
Article

Reengineering Financial Market Infrastructure

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INTRODUCTION

Scholars often portray financial regulators as eternal followers of the private sector, ever struggling to “keep pace” with technological change.¹ While this image captures the difficulty of regulating a dynamic industry, it also obscures central aspects of financial regulatory practice. This Article challenges the conventional depiction by highlighting and examining a practice whereby regulators catalyze efforts to transform financial market technology.

Consider one ambitious Securities and Exchange Commission (SEC) effort to enhance the supervision of stock-market trading activity.² Rather than hiring more staff or writing new rules of market conduct, the SEC has ordered the New York Stock Exchange, Nasdaq, and other trading-venue operators to jointly build a massive market surveillance system called the Consolidated Audit Trail (CAT).³ The idea is simple, yet astounding in its scope. Expected to “ingest 58 billion trade events on a daily basis” and to cost \$2.4 billion to build, the CAT is poised to become “the world’s largest data repository of securities transactions.”⁴ With access to this big-data behemoth, the SEC

1. See, e.g., MICHAEL S. BARR, HOWELL E. JACKSON & MARGARET E. TAHYAR, FINANCIAL REGULATION: LAW AND POLICY 32 (2d ed. 2018) (noting the common scholarly claim that “regulators cannot keep pace” with the evolution of the financial system); Leo E. Strine, Jr., *Who Bleeds When the Wolves Bite?: A Flesh-and-Blood Perspective on Hedge Fund Activism and Our Strange Corporate Governance System*, 126 YALE L.J. 1870, 1959 (2017) (lamenting that section 13 of the Securities Exchange Act has “not kept pace” with financial innovation); cf. CRISTIE FORD, INNOVATION AND THE STATE: FINANCE, REGULATION, AND JUSTICE 223 (2017) (observing that regulators’ fears of “fall[ing] behind” private-sector innovation contribute to a narrative that is easily “co-opted by industry actors”).

2. See Consolidated Audit Trail, 77 Fed. Reg. 45,722 (Aug. 1, 2012).

3. See *id.* at 45,723 (requiring the development of a joint plan to “govern the creation, implementation, and maintenance of a consolidated audit trail and central repository”).

4. Elizabeth P. Gray & Catherine E. Fata, *Increased Use of Big Data in SEC Enforcement*, 50 REV. SEC. & COMMODITIES REGUL. 145, 147 (2017); Order Approving the

believes it will be better equipped to police market manipulation and address risks posed by algorithmic trading.⁵

The CAT is but one example of a practice in which financial regulators seek to construct or renovate financial market infrastructure.⁶ Sometimes, agencies build it themselves: the Federal Reserve (Fed), for instance, owns and operates payment platforms that transmit trillions of dollars each day.⁷ More often, as with the CAT, agencies coerce industry actors into doing the gritty work. As shorthand, I will refer to this kind of activity as infrastructural *reengineering*.⁸ Through such efforts, agencies reshape the deep design of the financial markets' infrastructural systems—trading platforms, payment networks, data repositories, and more—in service of policy goals and statutory mandates.⁹

The practice has a long history. An early reengineering attempt—a failed one—took place in 1938, with then-SEC Chairman William O.

National Market System Plan Governing the Consolidated Audit Trail, Exchange Act Release No. 79,318, 81 Fed. Reg. 84,696, 84,863 (Nov. 23, 2016) (justifying an SEC estimate of \$2.4 billion in up-front industry implementation costs).

5. See Consolidated Audit Trail, 77 Fed. Reg. at 45,731, 45,747 (describing the utility of expanded data access when investigating market manipulation and destabilizing market events like the flash crash of May 2010).

6. Throughout the Article, when using the term “infrastructure,” I mean to denote the set of networked systems that intermediate transactions in the financial markets. For detailed background on these systems, see *infra* Part I.

7. See Peter Conti-Brown & David A. Wishnick, *Private Markets, Public Options, and the Payment System*, 37 YALE J. ON REGUL. 380, 388 (2020) (“The Fed operates multiple payment platforms that its thousands of accountholders—mainly banks, government entities, and private financial utilities—use to transmit over three trillion dollars between their Federal Reserve bank accounts on a daily basis.”).

8. In describing the construction and renovation of financial market infrastructure as a kind of engineering, I am picking up a longstanding (and, in my view, evocative) usage. See, e.g., ANNEISE RILES, COLLATERAL KNOWLEDGE: LEGAL REASONING IN THE GLOBAL FINANCIAL MARKETS 131 (2011) (describing a Bank of Japan effort to “engineer[]” a new payment system); Joseph H. Sommer, *A Law of Financial Accounts: Modern Payment and Securities Transfer Law*, 53 BUS. LAW. 1181, 1197 (1998) (comparing the rules governing payment and securities transfer systems to works of civil engineering); Charles W. Mooney, Jr., *Property, Credit, and Regulation Meet Information Technology: Clearance and Settlement in the Securities Markets*, 55 LAW & CONTEMP. PROBS. 131, 132 (1992) (discussing “the challenges that confront . . . legal ‘engineers’” when dealing with technological change in securities market infrastructure). To clear up a potential source of confusion, the engineering I am talking about is different from the “transaction cost engineering” work done by deal lawyers. See Ronald J. Gilson, *Value Creation by Business Lawyers: Legal Skills and Asset Pricing*, 94 YALE L.J. 239, 255 (1984) (introducing a conception of deal lawyers as transaction cost engineers). Gilson’s idea focuses on bespoke contract negotiations, see *id.* at 256–58, whereas the idea I am invoking focuses on the design of completely standardized transactional systems.

9. See *infra* Part II.

Douglas at the helm.¹⁰ Recent efforts in the wake of the Global Financial Crisis of 2007–09 have completely remade the infrastructure of derivatives markets by standardizing trade data and prompting the creation of central counterparty clearinghouses.¹¹ In between, infrastructural reengineering has enabled regulators to do everything from prevent securities theft to eliminate once-fearsome sources of systemic risk.¹² Existing literature has evaluated many of these efforts and proposed new ones on a market-specific basis.¹³ This Article’s contribution is to explore the practical and theoretical lessons that can be learned by examining reengineering efforts collectively, as constituents of a general category of practice.

Specifically, the Article aims to develop the literature’s understanding of why and how regulators engage in the potentially transformative (and often costly) practice of reshaping financial market infrastructure. It focuses, in particular, on three federal financial

10. See *infra* Part II.B.1.

11. See, e.g., Sean J. Griffith, *Substituted Compliance and Systemic Risk: How To Make a Global Market in Derivatives Regulation*, 98 MINN. L. REV. 1291, 1309–24 (2014) (describing the mandatory creation of central counterparty clearinghouses for over-the-counter derivatives markets).

12. See *infra* Part II. Systemic risk refers to “the risk of socially unbearable macroeconomic consequences” arising from the bankruptcy, distress, or breakdown of individual financial firms or infrastructure institutions. Adam J. Levitin, *In Defense of Bailouts*, 99 GEO. L.J. 435, 446 (2011).

13. For examples of the case-specific literature on financial market infrastructure, see Charles W. Mooney, Jr., *Global Standards for Securities Holding Infrastructures: A Soft Law/Fintech Model for Reform*, 40 MICH. J. INT’L L. 531 (2019), which proposes reforms to securities holding infrastructure; Delphine Nougayrède, *Towards a Global Financial Register? The Case for End Investor Transparency in Central Securities Depositories*, 4 J. FIN. REGUL. 276 (2018), which argues for transparent central securities depositories; Paolo Saguato, *The Liquidity Dilemma and the Repo Market: A Two-Step Policy Option To Address the Regulatory Void*, 22 STAN. J.L. BUS. & FIN. 85 (2017), which proposes reforms to repo market infrastructure; Dan Awrey, *The Mechanisms of Derivatives Market Efficiency*, 91 N.Y.U. L. REV. 1104, 1156–79 (2016), which evaluates reforms to derivatives market infrastructure; Merritt B. Fox, Lawrence R. Glosten & Gabriel V. Rauterberg, *The New Stock Market: Sense and Nonsense*, 65 DUKE L.J. 191, 276 (2015), which examines the “complete[] transform[ation]” of stock market infrastructure in light of “the information-technology revolution”; and Mark J. Roe, *Clearinghouse Overconfidence*, 101 CALIF. L. REV. 1641 (2013), which evaluates reform efforts regarding derivatives market infrastructure. For examination of the technological aspects of securities regulatory concerns outside the context of network infrastructure, see Jill E. Fisch, *Standing Voting Instructions: Empowering the Excluded Retail Investor*, 102 MINN. L. REV. 11 (2017), which examines the interaction of technology and regulation in addressing corporate voting deficiencies; Marcel Kahan & Edward Rock, *The Hanging Chads of Corporate Voting*, 96 GEO. L.J. 1227 (2008), which examines the prospects for reform of corporate voting institutions and their technological infrastructure; and George S. Geis, *Traceable Shares and Corporate Law*, 113 NW. U. L. REV. 227 (2018).

regulators that Congress has directly tasked with oversight of market infrastructure: the SEC, Fed, and Commodity Futures Trading Commission (CFTC).¹⁴ We know a great deal about why and how these agencies use many tools in their toolkits, from supervision to capital regulation.¹⁵ This Article aims to develop a similarly detailed sense of why and how regulators lead efforts to reengineer the markets' transactional systems. What can regulators hope to achieve by altering the underlying "rails,"¹⁶ "platforms,"¹⁷ and "plumbing"¹⁸ of the financial markets? How should they go about doing so? Are there pitfalls they should avoid? In addressing these questions, the Article highlights how financial regulators engage with system transformation and technological change well outside the "pace-keeping" paradigm.¹⁹

The Article's first claim is that reengineering efforts enable financial technocrats to impose a distinctive form of control over financial activity—one that legal theorists have, in other contexts, conceptualized as "architectural regulation."²⁰ Architectural regulation refers to the way that things like speed bumps, door locks, website designs, and other durable "structures of social life" regulate behavior.²¹ Scholars

14. See 12 U.S.C. § 5464 (placing primary responsibility for oversight of systemically important financial market infrastructure institutions in the hands of the SEC, CFTC, and Fed).

15. See, e.g., BARR ET AL., *supra* note 1, at 259–332 (discussing capital regulation and supervision).

16. *Id.* at 796 (describing payment systems as "rails").

