\\_bpea\\_gorton.pdf](http://www.brookings.edu/~media/projects/bpea/fall%202010/2010b_bpea_gorton.pdf).

239. GORTON, *supra* note 56, at 167–69.

240. Barr, *supra* note 190, at 99–100.

perceived regulatory gaps.<sup>241</sup> While these steps may begin to help alleviate some of the risks associated with the gaps of the old financial system, policymakers must also be mindful of new gaps created by the dynamism of cyborg finance.<sup>242</sup>

As cy-fi emerges and evolves, policymakers should, as a principled matter, craft rules that help regulators better mind the gaps of cyborg finance because it is in those openings that risks mutate and rewards blossom.<sup>243</sup>

### *E. Coordinate*

Policymakers should operate with the principle of promoting smarter coordination in designing regulations for cyborg finance. The coordinating function of law and regulation can create greater uniformity and lower transactional costs for the financial system while promoting interagency competition and accountability.<sup>244</sup> Similar to how market participants take advantage of gaps in the financial system, they also take advantage of uncoordinated regulations by engaging in highly profitable and dangerous games of arbitrage and evasion.<sup>245</sup> As cy-fi evolves, it will grow more complex, cutting across regulatory and sovereign boundaries through cables and spectra in cyberspace. Criminal laws pertaining to cybercrimes,

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241. See 12 U.S.C. § 5301 (2012); U.S. DEP'T OF TREASURY, FINANCIAL REGULATORY REFORM: A NEW FOUNDATION: REBUILDING FINANCIAL SUPERVISION AND REGULATION 3 (2010), available at [http://www.treasury.gov/initiatives/Documents/FinalReport\\_web.pdf](http://www.treasury.gov/initiatives/Documents/FinalReport_web.pdf); see, e.g., Barr, *supra* note 190, at 109 ("The Dodd-Frank Act took several key steps toward reorganizing the U.S. federal regulatory system and reducing regulatory arbitrage . . . [M]uch more could have been done to close gaps and relieve tensions arising from fragmentation."); U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-09-358, SECURITIES AND EXCHANGE COMMISSION: GREATER ATTENTION NEEDED TO ENHANCE COMMUNICATION AND UTILIZATION OF RESOURCES IN THE DIVISION OF ENFORCEMENT 3-8 (2009), available at <http://www.gao.gov/assets/290/288156.pdf>.

242. See Judge, *supra* note 6, at 659 ("[R]eforms adopted to produce a more stable financial system are unlikely to achieve that aim unless complemented by efforts to address the corresponding changes they are likely to induce in the capital markets.")

243. See, e.g., Hu, *supra* note 153, at 1502-03 (discussing the regulatory duty to monitor the systemic impact of financial innovation).

244. See Scott A. Beaulier et al., *Knowledge, Economics, and Coordination: Understanding Hayek's Legal Theory*, 1 N.Y.U. J.L. & LIBERTY 209, 211-15 (2005); Jody Freeman & Jim Rossi, *Agency Coordination in Shared Regulatory Space*, 125 HARV. L. REV. 1131, 1133 (2012) ("Coordination can also help to preserve the functional benefits of shared or overlapping authority, such as promoting interagency competition and accountability, while minimizing dysfunctions like discordant policy."); Charles K. Whitehead, *Destructive Coordination*, 96 CORNELL L. REV. 323, 325 (2011) ("In the financial markets, coordination helps to minimize costs and promote stability."); see also Richard H. McAdams, *A Focal Point Theory of Expressive Law*, 86 VA. L. REV. 1649, 1666-68, 1676-78 (2000) (explaining how law serves as a coordinating nexus for disparate individual actions); Cass R. Sunstein, *Problems with Rules*, 83 CALIF. L. REV. 953, 969-71 (1995) (discussing how legal rules mitigate collective action problems by encouraging coordination).

245. Whitehead, *supra* note 5, at 36-37.

for instance, are largely limited by sovereign jurisdiction even though the criminals and their financial crimes can cross multiple countries.<sup>246</sup> As financial market participants continue to innovate and grow with little regard for sovereign and regulatory borders, policymakers must explore new paradigms for coordination that break away from antiquated models based primarily on jurisdiction, be it sovereign jurisdiction or regulatory jurisdiction.<sup>247</sup>

In order to govern effectively and efficiently, policymakers must design regulations that promote smarter coordination among the regulators and the regulated to minimize thoughtless redundancies.<sup>248</sup> In practice, this may lead to more standardization among industry participants and regulators creating greater efficiencies.<sup>249</sup> To reduce transaction costs, participants may use more standardized forms and boilerplate provisions to create new industry conventions consistent with new regulations.<sup>250</sup> For instance, the International Swaps and Derivatives Association (ISDA), an industry organization, has already developed a robust body of standardized contracts, forms, terminology, and practices for industry participants.<sup>251</sup> Similarly, financial regulators across jurisdictions may develop common standards to ease doing business internationally and aid in achieving regulatory aims.<sup>252</sup>

Following the recent financial crisis, policymakers have initiated some steps aimed at promoting smarter coordination given the disastrous consequences of discordant policies prior to the crisis.<sup>253</sup> Through the enactment of Dodd-Frank, Congress has given regulators greater mandates to standardize banking capital reserves requirements and to stress test banks.<sup>254</sup> Similarly, Dodd-Frank also created new regulators and updated old ones to better harmonize the financial regulatory framework in order to

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246. Hathaway et al., *supra* note 105, at 877.

247. See Chris Brummer, *Post-American Securities Regulation*, 98 CALIF. L. REV. 327, 328–30 (2010) (summarizing challenges relating to coordination faced by American regulators); Judge, *supra* note 6, at 702–07 (discussing the “coordination challenges” of complex financial products).

248. See Freeman & Rossi, *supra* note 244, at 1138–39 (critiquing various agency rulemaking problems).

249. See, e.g., NOURIEL ROUBINI & STEPHEN MIHM, *CRISIS ECONOMICS: A CRASH COURSE IN THE FUTURE OF FINANCE* 193–94 (2010) (promoting standardization in pursuit of financial stability).

250. See Robert B. Ahdieh, *The Strategy of Boilerplate*, 104 MICH. L. REV. 1033, 1053–55 (2006).

251. See Sean M. Flanagan, *The Rise of a Trade Association: Group Interactions Within the International Swaps and Derivatives Association*, 6 HARV. NEGOT. L. REV. 211, 240–49 (2001).

252. See *id.*

253. See Ahdieh, *supra* note 185, at 585 (“The heart of the financial crisis, however, was a failure of coordination.”).

254. 12 U.S.C. §§ 5322, 5365 (2012).

meet the realities of the marketplace.<sup>255</sup> Internationally, similar efforts have been made to promote smarter regulation. The Basel III Accord, for instance, standardized capital reserve metrics for banks in many countries including the United States, those in the United Kingdom, and Japan.<sup>256</sup>

It is important to note that this principle of promoting coordination is not a call for an extraterritorial super-regulator devoid of respect for agency borders and sovereign jurisdictions. While too little coordination is problematic, too much coordination can also create serious risks. Too much coordination could lead to “destructive coordination,”<sup>257</sup> which could result in thoughtless herd behavior by regulators and participants.<sup>258</sup> Too much coordination can also erode competition among regulators with different areas of focus and expertise.<sup>259</sup> Rather than too much or too little coordination, this principle calls for smarter coordination: coordination that thinks anew about harmonizing financial regulation beyond traditional spaces bounded by anachronistic notions of jurisdiction, coordination that reduces redundancies thoughtfully while retaining the benefits of competition among regulators.<sup>260</sup>

#### F. *Trust but Verify*

Mindful of the structural limitations of government-oriented, top-down regulation, policymakers should place more trust in sensible private regulation by industry participants as part of regulating cyborg finance in concert with public regulation by government regulators. To better complement government regulations, policymakers can better leverage the

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255. See, e.g., 12 U.S.C. §§ 5321, 5322 (2012) (establishing the Financial Stability Oversight Council to monitor systemic risks and coordinate preemptive responses).