17. Chris Brummer & Yesha Yadav, *Fintech and the Innovation Trilemma*, 107 GEO. L.J. 235, 257 (2019) (describing derivatives trading venues as "platforms").

18. Henry T.C. Hu, *Too Complex To Depict? Innovation, "Pure Information," and the SEC Disclosure Paradigm*, 90 TEX. L. REV. 1601, 1703 (2012) (describing stock-market infrastructure as "plumbing").

19. Cf. Cary Coglianese, *Regulatory Vigilance in a Changing World*, REGUL. REV. (Feb. 25, 2019), <https://www.theregreview.org/2019/02/25/coglianese-innovation-regulatory-vigilance> [<https://perma.cc/P3ZY-SXZE>] (discussing the pace-keeping problem across the administrative state); Gary E. Marchant, *Addressing the Pacing Problem*, in THE GROWING GAP BETWEEN EMERGING TECHNOLOGIES AND LEGAL-ETHICAL OVERSIGHT 199 (Gary E. Marchant, Braden R. Allenby & Joseph R. Herkert eds., 2011) (same).

20. See, e.g., Sarah Schindler, *Architectural Exclusion: Discrimination and Segregation Through Physical Design of the Built Environment*, 124 YALE L.J. 1934, 1942–49 (2015) (reviewing literature on architectural regulation); Lawrence Lessig, *The New Chicago School*, 27 J. LEGAL STUD. 661 (1998) (first introducing the concept to legal literature); Langdon Winner, *Do Artifacts Have Politics?*, 109 DAEDALUS 121 (1980) (exemplifying groundwork outside of legal theory).

21. Lessig, *supra* note 20, at 665–66; see also Kate Klonick, *The New Governors: The People, Rules, and Processes Governing Online Speech*, 131 HARV. L. REV. 1598, 1616–18 (2018) (discussing the role of design in structuring the free speech situation on the Internet); Edward K. Cheng, *Structural Laws and the Puzzle of Regulating Behavior*, 100

of financial regulation have begun to explore this idea in relation to compliance and risk-management software.²² I build on this literature by arguing that the devices, operating protocols, and technical standards constituting financial market infrastructure exert a similar governing force—for instance, by making certain activities more or less difficult to undertake, or more or less visible to regulatory authorities.²³ Past and present efforts to reengineer market systems alike aim at leveraging the power of these key technologies.

To shed light on this practice, the Article begins by exploring three case studies. The first highlights the way a late-1960s change to the infrastructure of the securities markets helped prevent securities theft.²⁴ The second looks at the creation of CLS Bank, a payment system that currently transmits over a trillion dollars each day and that is named for its “continuous linked settlement” operating protocol.²⁵ CLS Bank is famous among lawyers for raising knotty questions of software patentability;²⁶ here it illustrates how financial market infrastructure can be designed to prevent undesirable risk-taking.²⁷ And the third case looks at an episode of data standardization in the credit

Nw. U. L. REV. 655, 689–91, 704 n.289 (2006) (discussing architectural barriers to speeding and trespassing).

22. See, e.g., Charles K. Whitehead, *Destructive Coordination*, 96 CORNELL L. REV. 323, 356–57 (2011) (arguing that software systems exert control over investor behavior); Kenneth A. Bamberger, *Technologies of Compliance: Risk and Regulation in a Digital Age*, 88 TEX. L. REV. 669 (2010) (exploring how compliance software intentionally and unintentionally structures corporate risk-taking); 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 (2009) (arguing that proprietary risk modeling software imposed architectural control on financial institution decision-making in the lead-up to the Global Financial Crisis); cf. James Grimmelmann, Note, *Regulation by Software*, 114 YALE L.J. 1719, 1722–23 (2005) (arguing that what Lessig calls “architecture” functions so differently in different sociotechnical contexts that it ought to be disaggregated).

23. See *infra* Part II.

24. See *infra* Part II.B.1. This effort also famously sped up the securities market’s back-office processes. Cf. Wyatt Wells, *Certificates and Computers: The Remaking of Wall Street, 1967 to 1971*, 74 BUS. HIST. REV. 193 (2000). However, I will focus on its impact on securities theft.

25. See *CLS FX Trading Activity January 2020*, CLS GRP., <https://www.cls-group.com/news/cls-fx-trading-activity-january-2020> [<https://perma.cc/WDU4-W7FV>] (“In January 2020, t]he average daily traded volume submitted to CLS was USD1.77 trillion.”).

26. See *Alice Corp. Pty. Ltd. v. CLS Bank Int’l*, 573 U.S. 208 (2014). See generally Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 U.C. IRVINE L. REV. 1115 (2015) (discussing the case’s role in delineating the outer bounds of patentability).

27. See *infra* Part II.B.2.

derivatives market that was a rare bright spot in the lead-up to the Global Financial Crisis.²⁸ Taken together, these cases show how past regulators have relied on changes to technical aspects of market infrastructure to fulfill statutory mandates from investor protection to crisis prevention.

After presenting these three examples, the Article then analyzes them to develop a sense of the comparative advantages and disadvantages of reengineering in different contexts.²⁹ When is the practice most likely to be valuable? How should regulators go about working with, and motivating, the private sector to participate in these efforts? What kinds of tradeoffs are regulators likely to face when considering reengineering efforts? Through analysis of both substantive and procedural aspects of the practice, I sketch out answers to those questions. First, I highlight the ability of infrastructural reengineering to reduce the variable costs of regulation, remove discretion from regulatory domains, and entrench governance decisions in the design of market technology.³⁰ Second, I discuss the conditions under which regulators should seek to coordinate industry actors in reengineering efforts and the conditions under which regulators should opt for coercive tactics.³¹ Finally, I consider potential systemic consequences, including the possibility that regulators deepen the problem of risk-centralization through their reengineering efforts.³²

With that framework in mind, the Article then identifies and evaluates opportunities for infrastructural reengineering efforts today.³³ In particular, the Article examines how the SEC can reduce the systemic risk posed by a major infrastructural institution in the securities market;³⁴ how the SEC should proceed on the CAT;³⁵ and how the Fed, SEC, and CFTC can work together to enhance the range and quality of market data that inform their crisis-prevention activities.³⁶ To seize these opportunities, regulators would be wise to draw from past episodes of infrastructural reengineering to inform the work of the present day.

28. *See infra* Part II.B.3.

29. *See infra* Part III.

30. *See infra* Part III.A.

31. *See infra* Part III.B.

32. *See infra* Part III.C.

33. *See infra* Part IV.

34. *See infra* Part IV.A.1.

35. *See infra* Part IV.A.2.

36. *See infra* Part IV.A.3.

Taken as a whole, the Article's account supplements prevailing paradigms about who leads efforts to integrate new technologies into the financial sector. The predominant mode of scholarship casts private actors as potentially creative (and unruly) innovators and financial regulators as under-resourced (and often hapless) technocrats who must deal with what the innovators have wrought.³⁷ This frame captures some of our present reality, but it lacks a place for the regulator-led practice of infrastructural reengineering. By shining a light on the ways that the Fed, SEC, and CFTC affirmatively reshape financial market infrastructure, the Article joins a burgeoning body of scholarship examining how the financial regulatory state is not just a follower but also a leader in the process of updating financial technology.³⁸

The Article also contributes to scholarly understandings of the financial sector's increasingly blurry public-private divide.³⁹ The task

37. Cf., e.g., FORD, *supra* note 1, at 153–55 (describing the private financial industry in response to the question, “Who Is Innovating?,” and calling for a new framework for engagement with financial innovation); Henry T.C. Hu, *Swaps, the Modern Process of Financial Innovation and the Vulnerability of a Regulatory Paradigm*, 138 U. PA. L. REV. 333, 340 (1989) (describing the innovation process that takes place among financial firms, with help from their lawyers).

38. One vein of this literature examines the involvement of financial regulators in the design and promotion of compliance software, risk models, and data-analysis software. See, e.g., Hilary J. Allen, *Driverless Finance*, 10 HARV. BUS. L. REV. 157 (2020); Hilary J. Allen, *Experimental Strategies for Regulating Fintech*, 3 J.L. & INNOVATION 1 (2020); James Fanto, *Dashboard Compliance: Benefit, Threat, or Both?*, 11 BROOK. J. CORP. FIN. & COM. L. 1 (2016); Onnig H. Dombalagian, *Preserving Human Agency in Automated Compliance*, 11 BROOK. J. CORP. FIN. & COM. L. 71 (2016); James A. Fanto, *The Vanishing Supervisor*, 41 J. CORP. L. 117 (2015); Bamberger, *supra* note 22; Gerding, *supra* note 22. Another examines the possibilities for public innovation in the payment and banking systems. See, e.g., Morgan Ricks, John Crawford & Lev Menand, *FedAccounts: Digital Dollars*, 89 GEO. WASH. L. REV. 113 (2021); Robert Hockett, *Digital Greenbacks: A Sequenced ‘TreasuryDirect’ and ‘FedWallet’ Plan for the Democratic Digital Dollar* (May 18, 2020) (unpublished manuscript), <https://ssrn.com/abstract=3599419>; Conti-Brown & Wishnick, *supra* note 7. See also sources cited *supra* note 13 for discussions of the roles of financial regulators in guiding the development of individual market infrastructure institutions. A third line of inquiry expands the lens to develop a financial-regulatory ethos that is proactive across the board. See Saule T. Omarova, *Technology v. Technocracy: Fintech as a Regulatory Challenge*, 6 J. FIN. REGUL. 75 (2020).

39. See, e.g., K. Sabeel Rahman, *The New Utilities: Private Power, Social Infrastructure, and the Revival of the Public Utility Concept*, 39 CARDOZO L. REV. 1621, 1657–68 (2018); Morgan Ricks, *Money as Infrastructure*, 2018 COLUM. BUS. L. REV. 757; Robert C. Hockett & Saule T. Omarova, *The Finance Franchise*, 102 CORNELL L. REV. 1143 (2017); Katharina Pistor, *A Legal Theory of Finance*, 41 J. COMPAR. ECON. 315, 315 (2013) (stating that finance “occup[ies] an essentially hybrid place between state and market”); Steven M. Davidoff & David Zaring, *Regulation by Deal: The Government’s Response to the Financial Crisis*, 61 ADMIN. L. REV. 463 (2009).

of financial regulation is inevitably a “collaborative, cooperative enterprise” operating across that boundary, albeit sometimes a fraught one.⁴⁰ This Article shows the design of financial market infrastructure to be a key product of the collaboration.

The Article proceeds as follows. Part I takes the reader on a quick tour of financial market infrastructure—the systems that are the objects of reengineering efforts. Part II presents three case studies of infrastructural reengineering, illuminating how the practice enables regulators to control financial activity at the level of system design. Part III develops a framework for analyzing where reengineering is likely to be most useful, distilling a set of guiding principles for future reengineering efforts. With those principles in hand, Part IV suggests efforts that regulators should prioritize and reevaluates the government’s role within broader discourse about innovation in the financial markets.

I. A QUICK TOUR OF MARKET INFRASTRUCTURE

To set the stage for the Article’s analysis of the promise and perils of public-private reengineering efforts, this Part provides background on the systems being reengineered. Earlier, I described these systems in metaphorical terms—as the “rails,” “platforms,” and “plumbing” of finance.⁴¹ These metaphors are useful because they point to the essential roles played by market infrastructure. They also hint at the importance of standardization in making market infrastructure work.⁴² But the metaphors can only take us so far. In the field of financial regulation, “infrastructure” is a term of art, and, unlike physical rails or plumbing, some readers may lack an intuitive sense of what the

40. Saule T. Omarova, *Wall Street as Community of Fate: Toward Financial Industry Self-Regulation*, 159 U. PA. L. REV. 411, 427 (2011).

41. See *supra* notes 16–18 and accompanying text.

42. The importance of standardization to financial markets is an old idea. See René Demogue, *Analysis of Fundamental Notions*, in MODERN FRENCH LEGAL PHILOSOPHY § 262, at 471, 471–73 (Ethel Clara Forbes Scott & Joseph P. Chamberlain trans., 1916) (discussing the forces militating in favor of “making transactions rapid” through the use of “simple formalities”—a technique “peculiarly well adapted to a world of the initiated, such as stockbrokers, merchants, or investors”). The treatment of standardized financial systems as a kind of machine, however, is a new one. See Margaret Jane Radin, *Online Standardization and the Integration of Text and Machine*, 70 FORDHAM L. REV. 1125, 1138 (2002) (arguing that “the digital revolution is bringing about a seismic shift in our conceptual landscape, [namely] . . . the breakdown of the distinction between text and technology, or between expression and functionality, or between words and machine”); see also Shaanan Cohny, David Hoffman, Jeremy Sklaroff & David Wishnick, *Coin-Operated Capitalism*, 119 COLUM. L. REV. 591 (2019) (exploring this merger of text and machine through a study of smart contracts).

infrastructural systems of the financial markets do. For that reason, it will be useful to take a quick tour of their operations. Those who already possess knowledge of financial market infrastructure should skip to Part II.

A. TRADING VENUES

Our tour begins with the most prominent infrastructural institutions in the markets—trading venues. These are the sites where market participants enter into contracts to exchange money for other financial assets.⁴³ As the digital age has progressed, trading venues have transmuted from physical marketplaces—iconic locations like the floor of the New York Stock Exchange (NYSE) or the octagonal pits of the Chicago Board of Trade—into online platforms.⁴⁴ Today, the floor of the NYSE mostly serves as a television set for CNBC’s financial news coverage.⁴⁵ Unlike the shouts and gestures of the people who populated the physical trading venues in their heyday, activity in the online venues is barely seen and never heard.⁴⁶ But in all cases, market participants seek to trade where a critical mass of other traders gather and where prices best reflect something like “true” supply and demand.⁴⁷

To transact with each other, traders rely on the legal and technical aspects of platforms like the NYSE. The key legal features are membership rules (who can participate in trading), conduct rules (how participants must behave), and the private enforcement apparatus backing up those rules.⁴⁸ The key technical features are

43. Cf. Jonathan R. Macey & Maureen O’Hara, *From Markets to Venues: Securities Regulation in an Evolving World*, 58 STAN. L. REV. 563, 563–64 (2005) (describing the rise of diverse trading venues in competition with the once-monolithic exchanges).

44. For detailed analysis of this shift, see CAITLIN ZALOOM, *OUT OF THE PITS: TRADERS AND TECHNOLOGY FROM CHICAGO TO LONDON* (2006).

45. See Tom Butts, *CNBC Moves to the Stock Exchange Floor*, TV TECH (Feb. 14, 2012), <https://www.tvtechnology.com/news/cnbc-moves-to-the-stock-exchange-floor> [<https://perma.cc/LE5Y-KWZ6>] (quoting a CNBC executive as saying that “our set designer worked closely with the NYSE staff and architects who are redesigning the floor of the exchange”).

46. See ZALOOM, *supra* note 44, at 148, 157 (describing the din of the trading floor and the silence of electronic trading desks).

47. See, e.g., Macey & O’Hara, *supra* note 43, at 568–69.

48. See Stavros Gadinis & Howell E. Jackson, *Markets as Regulators: A Survey*, 80 S. CAL. L. REV. 1239, 1246–57 (2007); cf. Stuart Banner, *The Origin of the New York Stock Exchange, 1791-1860*, 27 J. LEGAL STUD. 113, 113 (1998) (arguing that “[t]he origin and the early growth of the New York Stock and Exchange Board can be attributed in large part to the brokers’ success in regulating themselves”).

standardized communication protocols that mediate exchange.⁴⁹ In other words, trading platforms, like every infrastructural institution we will see on this tour, comprise private membership and conduct rules, devices, and operating rules that enable parties to transact with each other.⁵⁰ These systems necessarily involve “a combination of human practices and technological materials.”⁵¹ And as we shall see, the technologies and protocols used to mediate transactions govern market participants just as surely as traditional rules and regulations do.⁵²

Though this Article focuses on regulatory leadership of reengineering efforts to harness that governing power, regulators certainly are not the only potential leaders on the scene. Private actors have driven electronification in the stock market, for instance, where a growing set of electronic communications networks and “dark pools” now compete with the NYSE and Nasdaq.⁵³ Private innovation is always ongoing, and it serves as the backdrop to the regulatory efforts explored below.

B. POST-TRADE SYSTEMS

Trading is only the first step in a successful transaction. After parties make a trade, they must perform in accordance with their

49. See, e.g., Macey & O’Hara, *supra* note 43, at 590 (describing the way that “technology . . . determines [the] operational efficiency of trade processing and trading capacity” for any given venue).

50. In the field of commercial law, the idea of transactional “systems” has been used to characterize the structures in question. See LYNN M. LOPUCKI, ELIZABETH WARREN, DANIEL KEATING, RONALD J. MANN & ROBERT M. LAWLESS, *COMMERCIAL TRANSACTIONS: A SYSTEMS APPROACH*, at xxxix, 359 (6th ed. 2016) (describing transactional systems as comprising “not only abstract legal rules, but also people who engage in commercial transactions, contracts that are designed to guide those transactions, and physical tools that facilitate those transactions”). At a higher level of generality, these systems are just a particular kind of institution that relies on what David Grewal has called “network standards.” See DAVID SINGH GREWAL, *NETWORK POWER: THE SOCIAL DYNAMICS OF GLOBALIZATION* 20–22 (2008) (defining a network standard as a “shared norm or practice that enables network members to gain access to one another, facilitating their cooperation”).

51. ZALOOM, *supra* note 44, at xi.

52. Cf. Julie E. Cohen, *Pervasively Distributed Copyright Enforcement*, 95 GEO. L.J. 1, 43 (2006) (highlighting the “inevitab[ility]” of “a form of discipline that incorporates some form of regulation-by-protocol” in our networked information society).

53. See, e.g., Fox et al., *supra* note 13, at 191; Donald C. Langevoort, *Information Technology and the Structure of Securities Regulation*, 98 HARV. L. REV. 747 (1985) (addressing the implications of electronic systems and computer technology on the securities regulatory regime).

contractual promises. Though the post-trade process is entirely “un-glamorous,” the systems that handle it are essential to financial markets.⁵⁴

Post-trade systems may be divided into four categories of functionality: clearing, settlement, payment, and reporting. To keep things simple, this Part walks through each function as it plays out in the stock market. The basic concepts are similar, if not exactly the same, in other markets.⁵⁵

Clearing. After trades are made, they are cleared. Clearing refers to the process through which traders’ obligations to each other are verified and computed.⁵⁶ For instance, imagine that Dealer *A* sells Apple stock to Broker *B* through a Nasdaq trading venue. After the trade is made, Nasdaq will report the trade in a standardized data format to an institution called the National Securities Clearing Corporation (NSCC).⁵⁷ The NSCC clears nearly every trade that takes place in the public stock market.⁵⁸ First, the NSCC vets and validates the trade information it receives. Then, in a legal act called “novation,” it places itself between sellers and buyers.⁵⁹ In our Apple example, Dealer *A* would owe stock to the NSCC, and Broker *B* would owe cash. The NSCC would, in turn, owe cash to Dealer *A* and stock to Broker *B*. This function earns the NSCC the moniker of *central counterparty clearing-house*: it becomes “the seller to every buyer and the buyer to every seller.”⁶⁰ The clearinghouse is a conduit every bit as important as the trading venue itself.

54. HAL S. SCOTT & ANNA GELPERN, INTERNATIONAL FINANCE: TRANSACTIONS, POLICY, AND REGULATION 752 (23d ed. 2020).

55. See generally Guido Ferrarini & Paulo Saguato, *Regulating Financial Market Infrastructures*, in THE OXFORD HANDBOOK OF FINANCIAL REGULATION 568 (Niamh Moloney, Eilis Ferran & Jennifer Payne eds., 2015).

56. See COMM. ON PAYMENT & SETTLEMENT SYS., BANK FOR INT’L SETTLEMENTS & TECH. COMM. OF THE INT’L ORG. OF SEC. COMM’NS, PRINCIPLES FOR FINANCIAL MARKET INFRASTRUCTURES 155 (2012) [hereinafter PFMI], <http://www.bis.org/cpmi/publ/d101a.pdf> [<https://perma.cc/3S86-P37F>] (stating that clearance refers to “the computation of the counterparties’ obligations to make deliveries or payments on the settlement date” of a trade).