256. See BANK FOR INT’L SETTLEMENTS, BASEL COMM. ON BANKING SUPERVISION, BASEL III: A GLOBAL REGULATORY FRAMEWORK FOR MORE RESILIENT BANKS AND BANKING SYSTEMS 12–17, 27–28 (2011), available at <http://www.bis.org/publ/bcbs189.pdf>.

257. See Whitehead, *supra* note 244, at 326 (“By promoting coordination, regulations and standards can erode key presumptions underlying financial risk management, reducing its effectiveness and magnifying the systemic impact of a downturn in the financial markets.”).

258. See BANK FOR INT’L SETTLEMENTS, COMM. ON THE GLOBAL FIN. SYS., LONG-TERM ISSUES IN INTERNATIONAL BANKING 31 (CGFS Publications No. 41, 2010), available at <http://www.bis.org/publ/cgfs41.pdf> (“[C]onvergence to a single risk assessment or risk management framework . . . would encourage herd behaviour and weaken financial stability.”).

259. See Stavros Gadinis, *The Politics of Competition in International Financial Regulation*, 49 HARV. INT’L L.J. 447, 448–50 (2008); Park, *supra* note 147, at 626–28.

260. See FRANK H. EASTERBROOK & DANIEL R. FISCHEL, *THE ECONOMIC STRUCTURE OF CORPORATE LAW* 13–14 (1991) (praising the benefits of regulations that encourage competition); ROBERTA ROMANO, *THE GENIUS OF AMERICAN CORPORATE LAW* 148 (1993); see also Freeman & Rossi, *supra* note 244, at 1193–96 (discussing ways to improve regulatory coordination); Kathryn Judge, *Interbank Discipline*, 60 UCLA L. REV. 1262, 1281 (2013) (examining why and how banks can discipline one another).

expertise, proximity, and resources of industry participants, through existing industry regulatory groups and market mechanisms, to create governance tools that are more knowledgeable and more responsive to the issues facing the financial markets.<sup>261</sup> It is important to note that many financial industry participants are already governed by internal compliance policies, private industry rules, and financial customs.<sup>262</sup> Thus, the threshold inquiry is not about whether to permit private regulation or not, but about how best to design and partner private, industry-oriented regulation to complement public, government-oriented regulation.<sup>263</sup>

Private regulation, when appropriately designed, can break through some of the structural limitations of jurisdiction, origination, and resource faced by government regulators. In terms of jurisdiction, industry participants are not bound by the same issues of agency and sovereign boundaries as governmental regulators.<sup>264</sup> An American investment bank headquartered in New York can readily help monitor and discipline the financial soundness of a Spanish counterpart headquartered in Madrid through various financial instruments and transactions.<sup>265</sup> Similarly, private electronic networks can require foreign participants in those private spaces

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261. See, e.g., BANK FOR INT'L SETTLEMENTS, BASEL COMM. ON BANKING SUPERVISION, CONSULTATIVE DOCUMENT: PILLAR 3 (MARKET DISCIPLINE), SUPPORTING DOCUMENT TO THE NEW BASEL CAPITAL ACCORD 1 (2001), available at <http://www.bis.org/publ/bcbsca10.pdf> ("[M]arket discipline has the potential to reinforce capital regulation and other supervisory efforts to promote safety and soundness in banks and financial systems."); Ross P. Buckley, *The Role and Potential of Self-Regulatory Organizations: The Emerging Markets Traders Association from 1990 to 2000*, 6 STAN. J.L. BUS. & FIN. 135, 135–37 (2000); Omarova, *supra* note 1, at 413–16 (espousing the virtues of private financial regulation).

262. See generally Judge, *supra* note 260, at 1286–88; Miriam Hechler Baer, *Governing Corporate Compliance*, 50 B.C. L. REV. 949, 950 (2009); Gerding, *supra* note 22.

263. For general commentary on public-private partnerships in financial regulation, see William A. Birdthistle & M. Todd Henderson, *Becoming A Fifth Branch*, 99 CORNELL L. REV. 1, 12–24 (2013); Roberta S. Karmel, *Should Securities Industry Self-Regulatory Organizations Be Considered Government Agencies?*, 14 STAN. J.L. BUS. & FIN. 151, 151–55 (2008); Marianne K. Smythe, *Government Supervised Self-Regulation in the Securities Industry and the Antitrust Laws: Suggestions for an Accommodation*, 62 N.C. L. REV. 475, 480–87 (1984).

264. See Omarova, *supra* note 1, at 418 ("Unconstrained by matters of formal jurisdiction, private firms are also better equipped to monitor and manage their activities and risks on a global basis as an integrated economic enterprise."); Rolf H. Weber & Douglas W. Arner, *Toward a New Design for International Financial Regulation*, 29 U. PA. J. INT'L L. 391, 392–96 (2007).

265. See John C. Coffee, Jr., *Systemic Risk After Dodd-Frank: Contingent Capital and the Need for Regulatory Strategies Beyond Oversight*, 111 COLUM. L. REV. 795 (2011); Elena Cubillas, Ana Rosa Fonseca & Francisco González, *Banking Crises and Market Discipline: International Evidence*, 36 J. BANKING & FIN. 2285 (2012); Douglas D. Evanoff, *Preferred Sources of Market Discipline*, 10 YALE J. ON REG. 347, 350 (1993); Douglas D. Evanoff, Julapa A. Jagtiani & Taisuke Nakata, *Enhancing Market Discipline in Banking: The Role of Subordinated Debt in Financial Regulatory Reform*, 63 J. ECON. & BUS. 1 (2011); David G. Oedel, *Private Interbank Discipline*, 16 HARV. J.L. & PUB. POL'Y 327, 330 (1993). But see David A. Skeel, Jr. & Thomas H. Jackson, *Transaction Consistency and the New Finance in Bankruptcy*, 112 COLUM. L. REV. 152, 164 (2012) (detailing "the now-infamous Repo 105 transactions that Lehman employed at the end of each quarter to disguise the amount of its leverage" to fool regulators and counterparties).

to adhere to certain rules without facing the same jurisdictional issues that may be encountered by the SEC and other government regulators.<sup>266</sup> Because cy-fi participants exist across multiple jurisdictions, sensible private regulatory mechanisms can be an effective governance feature of a new framework for dealing with jurisdictional obstacles faced by government regulators.<sup>267</sup>

In terms of origination, relative to government regulators, industry participants are driven less by market booms and busts to create sensible regulation given their expertise and proximity to the daily operations of finance. Given the speed and complexity of cyborg finance,<sup>268</sup> regulatory needs will be dynamic and accelerated as well, perhaps too fast for the slog of governmental legislation and rulemaking.<sup>269</sup> In contrast to government fiats that are reactions to the latest scandal, scare, or bust, industry participants, in some cases, can be more knowledgeable than government regulators about how best to craft and refine rules and practices as needed.<sup>270</sup> Moreover, because of the interconnectedness of cy-fi, many of the participants share a stake in the soundness and stability of the system.<sup>271</sup> A recent study suggested that many of the largest banks in the country had substantial credit exposures to one another.<sup>272</sup> Mindful of these shared interests, policymakers should design regulations that encourage institutions to regulate and moderate one another. For instance, policymakers can encourage market-based mechanisms, like special debt securities, that better position investment banks to monitor the financial soundness of their peers and counterparties by being watchful of the pricing of the assets being used as collateral among and between institutions.<sup>273</sup>

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266. See Brummer, *supra* note 6, at 1450–63.