57. See Securities Transaction Settlement Cycle, Exchange Act Release No. 80,295, 116 SEC Docket 1570, 1575 (Mar. 22, 2017) [hereinafter T+2 Settlement Cycle Adopting Release] (describing the NSCC’s role in “accept[ing] trades . . . for clearing from exchanges and other trading venues”).

58. See *id.* at 1607.

59. See *id.* at 1575.

60. See RUBEN LEE, RUNNING THE WORLD’S MARKETS: THE GOVERNANCE OF FINANCIAL INFRASTRUCTURE 22 (2011). This insulates Dealer *A* and Broker *B* from the risk of each other’s defaults—but not, of course, from the risk that NSCC itself defaults.

Settlement. After a trade is cleared, it is settled. Settlement refers to the process by which securities, commodities, or money are ultimately transferred.⁶¹ In the securities markets, settlement used to involve handing over gilt-edged securities certificates.⁶² But no longer. Today, nearly all corporate securities certificates are held on the shelves of an institution called the Depository Trust Company (DTC).⁶³ The DTC is a large safekeeping and bookkeeping operation for the securities markets.⁶⁴ To settle securities trades, the NSCC computes them and then instructs the DTC to update its books regarding who owns an entitlement to the securities in the storehouse.⁶⁵ These updates are conducted after periodic netting of transactions: if Dealer *A* both buys and sells Apple stock throughout the day, it will only owe (or be owed) a single net amount.⁶⁶

Payment. Finally, in exchange for the securities transfers made on the books of the DTC, securities market participants must make payment to the NSCC, and the NSCC must make payments to participants.⁶⁷ These are not made by sending a courier across town with a pile of greenbacks or a paper check, though they used to be.⁶⁸ Instead, at the end of each day, after netting of monetary obligations, each market participant (Dealer *A*, Broker *B*, and so on) makes or receives a single payment to or from the NSCC.⁶⁹

Reporting. The final category of the post-trade system records and distributes data about market activity. The CAT project described

61. See PFMIS, *supra* note 56, at 155 (“Settlement of a trade involves the final transfer of . . . securities . . . to the buyer (delivery) and the final transfer of funds . . . to the seller (payment).”).

62. See JAMES STEVEN ROGERS, THE END OF NEGOTIABLE INSTRUMENTS: BRINGING PAYMENT SYSTEMS LAW OUT OF THE PAST 49–53 (2012).

63. See, e.g., Geis, *supra* note 13, at 229.

64. See Mooney, *supra* note 8, at 136–38.

65. See NAT’L SEC. CLEARING CORP., RULES & PROCEDURES 76–77 (2020), http://www.dtcc.com/~media/Files/Downloads/legal/rules/nsccl_rules.pdf [<https://perma.cc/F9M3-VY5E>].

66. *The Continuous Net Settlement System*, DTCC, <https://www.dtcc.com/clearing-services/equities-clearing-services/cns> [<https://perma.cc/ZGK3-PJAY>] (stating that the NSCC’s Continuous Net Settlement system “settles trades from the nation’s major exchanges, markets and other sources and nets these transactions to one security position per Member per day”).

67. See generally NAT’L SEC. CLEARING CORP., *supra* note 65.

68. See Conti-Brown & Wishnick, *supra* note 7, at 390.

69. This is done over the Federal Reserve’s large-value payment system, Fedwire. See NAT’L SEC. CLEARING CORP., *supra* note 65, at 190, 274–75. For background on Fedwire, see Conti-Brown & Wishnick, *supra* note 7, at 401.

in the Introduction is one prominent example.⁷⁰ Efforts to create similar reporting systems have proceeded across the financial markets in recent years, and enthusiasm is on the rise.⁷¹ These systems are valuable not only because they keep market participants informed of crucial information about market conditions, but also because they help regulators detect and respond to problematic conduct.⁷²

Post-trade processes may not be as exciting as the trading activity depicted in popular culture as the core of financial markets, but they are every bit as essential. The financial default or operational breakdown of any one of the major post-trade systems in the financial markets would spell disaster for the financial system as a whole.⁷³ Under the Dodd-Frank Act of 2010, federal regulators have declared eight of them to be “too big to fail” and are working to ensure that they remain resilient.⁷⁴

How do regulators go about that work? Much of it happens through well-studied methods like corporate governance mandates and regulatory monitoring.⁷⁵ But regulators can also change the post-trade process and its underlying technologies at the level of design. The next Part offers detail on such efforts.

II. REGULATING BY REENGINEERING INFRASTRUCTURE

What can regulators achieve by reengineering financial market infrastructure? One obvious set of goals falls under the umbrella of efficiency.⁷⁶ Indeed, efficiency has long been an objective of

70. See *supra* notes 2–5 and accompanying text; discussion *infra* Part II.B.1.

71. Much of this enthusiasm relates to the goal of crisis prevention. See *infra* Parts II.B.3, IV.A.3.

72. See Ferrarini & Saguato, *supra* note 55, at 583 (explaining that reporting systems “make the relevant market more transparent, providing regulators with information on relevant transactions, and market participants with aggregated data on concluded deals”).

73. See, e.g., Colleen Baker, *The Federal Reserve as Last Resort*, 46 U. MICH. J.L. REFORM 69, 75–76 (2012) (describing the “financial Armageddon” that would ensue).

74. See Press Release, U.S. Dep’t of the Treasury, Financial Stability Oversight Council Makes First Designations in Effort To Protect Against Future Financial Crises (July 18, 2012), <http://www.treasury.gov/press-center/press-releases/Pages/tg1645.aspx> [<https://perma.cc/SCR6-9XFZ>].

75. See Dan Ryan, *Financial Market Utilities: Is the System Safer?*, HARV. L. SCH. F. ON CORP. GOVERNANCE (Feb. 21, 2015), <https://corpgov.law.harvard.edu/2015/02/21/financial-market-utilities-is-the-system-safer> [<https://perma.cc/U86E-DBA3>] (describing some of these methods).

76. Under the efficiency umbrella, one goal is Coasean transaction-cost reduction. Cf. Adam J. Levitin, *Priceless? The Economic Costs of Credit Card Merchant Restraints*, 55 UCLA L. REV. 1321, 1324 (2008) (calling payment costs “the ultimate transaction cost”).

infrastructure design.⁷⁷ But this Article's focus is different. It concerns not how infrastructure design can make financial markets more efficient, but rather how it can support efforts to regulate harmful and risky financial activities.

A. THE ARCHITECTURE OF TRANSACTIONAL PLATFORMS

The relationship between financial market infrastructure design and the regulation of undesirable financial activities is perhaps not obvious. Most thought on how to regulate market activity centers on human actors: the rule-writers, supervisors, compliance officers, norms-entrepreneurs, and gatekeepers who govern the financial sector through their actions.⁷⁸ But sometimes, regulation does not rely only on supervisors and gatekeepers: it relies on cameras and gates. I argue that the design of financial market infrastructure exerts a governing force on market behavior akin to a set of cameras and gates. This force makes reengineering a valuable tool in the financial regulation toolkit.

To elucidate the regulatory role played by infrastructure design, it is useful to draw on work in legal theory dealing with what Lawrence Lessig has characterized as society's "architecture"—the durable environments within which action takes shape.⁷⁹ The animating insight of this work holds that society's architecture governs behavior alongside other, better-studied forces and therefore deserves to be taken seriously as a kind of clandestine regulator.⁸⁰ The particular methods through which architecture governs behavior are quite different from its peers. While law classically works through conduct rules backed by state violence, norms work through social sanction, and markets work through prices, architecture governs by "creat[ing] the parameters of action" in the first place.⁸¹ Seeing how it operates alongside those other regulatory forces reveals its surprising power.

Another is market efficiency, defined as the ability of a market to "incorporate [material information] into the price[]" of financial assets "without delay." Burton G. Malkiel, *The Efficient Market Hypothesis and Its Critics*, 17 J. ECON. PERSPS. 59, 59 (2003).

77. See, e.g., Regulation NMS, 70 Fed. Reg. 37,496, 37,497 (June 29, 2005) (discussing efficiency justifications for changes to securities market infrastructure); Jill M. Considine, *Designing and Building a New Securities Landscape: Customers as Architects*, 22 ANN. REV. BANKING & FIN. L. 423, 428 (2003) (describing efficiency as a motivation for the formation of the DTC and NSCC). For a theoretical account of pervasive blocks to efficiency in the evolution of market infrastructure, see Kathryn Judge, *Intermediary Influence*, 82 U. CHI. L. REV. 573 (2015).

78. See generally BARR ET AL., *supra* note 1 (providing a survey of the field).

79. Lessig, *supra* note 20, at 665–66.

80. See generally Lessig, *supra* note 20.

81. Amy Kapczynski, *The Law of Informational Capitalism*, 129 YALE L.J. 1460, 1471 (2020); see also Lessig, *supra* note 20, at 665–66.

To fix the conceptual differences between the forces, consider how each of them governed market participants in the trading pits at the Chicago Board of Trade circa the turn of the millennium. Participants' entry to the pits was governed by market forces (the price of a seat) and law (membership rules).⁸² Once inside, their behavior was governed by more law (conduct rules)⁸³ and by norms (reciprocity, retaliation).⁸⁴ Crucially for our purposes, it was also governed by multiple types of Lessigian architecture. Straightforwardly, the octagonal, bowl-shaped design of the pit created a kind of panopticon for traders.⁸⁵ This design made most on-site actions visible to market participants and regulators alike and thereby disciplined traders' behavior.⁸⁶ Less straightforwardly, the protocols used to communicate and memorialize deals also constituted a kind of Lessigian architecture. These included an open-outcry method of establishing trades and carbon-copy memorialization cards to be processed by legions of clerks.⁸⁷ Each of these elements affected the trading environment, determining who could deal with whom easily, how quickly trades could be made, what information was reliable or less reliable, and who saw what. In the words of Caitlin Zaloom, those elements combined to "define the actions that [could] happen" at the Chicago Board of Trade and also "define[d] the actions that . . . *must* happen there to produce successful deals."⁸⁸ They regulated action by constituting the very environment in which it could be conducted.

To describe a physical trading pit circa 1999 is, of course, to imply that market technology can be reengineered. By now, physical buildings and paper transactional systems have been near-completely replaced by cyberspace architecture—what Lessig called "West Coast code."⁸⁹ Private interests often drove that reengineering process. But in the cases that follow, public regulators played leading roles.