267. See Omarova, *supra* note 1, at 431 (discussing the capacity of financial participants “to regulate and monitor their own activities and risks on a seamlessly global, cross-border basis”).

268. See Andrew W. Lo & Robert C. Merton, *Preface to the Annual Review of Financial Economics*, 1 ANN. REV. FIN. ECON. 1, 12 (2009) (“[T]he implementation of financial innovation is likely to be more rapid because the threshold for change is lower.”).

269. Hu, *supra* note 153, at 1463.

270. See, e.g., Hu, *supra* note 6, at 412 (suggesting that regulators may not possess sufficient expertise to effectively regulate some complex financial products); Judge, *supra* note 260, at 1296–97.

271. See, e.g., JPMorgan Chase & Co., Annual Report (Form 10-K) 10 (Feb. 29, 2012) (“The financial condition of JPMorgan Chase’s customers, clients and counterparties, including other financial institutions, could adversely affect the Firm.”); Omarova, *supra* note 1, at 422, 443–47 (articulating shared, collective interests as the bases of meaningful private regulation in the financial industry).

272. See Judge, *supra* note 260, at 1283–84; Letter from The Clearing House et al., to Jennifer J. Johnson, Sec’y, Bd. of Governors of the Fed. Reserve Sys. C-3 (Apr. 27, 2012), available at <http://www.aba.com/ABASA/Documents/Dodd-Frank-Sections-165166-Comment-Letter.pdf>.

273. See, e.g., Charles W. Calomiris, *Blueprints for a New Global Financial Architecture*, in INTERNATIONAL FINANCIAL MARKETS: THE CHALLENGE OF GLOBALIZATION 259, 270–72 (Leonardo Auernheimer ed., 2003) (recommending that banks hold debt in one another to promote stability); Craig H. Furfine, *Banks as Monitors of Other Banks: Evidence from the Overnight Federal Funds Market*, 74 J. BUS. 33, 54 (2001) (“[B]anks with higher profitability, fewer problem loans, and higher capital ratios

In terms of resources, industry participants do not face the same political and budgetary constraints as government regulators. Instead, private regulation would be driven by industry incentives for profit, certainty, and sustainability.<sup>274</sup> For instance, because cyborg finance is so reliant on expensive, advanced information technology, private industry may be better positioned, in terms of resources, to leverage technology and expertise to monitor and manage risk in partnership with government regulators.<sup>275</sup> In an era of growing mandates and shrinking budgets, policymakers should consider sensible private regulation as a tool for overcoming their resource challenges.<sup>276</sup>

This advocacy for private regulation as a first principle for regulating cyborg finance should not be mistaken as a call for deregulation or an abdication of the state's role in financial governance. It is understood that the financial industry cannot perfectly regulate itself.<sup>277</sup> As such, this principle is not advocating for exclusive private regulation or self-regulation. Rather, this proposed principle is an invitation for thinking

pay lower interest rates . . ."); John Geanakoplos, *Solving the Present Crisis and Managing the Leverage Cycle*, 16 FED. RES. BANK OF N.Y. ECON. POL'Y REV. 101, 104 (2010) ("[T]he best way to monitor leverage is to do it at the *security* level by keeping track of haircuts on all the different kinds of assets used as collateral, including in the repo market and in the housing market.").

274. See Jonathan R. Macey & Elizabeth H. Garrett, *Market Discipline by Depositors: A Summary of the Theoretical and Empirical Arguments*, 5 YALE J. ON REG. 215, 220 (1988) ("The likelihood that regulators are as effective as private parties at designing methods to control bank risk is slight, because unlike private parties, regulators do not have their own funds at stake . . .").

275. See Kenneth A. Bamberger, *Technologies of Compliance: Risk and Regulation in a Digital Age*, 88 TEX. L. REV. 669, 685–87, 689–92 (2010); Judge, *supra* note 260, at 1296–97 (discussing how financial institutions, unlike government regulators, can "hire the best and the brightest personnel available").

276. See, e.g., SEC, FY 2014 CONGRESSIONAL BUDGET JUSTIFICATION (2014), available at <http://www.sec.gov/about/reports/secfy14congbudjust.pdf>; William Alden, *For 2 Wall Street Regulators, More Belt-Tightening*, N.Y. TIMES: DEALBOOK, (Jan. 14, 2014), <http://dealbook.nytimes.com/2014/01/14/for-2-wall-street-regulators-more-belt-tightening/>; Matthew Philips, *The CFTC Is Drowning in Data*, BUS. WK., Nov. 4, 2013, at 35–36. ("The CFTC's budget has risen from \$111 million to about \$200 million over the past five years, but that's coincided with a more than tenfold increase in the size of the markets it oversees.")

277. See, e.g., Baer, *supra* note 262, at 950–56 (critiquing internal compliance programs); Brooksley Born, *Foreword: Deregulation: A Major Cause of the Financial Crisis*, 5 HARV. L. & POL'Y REV. 231, 242–43 (2011) ("The causative role of deregulation and inadequate regulation in the financial crisis demonstrates the fallacies of reliance on self-regulation in a field central to the American economy and the welfare of the American people."); Kimberly D. Krawiec, *The Return of the Rogue*, 51 ARIZ. L. REV. 127, 128–32 (2009) (discussing flaws of self-regulated risk management); Langevoort, *supra* note 6, at 1214; Macey & O'Hara, *supra* note 1 (theorizing that profit-maximizing may conflict with private, industry-oriented regulation); Leo E. Strine, Jr., *Our Continuing Struggle with the Idea that For-Profit Corporations Seek Profit*, 47 WAKE FOREST L. REV. 135, 136 (2012) ("In the end, policy makers should not delude themselves about the corporation's ability to police itself; government still has a critical role in setting the rules of the game."); *Morgan Stanley's Mack: "We Cannot Control Ourselves"*, N.Y. TIMES: DEALBOOK, (Nov. 19, 2009), <http://dealbook.blogs.nytimes.com/2009/11/19/morgan-stanleys-mack-we-cannot-control-ourselves/> (quoting Morgan Stanley CEO John Mack as stating "[w]e cannot control ourselves").

anew about financial governance, about balancing and partnering traditional government-oriented regulation with more industry-oriented regulation.<sup>278</sup> If cy-fi is a manifestation of Lawrence Lessig's famous observation that "code is law,"<sup>279</sup> then the industry participants, who are at the forefront of creating and implementing the code, should also be key partners at the forefront of creating and implementing the law.<sup>280</sup> There are significant advantages to private industry regulation in terms of expertise, proximity, and incentives that should be harnessed "to serve public goals."<sup>281</sup> Thus, policymakers should place more trust in industry-based frameworks for regulation coupled with sensible government oversight in theorizing a new regulatory framework for cyborg finance.

### G. Customize

Policymakers, in designing regulations for cyborg finance, should prefer narrowly tailored, customized rules whenever possible and favor broadly construed, categorical rules only when necessary. Customization would help minimize the harmful, unintended, and unanticipated consequences of one-size-fits-all, comprehensive rules.<sup>282</sup> Customization would allow regulators and industry participants to carefully target areas where risks are most significant without inhibiting the potential rewards from areas where risks are manageable.<sup>283</sup>

Because financial regulatory reform efforts historically follow busts, scandals, or scares,<sup>284</sup> policymakers tend to react and overreact in an

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278. See Cristie L. Ford, *New Governance, Compliance, and Principles-Based Securities Regulation*, 45 AM. BUS. L.J. 1, 27–28 (2008); Lobel, *supra* note 177, at 468 ("There is a tendency to equate shifts from top-down regulation with deregulation, privatization, and devolution. The new governance paradigm resists this dichotomized world and requires ongoing roles for government and law.").

279. LAWRENCE LESSIG, *CODE: VERSION 2.0*, 5 (2006).

280. See Gerding, *supra* note 22, at 184–85; Joel R. Reidenberg, *Lex Informatica: The Formulation of Information Policy Rules Through Technology*, 76 TEX. L. REV. 553, 565–69 (1998).

281. Jody Freeman, *The Private Role in Public Governance*, 75 N.Y.U. L. REV. 543, 549 (2000).

282. See J.B. Ruhl & James Salzman, *Mozart and the Red Queen: The Problem of Regulatory Accretion in the Administrative State*, 91 GEO. L.J. 757, 814 (2003) ("The unintended consequences of a rule thus emerge from the complex interactions between the full set of rules and the human behaviors they motivate."); Whitehead, *supra* note 226, at 1270 (opining that there is "a real risk that new rules will have unanticipated consequences, particularly in a system as complex as today's financial markets").

283. Judge, *supra* note 6, at 724.

284. See Whitehead, *supra* note 5, at 2 ("Financial regulation is often reactive. New regulation seals up leaks in the financial system – usually following a crisis, a shift in the markets, or other change that threatens financial stability.").

omnibus manner.<sup>285</sup> As financial crises grow in size, so do the regulatory responses to those crises. The Glass-Steagall Act of 1933, which was implemented following the Great Depression, ran 37 pages; Dodd-Frank is contained in 848 pages with thousands of pages' worth of additional rules.<sup>286</sup> The so-called "Volcker Rule" alone which stemmed from Dodd-Frank is contained in 964 pages, including an 893-page preamble.<sup>287</sup> The rule involved 18,223 comments and 1,238 days of rulemaking.<sup>288</sup>

Moreover, regulations promulgated by such efforts in down times usually become deregulated in good times—creating a consequential and costly cycle of over-regulation, deregulation, and re-regulation.<sup>289</sup> In order to prevent the last crisis from repeating itself, policymakers frequently use sledgehammers rather than scalpels in creating new regulations, which may be politically and psychologically satisfying, but not necessarily most workable and effective.<sup>290</sup> Mandating that diverse groups of banks and other financial institutions adhere to the same rules, irrespective of their differences, can reduce institutional and systemic welfare as capital is obtusely shifted from productive efforts to costly compliance efforts.<sup>291</sup> Additionally, a "one-size-fits-all" regulatory approach may "force risk migration rather than mitigation."<sup>292</sup> For instance, when new rules on futures and swaps were promulgated some institutions simply "faturized" swaps by converting them into futures to receive more favorable regulatory

285. See Banner, *supra* note 154; Erik F. Gerding, *The Next Epidemic: Bubbles and the Growth and Decay of Securities Regulation*, 38 CONN. L. REV. 393, 418–24 (2006); Grundfest, *supra* note 6; Tom C.W. Lin, *Vistas of Finance*, 61 UCLA L. REV. DISCOURSE 78, 85 (2013).

286. Andrew G. Haldane, Exec. Dir., Fin. Stability, Bank of Eng., *The Dog and the Frisbee*, Speech at the Federal Reserve Bank of Kansas City's 36th Economic Policy Symposium: The Changing Policy Landscape, Jackson Hole, Wyoming 8 (Aug. 31, 2012), available at <http://www.bankofengland.co.uk/publications/Documents/speeches/2012/speech596.pdf>.

287. See Prohibitions and Restrictions on Proprietary Trading and Certain Interests in, and Relationships with, Hedge Funds and Private Equity Funds, 12 C.F.R. §§ 44, 248, 351, 255 (2013).

288. Peter Coy, et al., *1,238 days, 18,223 comments, 71-page rule, 893-page preamble, 5 agencies, 1 man*, BUS. WK., Dec. 16, 2013, at 41.

289. See GERDING, *supra* note 154, at 137–39; NOLAN MCCARTY ET AL., POLITICAL BUBBLES: FINANCIAL CRISES AND THE FAILURE OF AMERICAN DEMOCRACY 14–15 (2013); Coffee, *supra* note 154, at 1029 (calling this phenomenon, the "Regulatory Sine Curve"); Patricia A. McCoy et al., *Systemic Risk Through Securitization: The Result of Deregulation and Regulatory Failure*, 41 CONN. L. REV. 1327, 1333 (2009); Omarova, *supra* note 1, at 416 (discussing the "never-ending spiral of rulemaking and rule evading"); Reuters, *Global Banking Regulators Agree to Ease Capital Rule*, N.Y. TIMES, Jan. 13, 2014, at B6; see also Susan Rose-Ackerman, *Defending the State: A Skeptical Look at "Regulatory Reform" in the Eighties*, 61 U. COLO. L. REV. 517, 520–22 (1990).

290. See Greene & Broomfield, *supra* note 149, at 8 ("[The current regulatory approach] subjects diverse entities to a 'one-size-fits-all' regulatory approach, ignoring the different causes of risk, and also further complicating legal obligations for entities that are often already subject to other complex regulatory regimes.")

291. See RAJAN, *supra* note 6, at 174–75.

292. Greene & Broomfield, *supra* note 149, at 8.

treatment.<sup>293</sup> When these types of unintended and unanticipated consequences occur over large portions of the industry, senseless and broad regulations can inhibit the progression and recovery of the entire financial system and economy.

Given the complexity of cyborg finance and the diversity of its participants,<sup>294</sup> a first principle towards customization makes much sense. In a financial marketplace where participants come in all forms and sizes, broad categorical rules should be favored only when necessary, and narrowly customized rules should be preferred whenever possible. While customization may require more diligence and may be less politically satisfying, it may ultimately prove to be more sensible and effective in the long run.

### H. Incentivize

In designing regulation for cyborg finance, as a matter of principle, policymakers should use affirmative incentives in addition to negative penalties to help encourage industry participants to behave sensibly.<sup>295</sup> This first principle of using affirmative incentives in designing a regulatory framework for cy-fi is rooted in the belief that individuals and institutions do not react equally or with perfect rationality to rewards and punishments, so policymakers need to sensibly use both towards achieving their goals.<sup>296</sup> While penalties and punishments may be psychologically, politically, and administratively more satisfying following financial misbehavior,<sup>297</sup>

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293. Katy Burne, *Traders Seek Harmonization in New Futures, Swaps Rules*, WALL ST. J., Jan. 30, 2013, <http://online.wsj.com/article/SB10001424127887323701904578274704132048858.html>.

294. See, e.g., Hu, *supra* note 5, at 1713 (“The modern process of financial innovation has resulted in financial strategies and other products, as well as major financial institutions, that are far more complex than in the past.”).

295. See MICHAEL G. AAMODT, *INDUSTRIAL/ORGANIZATIONAL PSYCHOLOGY: AN APPLIED APPROACH* 349–54 (7th ed. 2013) (providing an overview of reward versus punishment in organizational settings).