82. See CME GRP., CBOT RULEBOOK §§ 100–195, <https://www.cmegroup.com/rulebook/CBOT>.

83. See *id.* §§ 500–590.

84. See ZALOOM, *supra* note 44, at 99–100.

85. See DONALD MACKENZIE, AN ENGINE, NOT A CAMERA: HOW FINANCIAL MODELS SHAPE MARKETS 15 (2006).

86. See *id.*; cf. BERNARD E. HARCOURT, THE ILLUSION OF FREE MARKETS: PUNISHMENT AND THE MYTH OF NATURAL ORDER 1–33, 180 (2011) (characterizing the Chicago Board of Trade as a "disciplinary mechanism" and reflecting on the role of market surveillance in creating the conditions for disciplined behavior).

87. See MACKENZIE, *supra* note 85, at 58, 61.

88. ZALOOM, *supra* note 44, at 26.

89. LAWRENCE LESSIG, CODE: VERSION 2.0, at 72 (2006).

B. THREE EXAMPLES

1. The DTC: Structural Constraints on Securities Theft

Law and regulation prohibit many forms of market misconduct, from price manipulation to insider trading.⁹⁰ Usually, these prohibited acts are deterred by public enforcement and quelled by corporate compliance efforts.⁹¹ But sometimes, the design of financial market infrastructure can also prevent them. To illustrate this possibility—and to introduce the role of regulators in affirmatively pursuing it—this Part considers a multi-decade SEC effort to constrain brokers and clerks from stealing customers’ securities.

When the SEC was formed in 1934, and for more than three decades thereafter, Wall Street operated a “paper-based system of securities transfers.”⁹² Because the possession of paper certificates was evidence of securities ownership, these certificates had to be physically transferred, “pass[ing] from seller to buyer like the deed to a house or title to a car.”⁹³ This system made it surprisingly easy for brokers and clerks to misappropriate customers’ securities.

The problem first came into public view in 1938 with a “shocking” Wall Street scandal.⁹⁴ In this scandal, a former president of the NYSE named Richard Whitney was caught using his customers’ securities to serve as collateral for his own loans.⁹⁵ He was able to commit this act—a felony, for which he went to prison—because of his near-unilateral control over customers’ certificates.⁹⁶

90. See 15 U.S.C. §§ 78i–78j (prohibiting various forms of securities manipulation).

91. See, e.g., JOHN C. COFFEE, JR., HILLARY A. SALE & CHARLES K. WHITEHEAD, *SECURITIES REGULATION: CASES AND MATERIALS* 1187–288 (14th ed. 2021).

92. James Steven Rogers, *Policy Perspectives on Revised U.C.C. Article 8*, 43 *UCLA L. REV.* 1431, 1447 (1996).

93. Geis, *supra* note 13, at 232; see also Charles W. Mooney, Jr., *Beyond Negotiability: A New Model for Transfer and Pledge of Interests in Securities Controlled by Intermediaries*, 12 *CARDOZO L. REV.* 305, 307 (1990) (describing the ways in which the commercial-law regime applicable to securities at the time was “cut from the familiar fabric of property law”).

94. MALCOLM MACKAY, *IMPECCABLE CONNECTIONS: THE RISE AND FALL OF RICHARD WHITNEY* 11 (2011); see also *id.* (quoting the society column of the *New York Daily News* as stating, “Not in our time, in our father’s time, nor in our grandfather’s time has there been such a social debacle”).

95. See Karen Patton Seymour, *Securities and Financial Regulation in the Second Circuit*, 85 *FORDHAM L. REV.* 225, 228 (2016).

96. See Michael Beschloss, *From White Knight to Thief*, *N.Y. TIMES* (Sept. 13, 2014), <https://www.nytimes.com/2014/09/14/upshot/from-white-knight-to-thief.html> [<https://perma.cc/F9RG-A7MF>] (describing Whitney’s criminal sentence); *infra* notes

In response to the Whitney scandal, then-SEC Chairman William O. Douglas proposed a comprehensive reengineering of Wall Street's system for securities clearing and settlement.⁹⁷ His plan called for the development of a "brokers' trust company," which would centralize all settlement activities.⁹⁸ The institution Douglas envisioned looked, in many ways, like the modern-day DTC, described above in Part I.B. Though Douglas simultaneously pushed for legalistic reforms to curb abuses—heightened oversight responsibilities for the NYSE, increased enforcement efforts by the SEC⁹⁹—it was the infrastructural proposal that Douglas most favored. His SEC argued that the physical separation of brokers from customers' securities would "obviate the need" for much regulation¹⁰⁰ because, as he put it, the very structure of the system would "reduc[e] or eliminat[e]" the risk of Whitney-style theft.¹⁰¹ Douglas's SEC pushed hard for industry adoption of the proposal, but the effort went dormant once Douglas was appointed to the Supreme Court.¹⁰²

97, 113–17 and accompanying text (describing the importance of the paper certificate to securities theft).

97. See JOEL SELIGMAN, *THE TRANSFORMATION OF WALL STREET: A HISTORY OF THE SECURITIES AND EXCHANGE COMMISSION AND MODERN CORPORATE FINANCE* 176–77 (3d ed. 2003).

98. *Id.* Indeed, the central institution Douglas proposed went even further; in his sketch, it would control all "receipts and deliveries of securities, receipts and payments of cash, the obtaining of credit for security purchases, [and] clearing of securities." *Id.* at 177 (internal quotation marks omitted). This idea had technical and institutional components. At the technical level, the trust institution would enact a physical separation between brokers and their customers' assets and rely on book-entry registration procedures. See SEC, *DRAFT REPORT ON NEW YORK STOCK EXCHANGE REGULATION FOLLOWING THE FAILURE OF RICHARD WHITNEY & Co. 14* (1938), http://www.sechistorical.org/collection/papers/1930/1938_0921_SECWhitneyT.pdf [<https://perma.cc/7CA7-9M9Q>] (describing how the trust idea would undermine "the freedom with which customers' money and securities can be used by the broker for his own purposes" by separating the broker from them entirely). At the institutional level, the trust would be structured to ensure dutiful care of those assets and would also simplify the transactional and bookkeeping activities involved in clearing and settling trades. See 1 SEC, *IN THE MATTER OF RICHARD WHITNEY ET AL., REPORT ON INVESTIGATION* 172 (1938) [hereinafter SEC WHITNEY REPORT VOL. 1] (describing reductions of transaction-cost "overhead," costs of resolving broker-dealer bankruptcies, and the "safeguards" attendant to the trust as an entity form).

99. See SELIGMAN, *supra* note 97, at 163–72 (describing proposed reforms to NYSE rules and public regulations).

100. SEC WHITNEY REPORT VOL. 1, *supra* note 98.

101. William O. Douglas, Chairman, SEC, Address at the Dinner of the Association of Stock Exchange Firms 6 (May 20, 1938), <https://www.sec.gov/news/speech/1938/052038douglas.pdf> [<https://perma.cc/D9CX-ZMKG>].

102. See Norman S. Poser, *Why the SEC Failed: Regulators Against Regulation*, 3 BROOK. J. CORP. FIN. & COM. L. 289, 291–92 (2009).

The SEC returned to Douglas's idea for a centralized trust institution in the 1960s, most famously to cut the transaction costs associated with rising trading volumes, but also in part because it could help curb securities theft at the level of architecture.

Securities theft had become an increasing problem in the late 1960s because of an episode known as the "Paperwork Crisis."¹⁰³ Trading volumes were swiftly rising on the stock market; so much stock was being traded that the paper-transfer system simply broke down.¹⁰⁴ Brokers' back-office operations could not "locate, process, and move certificates fast enough" to keep up with the pace of trading.¹⁰⁵ The NYSE began closing on Wednesdays to focus on paperwork,¹⁰⁶ but even this stopgap was not enough. Brokerage firms increasingly failed to honor their settlement commitments to each other.¹⁰⁷ As the paper piled up, accounting discrepancies and outright thefts of certificates mounted.¹⁰⁸ In particular, organized crime operations began exploiting the "chaos" of the Paperwork Crisis "to dip into the securities till."¹⁰⁹ All told, securities worth over \$400 million were stolen in 1969 and 1970 alone.¹¹⁰ Due to all this, many brokerage firms were nearing or falling into insolvency, and something had to give.¹¹¹

What gave was the old, paper-based settlement system. In its place, the SEC prodded Wall Street's leading firms to develop the DTC. Later, this Article will discuss the tactics that the SEC used to lead the reengineering effort.¹¹² But for now, it is important to focus on what the SEC aimed to achieve. In addition to speeding up the settlement process (something again on the table today), the effort aimed to make securities heists much more difficult to carry out.¹¹³

103. See generally Wells, *supra* note 24 (describing the Paperwork Crisis).

104. See *id.* at 200-07.

105. *Id.* at 203.

106. See *id.* at 204, 207-08.

107. See *id.*

108. See *id.* at 206; Richard E. Rustin, *Securities-Theft Flurry Prompts Insurers To Mull Halting Coverage on Such Losses*, WALL ST. J., Nov. 17, 1969, at 2.

109. Rustin, *supra* note 108.

110. See Geis, *supra* note 13, at 232 (citing congressional testimony of U.S. Attorney General John Mitchell).

111. See Wells, *supra* note 24, at 203-07.

112. See *infra* text accompanying notes 252-57.

113. SEC, STUDY OF UNSAFE AND UNSOUND PRACTICES OF BROKERS AND DEALERS, H.R. DOC. NO. 92-231, at 44-45 (1971). For discussion of today's settlement process, see *infra* Part IV.A.1.

The effort illustrates the value of architectural regulation in the financial sector. It was well-known at the time that organized crime operations were exploiting the paper-based settlement system; as a result, reducing the use of paper certificates could help undermine those preconditions.¹¹⁴ This is exactly what the DTC reengineering effort achieved. As one insider explained to Congress in 1973, the DTC design “reduce[d] the chance for securities theft and counterfeiting operations” in multiple ways.¹¹⁵ First, it “reduce[d] the number of locations in which securities [we]re held,” resulting in “fewer locations to guard and examine.”¹¹⁶ Second, it “reduce[d] the number of securities movements . . . necessary to transact business,” resulting in “fewer shipments of securities to guard and examine.”¹¹⁷ Third, it “reduce[d] the physical size of the inventory that [wa]s necessary to transact securities business,” resulting in “fewer [certificates] . . . to guard and examine.”¹¹⁸ In essence, the DTC’s operational design itself curbed the ability of insiders to steal customers’ securities.