296. See Paul H. Robinson & John M. Darley, *Does Criminal Law Deter? A Behavioural Science Investigation*, 24 OXFORD J. LEGAL STUD. 173, 174 (2004) (“[E]ven if they know the legal rules and perceive a cost-benefit analysis that urges compliance, potential offenders commonly cannot or will not bring such knowledge to bear to guide their conduct in their own best interests, such failure stemming from a variety of social, situational, or chemical influences.”); Tobias Wächter et al., *Differential Effect of Reward and Punishment on Procedural Learning*, 29 J. NEUROSCIENCE 436, 436 (2009) (“Our results suggest that reward and punishment engage separate motivational systems with distinctive behavioral effects and neural substrates.”). *But see* Gary S. Becker, *Crime and Punishment: An Economic Approach*, 76 J. POL. ECON. 169, 172–80 (1968).

297. See Miriam H. Baer, *Choosing Punishment*, 92 B.U. L. REV. 577, 579 (2012) (“[P]ublic actors have ample reason to ‘choose’ punishment over other forms of government action as a means of attracting and maintaining public support.”); Max Minzner, *Why Agencies Punish*, 53 WM. & MARY L. REV. 853, 854–57 (2012); Jeffrey J. Rachlinski & Forest Jourden, *The Cognitive Components of Punishment*, 88 CORNELL L. REV. 457, 485 (2003); Paul H. Robinson & John M. Darley, *Intuitions of*

incentives may be more effective in preventing and correcting such misbehavior in the future. Incentives, when properly calibrated and designed, can be incredibly powerful regulatory tools for governing individuals and institutions in the face of complexity.<sup>298</sup>

On the individual level, policymakers can design incentives that better link executive compensation with risk management to encourage cy-fi leaders to broaden their focus beyond short-term profits. Prior to the Financial Crisis, many corporate stakeholders encouraged equity compensation as a tool to better align the interests of executives with the interests of shareholders.<sup>299</sup> In theory, equity compensation would lead to better governance to the benefit of shareholders.<sup>300</sup> In practice, equity compensation led to significant appreciation in executive compensation that did not always correspond with performance;<sup>301</sup> and sometimes it encouraged excessive risk-taking that caused significant harms to shareholders and other industry participants in the long run.<sup>302</sup> Immediately

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*Justice: Implications for Criminal Law and Justice Policy*, 81 S. CAL. L. REV. 1, 3–4 (2007) (contending that intuition, not reason, may be the main motivator for punishment); William J. Stuntz, *The Pathological Politics of Criminal Law*, 100 MICH. L. REV. 505, 507 (2001) (“[A]ll change in criminal law seems to push in the same direction—toward more liability . . .”); Neil Vidmar & Dale T. Miller, *Sociopsychological Processes Underlying Attitudes Toward Legal Punishment*, 14 L. & SOC’Y REV. 565, 565 (1980) (“Punishment . . . defines social boundaries, vindicates norms, and provides an outlet for the psychological tensions aroused by deviant acts.”).

298. See RICHARD H. THALER & CASS R. SUNSTEIN, *NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS* 8 (2008); Gerrit De Geest & Giuseppe Dari-Mattiacci, *The Rise of Carrots and the Decline of Sticks*, 80 U. CHI. L. REV. 341, 345 (2013) (suggesting that “carrots” are superior to “sticks” in the face of complexity); Manuel A. Utset, *Financial System Engineering*, 32 REV. BANKING & FIN. L. 371, 417–27 (2013) (discussing trade-offs in managing financial complexities).

299. See LUCIAN BEBCHUK & JESSE FRIED, *PAY WITHOUT PERFORMANCE: THE UNFULFILLED PROMISE OF EXECUTIVE COMPENSATION* 1 (2004); Holmstrom & Kaplan, *supra* note 204, at 12; Edward B. Rock, *Adapting to the New Shareholder-Centric Reality*, 161 U. PA. L. REV. 1907, 1917–18 (2013).

300. See Michael C. Jensen & Kevin J. Murphy, *Performance Pay and Top-Management Incentives*, 98 J. POL. ECON. 225, 226 (1990).

301. See Lucian Bebchuk & Yaniv Grinstein, *The Growth of Executive Pay*, 21 OXFORD REV. ECON. POL’Y 283, 289, 290 tbl.4 (2005); Daniel Costello, *The Drought Is Over (at Least for C.E.O.’s)*, N.Y. TIMES, Apr. 10, 2011, at BU1.

302. See Press Release, Bd. of Governors of the Fed. Reserve Sys., *Federal Reserve Issues Proposed Guidance on Incentive Compensation* (Oct. 22, 2009) (quoting Fed. Reserve Chairman Ben S. Bernanke) (“Compensation practices at some banking organizations have led to misaligned incentives and excessive risk-taking, contributing to bank losses and financial instability.”); Bebchuk & Spamann, *supra* note 6, at 255–74; Lucian A. Bebchuk et al., *The Wages of Failure: Executive Compensation at Bear Stearns and Lehman 2000–2008*, 27 YALE J. ON REG. 257, 273–76 (2010); Vicente Cuñat & Maria Guadalupe, *Executive Compensation and Competition in the Banking and Financial Sectors*, 33 J. BANKING & FIN. 495, 496 (2009); Heidi Mandanis Schooner, *Who Determines When Enough Is Enough? Refocusing Regulatory Limitations on Banks’ Compensation Practices*, 37 B.C. L. REV. 861, 867–68 (1996). *But see* Joel F. Houston & Christopher James, *CEO Compensation and Bank Risk: Is Compensation in Banking Structured to Promote Risk Taking?*, 36 J. MONETARY ECON. 405, 408 (1995) (stating that the authors could find “no evidence that equity-based compensation is used to promote risk taking in banking”).

before the Financial Crisis, executives of financial firms were compensated significantly in equity relative to executives at nonfinancial firms.<sup>303</sup> For instance, preceding the Financial Crisis, the financial executives with the largest equity stakes in their companies were the CEOs of Bear Stearns, Lehman Brothers, Merrill Lynch, and Countrywide.<sup>304</sup> Post-crisis, all of those companies were seen by many as having taken excessive risks.<sup>305</sup>

Following the crisis, some scholars and industry experts have suggested introducing subordinated debt,<sup>306</sup> long-term equity,<sup>307</sup> and representative baskets of securities<sup>308</sup> into executive compensation packages to better balance profit motives with risk management motives. Pursuant to Dodd-Frank, regulators have also promulgated new guidelines on how to better structure compensation to discourage imprudent, myopic risk-taking through mechanisms such as compensation claw-backs.<sup>309</sup> Given the incredible speed of cyborg finance, properly calibrated incentives should also be used to encourage executives to better balance short-term desires for profit with long-term interests in risk management.

On the institutional level, policymakers can also use incentives to better achieve regulatory aims. Given the vulnerabilities of cyborg finance to threats in cyberspace, one clear regulatory aim would be greater cyber security. A punishment-based approach to achieving that goal would be to penalize industry participants who do not meet certain government-mandated benchmarks on cyber security by levying a severe fine. Alternatively, an incentive-based approach would be to encourage industry participants to enhance their cyber defense by giving tax credits or allowing participants to write off their investments earlier through bonus depreciation or increased deductions of such expenditures.<sup>310</sup> Following the Financial Crisis, Congress, pursuant to the American Recovery and Reinvestment Act, used various tax mechanisms to incentivize businesses to make capital investments to help stimulate the economy.<sup>311</sup> Similar incentives can be utilized to motivate financial industry participants to act

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303. Tung, *supra* note 5, at 1222.

304. Sallie Krawcheck, *Four Ways to Fix Banks*, HARV. BUS. REV., June 2012, at 108–09.

305. *Id.*

306. Tung, *supra* note 5, at 1207.

307. Sanjai Bhagat & Roberta Romano, *Reforming Executive Compensation: Focusing and Committing to the Long-Term*, 26 YALE J. ON REG. 359, 359 (2009).

308. Bebchuk & Spamann, *supra* note 6, at 248–53.

309. See Guidance on Sound Incentive Compensation Policies, 75 Fed. Reg. 36,395 (June 25, 2010).

310. See I.R.S., CAT. NO. 13081F, PUBLICATION 946, HOW TO DEPRECIATE PROPERTY 3–24 (2012), available at <http://www.irs.gov/pub/irs-prior/p946--2011.pdf> (explaining bonus depreciation and increased deductions).

311. I.R.S., BONUS DEPRECIATION AND INCREASED SECTION 179 DEDUCTION UNDER THE AMERICAN RECOVERY AND REINVESTMENT ACT (Oct. 24, 2012).

more expediently towards achieving regulatory goals, like enhancing cyber security, in the new financial industry.

Additionally, on the institutional level, policymakers can also create better mechanisms to manage and monitor incentives so that transactions are driven by the fortunes of principals, and not by the fees of agents.<sup>312</sup> Being self-interested agents, financial intermediaries and gatekeepers such as auditors, investment banks, and credit ratings agencies can at times encourage transactions that harm long-term institutional and systemic stability for short-term fees.<sup>313</sup> Policymakers can perhaps dedicate more regulatory resources to examining fee structures for their distortive and harmful effects so as to better align financial incentives with regulatory objectives.

This principle of using incentives as well as penalties should not be misconstrued as one aimed at sparing the rods of punishment to spoil industry, nor should it be mistaken as rewarding bad financial behavior. Bad and dangerous financial actions should be punished, but punishments alone are insufficient to remedy financial flaws and failures.<sup>314</sup> Moreover, circumstances and negative externalities at times render penalties impractical and counterproductive.<sup>315</sup> Rather than just penalize bad and dangerous acts, this principle promotes using smart, affirmative incentives to better manage and prevent such harmful actions in the first place.

### *I. Promote Self-Insurance*

A key principle in creating regulations for cyborg finance should be the promotion of self-insurance mechanisms within the industry. Private failures of industry participants should have private solutions. Private losses should not require public bailouts, whenever possible.

During the recent financial crisis, some of the most unpopular and controversial regulatory actions of the government were the bailouts of faltering private businesses. These public bailouts of private failures

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312. Kathryn Judge, *Fee Effects*, 98 IOWA L. REV. 1517, 1529–34 (2013).

313. See, e.g., Lawrence A. Cunningham, *Too Big to Fail: Moral Hazard in Auditing and the Need to Restructure the Industry Before It Unravels*, 106 COLUM. L. REV. 1698, 1699–1722 (2006); Frank Partnoy, *How and Why Credit Rating Agencies Are Not Like Other Gatekeepers*, in FINANCIAL GATEKEEPERS: CAN THEY PROTECT INVESTORS? 59–65 (Yasuyuki Fuchita & Robert E. Litan eds., 2006).

314. See, e.g., John Braithwaite, *What's Wrong with the Sociology of Punishment*, 7 THEORETICAL CRIMINOLOGY 5, 15–30 (2003); Tracey L. Meares et al., *Updating the Study of Punishment*, 56 STAN. L. REV. 1171, 1172–96 (2004).

315. See, e.g., Andrew Ross Sorkin, *Realities Behind Prosecuting Big Banks*, N.Y. TIMES, March 12, 2013, at B1 (reporting that the size of some banks renders them too difficult to prosecute because of negative social externalities).

resulted in the strange phenomena of the American government owning significant stakes in large, faltering, American corporations.<sup>316</sup> In 2008, the government invested \$85 billion in the insurance giant, AIG, in exchange for majority ownership stake.<sup>317</sup> Between 2008 and 2009, the government purchased \$45 billion of securities, or a 34% ownership stake in the financial firm, Citigroup.<sup>318</sup> Between 2008 and 2009, \$82 billion in public funds poured into the American auto industry.<sup>319</sup> This resulted in the government, at various times, owning 8% of Chrysler,<sup>320</sup> 60% of General Motors,<sup>321</sup> and 56% of GMAC,<sup>322</sup> General Motor's financing affiliate.

Following the Financial Crisis, policymakers and scholars have contemplated various self-insurance mechanisms to prevent future public bailouts. For instance, American and international policymakers have raised capital reserve requirements for large financial institutions to ensure that losses can be better covered by the firms themselves.<sup>323</sup> Additionally, there have been proposals for levying transaction fees on financial institutions to create an insurance fund.<sup>324</sup> Beyond government-oriented initiatives, there have also been suggestions to create industry-oriented mechanisms to share costs in the event of another financial crisis, and bankruptcy law reforms to better address the complex structure of financial institutions in the event of future liquidations and breakdowns.<sup>325</sup> Mindful of moral hazards and other considerations emanating from past insurance

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316. Marcel Kahan & Edward B. Rock, *When the Government Is the Controlling Shareholder*, 89 TEX. L. REV. 1293, 1297 (2011).

317. Press Release, Bd. of Governors of the Fed. Reserve Sys., Federal Reserve Board, with Full Support of the Treasury Department, Authorizes the Federal Reserve Bank of New York to Lend up to \$85 Billion to the American International Group (Sept. 16, 2008).

318. See Jeff Zeleny & Eric Dash, *Citigroup Nears Payback Deal; Obama to Press Banks for Help*, N.Y. TIMES, Dec. 14, 2009, at A1.

319. Nick Bunkley, *G.M. Repays U.S. Loan, While Chrysler Posts Improved Quarterly Results*, N.Y. TIMES, Apr. 22, 2010, at B3.

320. *Id.*

321. See Bill Vlasic & Nick Bunkley, *Obama Is Upbeat for G.M. Future on a Day of Pain*, N.Y. TIMES, June 2, 2009, at A1.

322. Binyamin Appelbaum, *U.S. to Give \$3.8 Billion More in Aid to GMAC; Move Makes Government the Majority Owner of Troubled Auto Lender*, WASH. POST, Dec. 31, 2009, at A1.

323. See Dodd-Frank Wall Street Reform and Consumer Protection Act § 171, 12 U.S.C. § 5371 (Supp. IV 2010); BASEL COMM. ON BANKING SUPERVISION, *supra* note 256, at 3; see also ANAT ADMATI & MARTIN HELLMIG, *THE BANKERS' NEW CLOTHES: WHAT'S WRONG WITH BANKING AND WHAT TO DO ABOUT IT* 94–100 (2013).