In this way, the DTC functions as what one theorist of architectural regulation, Edward Cheng, has called a “structural constraint.” Structural constraint exists wherever architecture “prevent[s] undesirable activity in the first place by making it more difficult” or impossible to undertake.¹¹⁹ In the realm of the built environment, structural constraints are everywhere. From guardrails that prevent traffic collisions to bank vaults that prevent robberies, physical architecture controls what is possible or impossible, difficult or easy within an environment.¹²⁰ The same is true of the code-defined architecture of cyberspace, which enables and disables various forms of online

114. See Matthew G. Yeager, *The Gangster as White Collar Criminal: Organized Crime and Stolen Securities*, 8 ISSUES CRIMINOLOGY 49, 60 (1973).

115. *Organized Crime, Securities: Thefts and Frauds: Hearings Before the Permanent Subcomm. on Investigations of the S. Comm. on Gov’t Operations (Part 4)*, 93d Cong. 555, 556 (1974) (statement of Frank W. Kastner, Senior Vice President, Manufacturers Hanover Trust Co. of New York).

116. *Id.*

117. *Id.*

118. *Id.* at 556–57; see also *id.* at 623 (statement of Donald L. Calvin, Vice President, New York Stock Exchange) (stating that the DTC “reduces both the opportunity for theft and the possibility of loss”).

119. Cheng, *supra* note 21, at 664.

120. Cf. Neal Kumar Katyal, *Architecture as Crime Control*, 111 YALE L.J. 1039, 1067–68 (2002) (discussing bank design). The fact that structural constraint is effective says nothing, of course, of whether a particular constraint ought to be celebrated or condemned. See, e.g., Schindler, *supra* note 20 (showing how urban built environments in the United States are replete with structural constraints that wrongfully segregate and exclude citizens from civic life).

interaction.¹²¹ No matter where one looks, architecture in this broad sense—the durable elements of “the world as [we] find it”—creates the conditions of social possibility and also operates as a form of social control.¹²² Here, it shows up in a system for securities holding and settlement.

2. CLS Bank: Network Architecture and Settlement Risk

Strategic risk-taking is at the very core of financial activity. But not all risk-taking is socially beneficial. In particular, one class of risks—systemic risks—are potentially harmful to public welfare because they threaten to undermine the stability of the financial system.¹²³ To rein them in, financial regulators can use a range of approaches. They might forbid certain firms from participating in certain financial markets, or they might prohibit certain financial products from being bought and sold in the first place.¹²⁴ But as with plainly wrongful securities theft, regulators can also turn to the design of financial market infrastructure.

To show how financial risk-taking can be constrained by infrastructure design, this Part describes the construction of an international payment system, called CLS Bank, and the role of the Federal Reserve in making it happen.

Foreign exchange markets enable participants to trade one currency for another. The rise of today’s high-volume, telecommunication-based foreign exchange market began in the early 1970s.¹²⁵ But, as with the stock market situation described in Part II.B.1, back-office

121. See, e.g., LESSIG, *supra* note 89; Christopher S. Yoo, *Modularity Theory and Internet Regulation*, 2016 U. ILL. L. REV. 1, 47–48 (evaluating how the Internet Protocol suite both favors and disfavors different potential Internet applications).

122. Lessig, *supra* note 20, at 663.

123. See generally Hilary J. Allen, *Putting the “Financial Stability” in Financial Stability Oversight Council*, 76 OHIO ST. L.J. 1087, 1093–112 (2015) (delving into the concept of financial stability and its policy implications); Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193 (2008) (setting out the policy rationale for systemic risk regulation).

124. See, e.g., ARTHUR E. WILMARTH, JR., *TAMING THE MEGABANKS: WHY WE NEED A NEW GLASS-STEAGALL ACT* (2021) (arguing for a renewed separation of commercial banking from investment banking); Eric A. Posner & E. Glen Weyl, *An FDA for Financial Innovation: Applying the Insurable Interest Doctrine to 21st Century Financial Markets*, 107 NW. U. L. REV. 1307 (2013) (arguing for a regulatory preapproval screen for derivatives innovations based on the insurable interest doctrine); Saule T. Omarova, *License To Deal: Mandatory Approval of Complex Financial Products*, 90 WASH. U. L. REV. 63, 68–84 (2012) (arguing for a preapproval regime for complex financial products).

125. See generally Catherine R. Schenk, *Summer in the City: Banking Failures of 1974 and the Development of International Banking Supervision*, 129 ENG. HIST. REV. 1129, 1131–33 (2014) (describing the rise of the foreign exchange market).

settlement practices for foreign exchange were not well-matched to the pace of growth in front-office trading.¹²⁶

The first signs of serious design problems arose when losses by a now-infamous market participant, the high-risk Bankhaus Herstatt of Cologne, West Germany, plunged the bank into insolvency.¹²⁷ When it failed, Herstatt had a huge volume of “open” foreign exchange transactions.¹²⁸ For instance, its U.S. correspondent, Chase Manhattan Bank, had received currency from Herstatt’s counterparties for a day’s worth of trades, but—to the tune of \$3.3 billion in today’s dollar-equivalents—had conservatively refused to make the quid pro quo payments.¹²⁹ Banks exposed to losses from Herstatt’s defaults scrambled to avoid defaulting on their own obligations, and the market as a whole suffered a contraction of short-term credit.¹³⁰ Even once the

126. To clear and settle their foreign exchange transactions in the early 1970s, dealers active in the market would contract with a network of correspondent banks with access to the major wholesale payment systems for each of the currencies they traded. *See* Kurt H. Nadelmann, *Rehabilitating International Bankruptcy Law: Lessons Taught by Herstatt and Company*, 52 N.Y.U. L. REV. 1, 3, 5 n.23 (1977) (describing Herstatt’s local correspondent relationships). In essence, a promise of delivery of dollars on the books of the Federal Reserve would be consideration for a promise of delivery of yen on the books of the Bank of Japan or pounds on the books of the Bank of England. These would be effectuated via payments on each country’s local large-value payment system to the correspondents. *See id.*

127. *See* DAVID ZARING, *THE GLOBALIZED GOVERNANCE OF FINANCE* 4 (2020) (describing the Herstatt bankruptcy as a “systemic failure that rippled through the global economy”); CHRIS BRUMMER, *SOFT LAW AND THE GLOBAL FINANCIAL SYSTEM: RULE MAKING IN THE 21ST CENTURY* 77–79 (2015) (linking the Herstatt episode to the origins of the Basel regime); Emmanuel Mourlon-Druol, *‘Trust Is Good, Control Is Better’: The 1974 Herstatt Bank Crisis and Its Implications for International Regulatory Reform*, 57 J. BUS. HIST. 311, 313 (2015); Joseph D. Becker, *International Insolvency: The Case of Herstatt*, 62 A.B.A. J. 1290, 1291 (1976) (describing Herstatt as “living off its foreign exchange earnings”); Richard Herring, *International Financial Conglomerates: Implications for Bank Insolvency Regimes*, in *MARKET DISCIPLINE IN BANKING: THEORY AND EVIDENCE* 99, 101 (George G. Kaufman ed., 2003) (describing Herstatt as “notorious among market practitioners for . . . taking foreign exchange positions that were very large relative to its capital”).

128. *See* Mourlon-Druol, *supra* note 127, at 316.

129. *See* Schenk, *supra* note 125, at 1139 (stating that Chase “was caught with about \$620m of transfers due to customers on account of Herstatt”); *CPI Inflation Calculator*, U.S. BUREAU LAB. STAT., https://www.bls.gov/data/inflation_calculator.htm (last visited Apr. 11, 2021) (used to calculate the value of \$620 million June 1974 dollars in terms of February 2021 dollars). For the upshot of one counterparty’s grievances, see *Delbrueck & Co. v. Mfrs. Hanover Tr. Co.*, 609 F.2d 1047 (2d Cir. 1979).

130. *See generally* Richard Herring, *The Challenge of Resolving Cross-Border Financial Institutions*, 31 YALE J. ON REGUL. 853, 863–64 (2014) (“Herstatt also made clear that the impact of the failure of even a small bank can be amplified if it interrupts an important clearing and settlement process. In this case, the dollar/deutsche mark market, at the time the largest foreign exchange market in the world, came to a virtual halt

acute panic subsided, sorting out who owed what to whom was herculean work for the bankruptcy courts, and the confusions surrounding it prompted attempts at reform.¹³¹

But despite international regulatory attention, settlement risk continued to create problems throughout the last quarter of the twentieth century. In 1990, when leading Wall Street investment bank Drexel Burnham Lambert Group filed for bankruptcy, many parties ceased patterns of regular transacting out of fear they would be stuck in essentially the situation of Herstatt's uncompensated counterparties.¹³² And a year later, in 1991, the liquidation of the Luxembourgian Bank of Commerce and Credit International left several its foreign exchange counterparties in the United States, the United Kingdom, and Japan uncompensated in open foreign exchange transactions.¹³³ Regulators, including the Federal Reserve, increasingly searched for new ways to risk-proof the foreign exchange settlement system.

The push gained force in 1996 when an international consortium of regulators called the Committee on Payment and Settlement Systems announced a position that central banks like the Fed should take affirmative measures to "induce private sector progress" in reducing settlement risk.¹³⁴ Some of these measures were traditional, nuts-and-bolts risk regulation. For instance, regulators imposed "tough risk control" rules and standards backed by the threat of legal sanctions.¹³⁵ But they also pushed the leading international participants in the foreign exchange market to build a new payment system that met the regulators' specifications.

The result was a major international success: a technologically advanced system that eliminated Herstatt risk entirely for those who

for more than a month until the authorities and the New York Clearing House could restore confidence.").

131. See generally Schenk, *supra* note 125 (describing the bankruptcy cases and the Herstatt crisis's role in prompting financial regulatory reforms, including the founding of the Basel Committee on Bank Supervision).