324. See, e.g., Let Wall Street Pay for the Restoration of Main Street Act of 2009, H.R. 4191, 111th Cong. (2009).

325. See Kenneth Ayotte & David A. Skeel, Jr., *Bankruptcy or Bailouts?*, 35 J. CORP. L. 469, 470–75 (2010); Onnig H. Dombalagian, *Requiem for the Bulge Bracket?: Revisiting Investment Bank Regulation*, 85 IND. L.J. 777, 836–43 (2010); Gordon & Muller, *supra* note 5, at 205–06; Jonathan C. Lipson, *The Shadow Bankruptcy System*, 89 B.U. L. REV. 1609, 1664–68 (2009).

funds like the Federal Deposit Insurance Corporation (FDIC),<sup>326</sup> which protects the funds of depositors at insured banks,<sup>327</sup> policymakers can better design sensible self-insurance programs for the new financial industry.<sup>328</sup>

As cyborg finance continues to evolve and grow, so will its risks and the potential for significant losses. To create a fully self-insuring financial system that never needs public bailouts is perhaps an elusive goal, as policymakers are unlikely to permit the entire financial system to collapse.<sup>329</sup> Nonetheless, policymakers should pursue regulations that promote mechanisms for self-insurance, so that public bailouts of the magnitude of past financial crises can be better mitigated in future financial crises.

### *J. Review, Renew, Reform, or Relinquish*

In designing regulations for cyborg finance, policymakers should create a framework that better accounts for its dynamic nature by defaulting to a principle of predetermined reassessment. In practice, this means that whenever sensible, policymakers should favor temporary rules with sunset provisions and preset opportunities for review over permanent or “lasting” rules.<sup>330</sup> This would apply to both new laws and rules that regulated

326. See, e.g., Jens Forssbaeck, *Ownership Structure, Market Discipline, and Banks' Risk-Taking Incentives Under Deposit Insurance*, 35 J. BANKING & FIN. 2666, 2666 (2011) (“What deposit insurance does is to remove depositors’ incentives to discipline the bank by charging a risk premium commensurate with the bank’s risk level, their own costs of monitoring, and other agency-related costs . . . .”); Macey & Garrett, *supra* note 274 (suggesting that deposit insurance could reduce market discipline and lead to greater systemic risk); William Poole, *Moral Hazard: The Long-Lasting Legacy of Bailouts*, 65 FIN. ANALYSTS J. 17, 21 (2009).

327. See 12 U.S.C. § 1821 (2006) (establishing the FDIC).

328. See Charles W. Calomiris, *Is Deposit Insurance Necessary? A Historical Perspective*, 50 J. ECON. HIST. 283, 284 (1990); Richard S. Grossman, *Deposit Insurance, Regulation, and Moral Hazard in the Thrift Industry: Evidence from the 1930's*, 82 AM. ECON. REV. 800, 802–03 (1992); Jonathan R. Macey & Geoffrey P. Miller, *Bank Failures, Risk Monitoring, and the Market for Bank Control*, 88 COLUM. L. REV. 1153, 1155, 1165 (1988); Patricia A. McCoy, *The Moral Hazard Implications of Deposit Insurance: Theory and Evidence*, in 5 CURRENT DEVELOPMENTS IN MONETARY AND FINANCIAL LAW 417, 423–25 (Int’l Monetary Fund Legal Dep’t ed., 2008).

329. See, e.g., Oliver Hart & Luigi Zingales, *Curbing Risk on Wall Street*, 2010 NAT’L AFFAIRS 20, 21 (opining on the pragmatic need for bailouts to safeguard the financial system during periods of serious distress); Levitin, *supra* note 5, at 439 (“Bailouts are an inevitable feature of modern economies . . . .”); Jonathan R. Macey & James P. Holdcroft, Jr., *Failure is an Option: An Ersatz-Antitrust Approach to Financial Regulation*, 120 YALE L.J. 1368, 1370 (2011) (“Policymakers . . . cannot credibly commit to refrain from supporting large, important financial institutions” when inaction could seriously threaten financial stability.”).

330. See, e.g., Jacob E. Gersen, *Temporary Legislation*, 74 U. CHI. L. REV. 247, 298 (2007) (“Normatively, temporary legislation should not be globally eschewed, and at least in specific policy domains such as responses to newly recognized risk, there should be a presumptive preference in favor of temporary legislation.”); George K. Yin, *Temporary-Effect Legislation, Political Accountability, and Fiscal Restraint*, 84 N.Y.U. L. REV. 174, 187–94 (2009) (espousing the benefits of temporary legislation for budgeting purposes); Romano, *supra* note 161, at 1600–02. *But see* STEPHEN BREYER,

industry as well as those that deregulated industry. This principle of predetermined reassessment and its practical features are neither new nor radical. Tax legislation, in this country, frequently has had sunset provisions and preset reviews,<sup>331</sup> and the same is true for legislation in other areas of the law in our history.<sup>332</sup>

Because of prevalent rulemaking pathologies and cognitive biases,<sup>333</sup> financial rulemaking in response to the last crisis and past problems can quickly grow stale in a dynamic marketplace.<sup>334</sup> Policymakers, like most individuals, are bad judges of risk.<sup>335</sup> They often overreact and overestimate risk, especially in the aftermath of crises or catastrophes.<sup>336</sup> Moreover, policymakers, again, like most individuals, suffer from status quo bias, where they become attached to the current state of affairs with no rational basis.<sup>337</sup> Such pathologies and biases can create costly issues for industry participants, regulators, and the entire financial system.<sup>338</sup> Absent

REGULATION AND ITS REFORM 366–67 (1982) (disfavoring sunset provisions as a way to reform administrative law); Coffee, *supra* note 154, at 1023–26 (arguing against sunset provisions in financial regulation); Rebecca M. Kysar, *Lasting Legislation*, 159 U. PA. L. REV. 1007, 1009–10 (2011) (favoring lasting or permanent legislation over temporary legislation).

331. See Joint Comm. On Taxation, *List of Expiring Federal Tax Provisions, 2009–2020* (JCX-3-10), Jan. 29, 2010, available at <https://www.jct.gov/publications.html?func=startdown&id=3646>; William G. Gale & Peter R. Orszag, *Sunsets in the Tax Code*, 99 TAX NOTES 1553, 1554–57 (2003).

332. Kysar, *supra* note 330, at 1014–21 (summarizing the history of temporary legislation).

333. See, e.g., David A. Dana, *A Behavioral Economic Defense of the Precautionary Principle*, 97 NW. U. L. REV. 1315, 1324–25 (2003) (explaining cognitive biases towards recent and immediate losses and its impact on rulemaking); Jolls et al., *supra* note 184, at 1473; John O. McGinnis & Michael B. Rappaport, *Symmetric Entrenchment: A Constitutional and Normative Theory*, 89 VA. L. REV. 385, 444 (2003) (suggesting that sunset provisions do not suffer from the “special problems of public choice, aberrational majorities, partisanship, or imperfect psychological heuristics”); Jeffrey J. Rachlinski & Cynthia R. Farina, *Cognitive Psychology and Optimal Government Design*, 87 CORNELL L. REV. 549, 603–06 (2002) (discussing how to craft rules and legislation that better account for behavioral tendencies).

334. See Calomiris, *supra* note 6, at 43 (opining that the financial system “will probably undergo significant changes over the next few years”); Gersen, *supra* note 330, at 271 (“Empirically, it is true that new policy initiatives are often enacted in the immediate aftermath of realized or recognized risks.”).

335. See CASS R. SUNSTEIN, *RISK AND REASON: SAFETY, LAW, AND THE ENVIRONMENT* 33–35 (2002) (discussing cognitive bias where “people tend to think that events are more probable if they can recall an incident of their occurrence”); Amos Tversky & Daniel Kahneman, *Availability: A Heuristic for Judging Frequency and Probability*, 5 COG. PSYCHOL. 207, 230 (1973).