132. See Herring, *supra* note 127, at 105–07.

133. See BANK FOR INT'L SETTLEMENTS, SETTLEMENT RISK IN FOREIGN EXCHANGE TRANSACTIONS 7 (1996), <https://www.bis.org/cpmi/publ/d17.pdf> [<https://perma.cc/2K73-2W8X>].

134. See Alexandra Schaller, Continuous Linked Settlement: History and Implications 44, 47–48 (Dec. 5, 2007) (Ph.D. dissertation, University of Zurich), <https://www.zora.uzh.ch/id/eprint/163690/1/20080261.pdf> [<https://perma.cc/96WD-L5LY>].

135. Jeffrey M. Lacker, *The CLS Bank: A Solution to the Risks of International Payments Settlement? A Comment*, 54 CARNEGIE-ROCHESTER CONF. SERIES ON PUB. POL'Y 227, 229 (2001).

use it.¹³⁶ The system is called CLS Bank, for its “continuous linked settlement” technology. It reveals how infrastructure design can obviate certain forms of financial risk-taking.

CLS Bank transforms the previously risky business of foreign exchange settlement into a process where settlement risk has been eliminated. It does so first through a fundamental change to the foreign exchange network topology. Because CLS Bank itself holds accounts at the Fed and sixteen other central banks in countries where its members trade currency, it acts as the central payor and payee for every foreign exchange transaction that its members undertake.¹³⁷ Second, in addition to being central payor and payee, CLS Bank also is designed to render unfunded transactions impossible within its software.¹³⁸ As a result, each transaction is settled on a “payment versus payment” basis.¹³⁹ This design completely eliminates the risk of the one-way delivery that accompanies Herstatt-style transactions.¹⁴⁰

3. The Fourteen Families: Visibility and Counterparty Risk

In addition to imposing structural constraints on undesirable behavior and reorganizing network topology, reengineering efforts can also affect what types of information are visible within firms, horizontally across markets, and vertically by regulators. The major determinants of visibility are not limited to disclosure rules and supervisory powers; they also include the data standards and technologies

136. See CLS GRP., INTRODUCTION TO CLS 4 (2015), <https://www.newyorkfed.org/medialibrary/media/banking/international/14-CLS-2015-Kos-Puth.pdf> [<https://perma.cc/R96E-WYRK>] (stating that CLS Bank was “[c]reated as a result of regulatory concern regarding the potential for FX settlement risk to be a major source of systemic risk”).

137. See David Humphrey, *Payments and Payment Systems*, in THE OXFORD HANDBOOK OF BANKING 423 (Allen N. Berger, Philip Molyneux & John O.S. Wilson eds., 2d ed. 2015) (“CLS is open simultaneously, in all the countries whose currency it trades, for approximately five hours during the day with final settlement through CLS accounts it holds with the central banks of the traded currencies. Member banks each have a multicurrency account with CLS and make payments into these accounts to cover the trades they wish to make. The trades are transacted by simultaneously debiting the account of the bank in the currency being sold, and crediting the account of another bank in the currency being purchased. Trades take place if, and only if, both sides of the trade successfully complete all the requirements of the payment.”).

138. See Charles M. Kahn & William Roberds, *The CLS Bank: A Solution to the Risks of International Payments Settlement?*, 54 CARNEGIE-ROCHESTER CONF. SERIES ON PUB. POL’Y 192, 208 (2001).

139. *Id.* at 197.

140. *Id.*; see also David F. DeRosa, *Sponsored Transactional Patterns: Comments on Mehrling’s Essential Hybridity: A Money View of FX*, 41 J. COMPAR. ECON. 364, 366 (2013) (describing the resulting payments as “better than gold”).

employed to organize and distribute information about market activity in the first place.¹⁴¹ These elements of the financial markets' West Coast code have gained prominence in the wake of the Global Financial Crisis, and they present an important frontier for regulatory leadership in the future.

To understand why, consider an episode involving the credit derivatives markets. While the legal literature contains much engagement with post-Global Financial Crisis mandatory central counterparty clearing,¹⁴² this episode comes from the pre-Crisis era. As students of the Crisis well know, these markets were burgeoning prior to 2008.¹⁴³ But their post-trade systems remained stuck in the 1990s. In a typical pre-Crisis credit default swap transaction,¹⁴⁴ two parties to a trade handled all post-trade processes bilaterally.¹⁴⁵ Until 2005, traders and their clerks still recorded their agreed-upon transactions by hand and faxed them to their counterparties.¹⁴⁶

As the market grew, the back-office state of affairs worsened. For a large set of derivatives trades, parties left those faxed details unconfirmed for months at a time.¹⁴⁷ Parties were left in the dark about the assignment of their trades to third parties.¹⁴⁸ In the event of insolvency of one of the major market participants—and there would be

141. On the role of data standards in financial regulation, see Richard Berner & Kathryn Judge, *The Data Standardization Challenge*, in SYSTEMIC RISK IN THE FINANCIAL SECTOR: TEN YEARS AFTER THE GREAT CRASH 135 (Douglas W. Arner, Emiliios Avgouleas, Danny Busch & Steven L. Schwarcz eds., 2019).

142. See, e.g., Yesha Yadav, *Clearinghouses and the Swaps Market: A Decade On*, in OXFORD RESEARCH ENCYCLOPEDIA OF ECONOMICS AND FINANCE 1 (2019).

143. See, e.g., Anupam Chander & Randall Costa, *Clearing Credit Default Swaps: A Case Study in Global Legal Convergence*, 10 CHI. J. INT'L L. 639, 640 (2010) ("When the credit crisis struck in the fall of 2008, there were \$57 trillion in outstanding notional amount of CDS. In each of the preceding three years, the amount of CDS had nearly doubled. In 2004, positions in CDS stood at \$4.5 trillion." (footnotes omitted)).

144. "In simple terms, a credit default swap is a promise by one party to pay another party in the event that a third party defaults on its debt." Jeremy C. Kress, *Credit Default Swaps, Clearinghouses, and Systemic Risk: Why Centralized Counterparties Must Have Access to Central Bank Liquidity*, 48 HARV. J. ON LEGIS. 49, 52 (2011). The promisor is known as a "protection seller," and the promisee is known as a "protection buyer." *Id.* Over the course of the transaction, the protection buyer makes periodic payments to the protection seller, who bears the risk of owing the buyer a lump payment in the event of third-party default. *Id.*

145. See Chander & Costa, *supra* note 143, at 649–51.

146. See U.S. GOV'T ACCOUNTABILITY OFF., GAO-07-716, CREDIT DERIVATIVES: CONFIRMATION BACKLOGS INCREASED DEALERS' OPERATIONAL RISKS, BUT WERE SUCCESSFULLY ADDRESSED AFTER JOINT REGULATORY ACTION 12 (2007); TIMOTHY F. GEITHNER, STRESS TEST: REFLECTIONS ON FINANCIAL CRISES 102 (2014).

147. See sources cited *supra* note 146.

148. See sources cited *supra* note 146.

one such insolvency during the Crisis, along with many near-insolvencies only avoided by extraordinary governmental intervention¹⁴⁹—the other participants would have had no idea of their exposures.

Regulators at the Federal Reserve Bank of New York (New York Fed) and the SEC engaged in close collaboration with the major market participants, known colloquially as “the Fourteen Families,” to clear the fog.¹⁵⁰ Specifically, the regulators pressured the Fourteen Families to act using the powers of supervisory oversight and moral suasion.¹⁵¹ In response, the Fourteen Families reduced trade-confirmation backlogs, adopted technical standards for computerized trade-tracking, and adopted protocols to ensure awareness of third-party assignments.¹⁵² Through a new platform called Deriv/SERV, they collectively automated many aspects of the information-distribution process.¹⁵³

This reengineering of the derivatives post-trade process proved to be crucial. Had this paper-and-fax system remained in place, the confusion it created would have worsened the eventual crisis.¹⁵⁴ As Tim Geithner, who had been the President of the New York Fed at the time, put it, “In a crisis, nobody would have [had] any idea who owed what to whom, or whether whoever owed it would be able to pay.”¹⁵⁵

149. Of the fourteen major market participants at the time, Lehman Brothers would fail, while Bear Stearns, Credit Suisse, Citigroup, UBS, Merrill Lynch, and Wachovia were only saved by massive support from the Fed and the Swiss National Bank. See U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 146, at 11 n.16 (listing the fourteen dominant credit derivatives dealers); ADAM TOOZE, *CRASHED: HOW A DECADE OF FINANCIAL CRISES CHANGED THE WORLD* 177–78, 181–85, 220–23 (2018) (describing the bankruptcy of Lehman Brothers and the government support that averted the bankruptcies of Bear Stearns, Credit Suisse, Citigroup, Merrill Lynch, and UBS).

150. See GEITHNER, *supra* note 146, at 103. The details of the collaborative process are discussed *infra* Part III.

151. See U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 146.

152. *Id.* at 18–25.

153. See Christopher L. Culp, *OTC-Cleared Derivatives: Benefits, Costs, and Implications of the “Dodd-Frank Wall Street Reform and Consumer Protection Act,”* 20 J. APPLIED FIN., no. 2, 2010, at 103, 109.

154. The basic mechanism of exacerbation would have been opacity about counterparty risk relationships, which would have increased the likelihood of contractions in short-term credit and of asset fire-sales. See Kathryn Judge, *Information Gaps and Shadow Banking*, 103 VA. L. REV. 411, 457 (2017).

155. GEITHNER, *supra* note 146, at 103; see also Frank Partnoy & David A. Skeel, Jr., *The Promise and Perils of Credit Derivatives*, 75 U. CIN. L. REV. 1019, 1036 (2007) (discussing the downsides of market opacity).

The extra knowledge afforded by newly-digitized clearing systems limited the contagion of the failures that eventually did take place.¹⁵⁶

* * *

These three examples are very different—in terms of policy rationale, efficacy, ease of implementation, and more. Yet, together they show how regulators can embed policy goals into the design of market infrastructure. They also suggest the importance of public-private reengineering efforts within the broad set of approaches available to regulate the financial system.