336. Gersen, *supra* note 330, at 269; Roger G. Noll & James Krier, *Some Implications of Cognitive Psychology for Risk Regulation*, 19 J. LEGAL STUD. 747, 774–75 (1990); Paul Slovic, Baruch Fischhoff & Sarah Lichtenstein, *Regulation of Risk: A Psychological Perspective*, in *REGULATORY POLICY AND THE SOCIAL SCIENCES* 241, 256–59 (Roger G. Noll ed., 1985).

337. See Lin, *supra* note 183, at 341–42 (discussing status quo bias); William Samuelson & Richard Zeckhauser, *Status Quo Bias in Decision Making*, 1 J. RISK & UNCERTAINTY 7 (1988).

338. See Cass R. Sunstein, *Paradoxes of the Regulatory State*, 57 U. CHI. L. REV. 407, 411 (1990) (“Sometimes [regulation] has imposed enormously high costs for speculative benefits; sometimes it has accomplished little or nothing; and sometimes it has aggravated the very problem it was designed to solve.”); Yin, *supra* note 330, at 178 (“[T]he legislative process fails to account for the complete costs of programs enacted through permanent legislation . . .”).

predetermined mechanisms for review, revision, and renewal, industry participants can incur significant costs complying with rules that no longer make sense in a changed marketplace.<sup>339</sup>

For regulators, stale and sticky rules without built-in exits can be costly to enforce and even more costly to unwind.<sup>340</sup> Permanent rules continue until repeal, and as such, their ongoing costs, in terms of budget and impact, are not properly accounted for, given changes in the regulated space.<sup>341</sup> At minimum, a predetermined reassessment principle would permit policymakers to periodically examine whether rules drafted in the past still make financial and pragmatic sense for the present and the near future.<sup>342</sup>

For the financial system, leaving outdated regulation in place can sow the seeds for new problems and crises as industry participants gravitate towards shadowed areas cast by the old regulations.<sup>343</sup> Additionally, it can also lead to suboptimal allocations of capital, decreases in competition, and reductions in social welfare as regulators and industry participants incur significant costs navigating stale rules.<sup>344</sup>

A primary intent for this principle of predetermined reassessment is to ensure that financial regulation best reflects the current market realities and the best available information.<sup>345</sup> From the regulator's perspective, this principle will probably manifest in staged rulemaking processes as features like preset reviews and sunset provisions drive policymakers to incorporate

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339. See Bruce Adams, *Sunset: A Proposal for Accountable Government*, 28 ADMIN. L. REV. 511, 519–21 (1976) (opining that sunset provisions can create more government accountability); Lewis Anthony Davis, *Review Procedures and Public Accountability in Sunset Legislation: An Analysis and Proposal for Reform*, 33 ADMIN. L. REV. 393, 407–08 (1981) (suggesting methods to design better sunset provisions); see also PAUL ROSE & CHRISTOPHER J. WALKER, *THE IMPORTANCE OF COST-BENEFIT ANALYSIS IN FINANCIAL REGULATION* (2013).

340. See Yin, *supra* note 330, at 180 (discussing the budget benefits of temporary legislation); Roberta Romano, *Regulating in the Dark*, in *REGULATORY BREAKDOWN: THE CRISIS OF CONFIDENCE IN U.S. REGULATION* 88–98 (Cary Coglianese ed., 2012).

341. Romano, *supra* note 340, at 88–89.

342. See Robert W. Hahn, *Achieving Real Regulatory Reform*, 1997 U. CHI. LEGAL F. 143, 156; Romano, *supra* note 340, at 95.

343. See *infra* Part V.D; see also Calomiris, *supra* note 150; McCoy et al., *supra* note 289; Andrei Shleifer & Robert W. Vishny, *Unstable Banking*, 97 J. FIN. ECON. 306, 306–07 (2010); Christine Harper and Yalman Onaran, *Pushing Banks to Unwind Their Global Bets*, BUS. WK., Dec. 17, 2012, at 45 (discussing the increased operational costs of international banks in light of new U.S. capital rules).

344. See Whitehead, *supra* note 226, at 1295 (“Permitting new rules to be adjusted to reflect market feedback can assist in minimizing uncertainty over the rules’ benefits, as well as lower the likelihood that regulation will be ineffective or result in unanticipated costs.”).

345. See Gersen, *supra* note 330, at 248 (“From an informational perspective, temporary legislation provides concrete advantages over its permanent cousin by specifying windows of opportunity for policymakers to incorporate a greater quantity and quality of information into legislative judgments.”).

the latest information, mitigate past cognitive biases, and assuage certain political pathologies related to rulemaking.<sup>346</sup> From the industry's perspective, the principle of predetermined assessment will allow industry participants to better adjust to regulatory realities and help inform policymakers of regulatory mismatches. Collectively, with well-designed regulations, this principle will better facilitate regulators and industry to periodically engage in a dynamic, information-sharing regulatory process.<sup>347</sup>

This advocacy for a first principle of reassessment is not to suggest that the benefits of adhering to this principle are not without their drawbacks; there are shortcomings to mechanisms like sunset provisions and mandatory reviews inherent in temporary rules.<sup>348</sup> Rather, this commentary suggests that, on balance, by adhering to a principle of default reassessment, policymakers can better create a regulatory framework that is more dynamic, more adaptive, and more flexible just like the new financial industry that it seeks to govern.

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Regulating the emerging, new financial industry will be one of the most challenging endeavors for policymakers in the coming years. It is understood that much of the difficulties of financial regulation lie in the actual drafting, passage, implementation, execution, and enforcement of new rules and regulations. The tenets proposed herein aim to serve as principles of regulatory design for policymakers as they face those difficulties, as they contemplate fresh rules and regulations for cyborg finance. Admittedly, some of the proposed principles can be perceived as competing, complementary, and crosscutting. Nevertheless, these principles are intended to serve as guideposts and not roadblocks for creating a better, workable framework for the new financial industry in the years ahead.

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346. See *id.* at 266–67; Cass R. Sunstein, *Irreversible and Catastrophic*, 91 CORNELL L. REV. 841, 859–60 (2006); Whitehead, *supra* note 226, at 1273 (espousing the virtues of staged regulation).

347. See Gersen, *supra* note 330, at 271 (“Under these circumstances, temporary legislation should create stronger incentives for accurate information revelation because staged decision procedures ensure repeated interaction between affected interests and legislators.”); Yair Listokin, *Learning Through Policy Variation*, 118 YALE L.J. 480, 524–27 (2008).

348. See GUIDO CALABRESI, A COMMON LAW FOR THE AGE OF STATUTES 61–62 (1982) (arguing against the utility of sunset provisions); Coffee, *supra* note 154, at 1023–26 (criticizing mandatory sunset provisions financial reform regulation); Kysar, *supra* note 330, at 1009 (“[T]emporary legislation is worse than ineffective: such legislation creates serious political-economy concerns, entrenchment problems, and planning disruptions.”).

## CONCLUSION

Modern finance is undergoing a fundamental transformation. A financial industry built largely on human actions and human relationships is changing into one built on artificial intelligence, mathematical models, and supercomputers. Humans and machines now inextricably reign over a new financial industry that is faster, larger, more complex, more global, more interconnected, and less human.

This Article offered an early systemic account of this complex, ongoing metamorphosis and its wide-ranging policy ramifications for financial regulation. This Article provided a normative and descriptive cartography of this changing financial landscape. It identified particular dangers, systemic risks, and current regulatory shortcomings. It then presented an original set of guiding principles for the future of financial regulation. In the end, this Article is intended to serve as an early framework for further study on how best to regulate the emerging, new financial industry.