III. EVALUATING THE PRACTICE

As the theoretical discussion and case studies presented in Part II suggest, financial regulators can leverage the design of market technology to achieve a range of policy goals. But that fact alone cannot tell a regulator whether to pursue a reengineering effort in lieu of, or alongside, other techniques of governance. The answer to that question will depend on the comparative advantages and disadvantages of reengineering in a given context. This Part develops a framework for evaluating a reengineering idea's context-specific utility. Part A focuses on efficacy. As a technique, how effective is architectural "governance by infrastructure design"¹⁵⁷ at achieving policy objectives compared with direct conduct regulation or, say, the promotion of behavioral norms? Next, Part B turns to process. How should regulators think about the pros and cons of enlisting the private sector to engage in a reengineering effort? Finally, Part C steps back to consider systemic implications. How are individual reengineering efforts likely to interact with the broader project of financial regulation? Taken together, answers to these questions can shed light on reengineering's proper place in the financial regulatory toolkit.

A. THE EFFICACY OF REGULATING THROUGH DESIGN

When pursuing policy goals, financial regulators often write rules prohibiting harmful conduct, bring enforcement actions penalizing rule-violations, or extol behavioral norms from the bully pulpit. Infrastructural reengineering efforts are different. They aim to change the design elements of standardized financial platforms—elements that

156. See Jeffrey N. Gordon, "Dynamic Precaution" in *Maintaining Financial Stability: The Importance of FSO*, in *AFTER THE CRASH: FINANCIAL CRISES AND REGULATORY RESPONSES* 144 (Sharyn O'Halloran & Thomas Groll eds., 2019).

157. Cf. Deirdre K. Mulligan & Kenneth A. Bamberger, *Saving Governance-by-Design*, 106 CALIF. L. REV. 697, 722–38 (2018) (examining the use of technological design as a form of governance across regulatory domains).

themselves will do the work of controlling behavior or making it susceptible to surveillance.¹⁵⁸ To the extent that rulemaking, enforcement, or moral suasion are involved in reengineering, those tools are used to cajole market participants into altering market infrastructure; it is the infrastructure itself that imposes the desired governance. The qualities associated with this mode of governance render it fit for a range of purposes within the traditional financial regulatory ambit. This Part draws on Part II's cases to describe these qualities and then assesses the tradeoffs they are likely to produce in the context of financial market infrastructure.

1. Infrastructure Design as Mechanical Governance

The most important quality of infrastructure design relates to the way it operates on behavior. Specifically, its modes of control are *mechanical*. In Part II's cases, I highlighted how the design of financial market infrastructure can serve policy goals by imposing structural constraints on behavior or increasing the visibility of market activity.¹⁵⁹ Once installed, these structural constraints and surveillance technologies operate like clockwork, "without further human intervention."¹⁶⁰ They operate on behavior not through ex-post enforcement but rather through ex-ante conditions that apply in an immediate and automatic way to participants in a given financial market.¹⁶¹ They do so because they become fixtures of the very environment within which market activity takes place.

What does mechanical governance look like in the financial sector? The cases presented in Part II help shed light here. Though the process of reengineering infrastructure in each case was of course anything but mechanical,¹⁶² the products now operate in a mechanical way. First, take the way the DTC helps address securities theft. While traditional methods of policing securities theft rely on ex-post prosecution, the central securities depository design delivers ex-ante prevention. The replacement of a decentralized, paper-based settlement process with a centralized process relying on electronic records at the DTC deprives would-be embezzlers of their back-office access to

158. See *supra* note 7 and accompanying text.

159. See *supra* Part II.B.

160. See Grimmelmann, *supra* note 22, at 1723.

161. On the immediacy and automation of architectural regulation generally, see LESSIG, *supra* note 89, at 236-37. On the immediacy of software, in particular, see Grimmelmann, *supra* note 22, at 1729-30.

162. For discussion of the process aspects of reengineering, see *infra* Section III.B.

misappropriate securities certificates.¹⁶³ It is the complex-systems equivalent of a locked vault. Similarly, CLS Bank's design removed the ability of its users to incur Herstatt risk. A cop need not be on the beat to ensure it; the CLS Bank system automates the payment-versus-payment requirement.¹⁶⁴ Participants in CLS Bank could not subvert it if they tried. Finally, consider the changes to the standard data forms and trade-confirmation practices in the credit derivatives markets. These changes rendered information about counterparty risk visible internally, between firms, and to regulators. And they did so not through the imposition of ex-post reporting requirements but rather by changing the technical standards according to which deals are conducted in the first place. In the run-up to the Global Financial Crisis, this had the effect of heightening private-sector and public-sector awareness of the markets' growing risks.¹⁶⁵

The mechanical nature of governance-by-infrastructure-design renders it different from other techniques of regulating financial markets along two key dimensions: its cost structure and its relationship to bureaucratic discretion. Though these differences by no means guarantee that reengineering ought to be employed in any particular case, they do present a number of reasons why regulators may benefit from pursuing it in general.

Reduced Variable Costs. The first consequence of the mechanical nature of governance-by-infrastructure-design is that it likely will reduce the variable costs of achieving particular agency objectives when compared with traditional regulatory techniques. In the case of securities theft, for instance, William O. Douglas saw this in the 1930s. Though the mischief of securities theft can of course be addressed by heightened investigation and enforcement efforts, Douglas advocated the construction of a central securities depository to "obviate the need" for the ongoing costs such efforts would generate.¹⁶⁶ Similarly, when regulators around the world considered the problem of Herstatt-style settlement risk in the foreign exchange markets, they pursued a regime of governance reforms and capital regulations that require ongoing investment and oversight to render effective.¹⁶⁷ CLS Bank represents an effective substitute for this regime as a method of dealing with the particular problem of Herstatt risk. It therefore takes

163. See *supra* Part II.B.1.

164. See *supra* Part II.B.2.

165. See *supra* Part II.B.3.

166. See *supra* note 100 and accompanying text.

167. See, e.g., Michael S. Barr & Geoffrey P. Miller, *Global Administrative Law: The View from Basel*, 17 EUR. J. INT'L L. 15, 16-17 (2006).

one task off the plate of the financial regulatory regime when dealing with systemic risk regulation.

Reduced variable costs are significant, of course, because agencies always select priorities in the shadow of budget constraints.¹⁶⁸ When embedding a given priority into market infrastructure obviates the need for ongoing rulemaking, monitoring, and enforcement related to that priority, it frees up agency resources for other matters. A Fed that worries less about Herstatt risk can devote more resources to dealing with operational risk, for instance. This is not to say such trades are costless. A reengineering effort may create the need for ongoing attention to a new problem—for instance, with CLS Bank or the DTC, the problem of centralized cyber risk.¹⁶⁹ The benefits of solving old problems must be weighed against the costs of creating new ones in any particular case. But just as the purchase of a sturdy bank vault reduces the need for hired guns, reengineering efforts hold out the promise of reducing the ongoing costs of addressing problems in the financial sector.

The Removal of Discretion. A second quality of mechanical governance is that it eliminates human agency and discretion from a given policy space. This is not only a potential source of cost-savings in the budgetary sense; in some cases, it also can increase the reliability of regulation. Most prominently, eliminating discretion can be useful in situations where line personnel might bring in undue bias¹⁷⁰ or might become excessively cozy with the firms they supervise.¹⁷¹ For instance, one reason why it took so long to uncover the scandal of Richard Whitney's securities thefts was that his reputation as the "white knight" of Wall Street rendered him above suspicion.¹⁷² Regulatory

168. See, e.g., Zachary D. Clopton, *Redundant Public-Private Enforcement*, 69 VAND. L. REV. 285, 309 (2014).

169. See, e.g., JASON HEALEY, PATRICIA MOSER, KATHERYN ROSEN & ADRIANA TACHE, BROOKINGS CYBERSECURITY PROJECT, *THE FUTURE OF FINANCIAL STABILITY AND CYBER RISK* 7, 9–10 (2018), https://www.brookings.edu/wp-content/uploads/2018/10/Healey-et-al_Financial-Stability-and-Cyber-Risk.pdf [<https://perma.cc/CXN6-LSUN>]; see also *infra* Part III.C (discussing the systemic tradeoffs of reengineering efforts).

170. See, e.g., Cary Coglianese & David Lehr, *Regulating by Robot: Administrative Decision Making in the Machine Learning Era*, 105 GEO. L.J. 1147 (2017) (examining whether "robotic" decision making tools are constitutional). *But see, e.g.,* Danielle Keats Citron, *Technological Due Process*, 85 WASH. U. L. REV. 1249 (2008) (arguing automated systems jeopardize due process norms).

171. See Peter Conti-Brown, *The Twelve Federal Reserve Banks: Governance and Accountability in the 21st Century* 16–17 (Hutchins Ctr. on Fiscal & Monetary Pol'y at Brookings, Working Paper No. 10, 2015), https://www.brookings.edu/wp-content/uploads/2015/02/fed_banks_21st_century.pdf [<https://perma.cc/S7BV-7L2A>].

172. See Beschloss, *supra* note 96.

discretion allowed him to go relatively unchecked for too long. Similarly, consider the example of CLS Bank. The pre-CLS Bank era was rife with prudential discretion for bank supervisors over Herstatt risk. How seriously should they view the risk? Should they penalize banks that transact with risky counterparties? How severely? With regard to foreign exchange settlement risk, CLS takes these questions off the table. Finally, consider the problem of regulatory access to high-quality data about the financial markets. Such data—essential to the task of financial crisis prevention¹⁷³—might be produced post-hoc, through periodic reporting, or might be produced by a system that is integrated with a given market’s trading operations. Only the latter will automatically deliver timely, useful data as a matter of course, without room for shirking by regulated firms. And the latter is what the Fourteen Families’ derivatives reengineering produced, enabling regulators and firms to obtain at least a partial handle on the risks arising in the credit derivatives markets.¹⁷⁴

Of course, there are also potential downsides to the absence of discretion. A fundamental quality of traditional regulation is that its enforcers may exercise discretion to temper the severity of any given regulatory decree. In the context of the common law, this possibility falls under the rubric of equity; in the context of financial regulation, it is typically thought of as forbearance.¹⁷⁵ Financial regulators exercise discretion against applying legal rules and standards for many reasons—to achieve deregulatory goals, to bargain with regulated entities, or even to mitigate the effects of a crisis. Mechanical governance takes these options off the table. Because it is automatic, no human agent can play the role of “shield[]” between a policy and its unwise application.¹⁷⁶

In practice, financial regulators are likely to be capable of balancing the tradeoffs inherent in removing policy discretion fairly well. Consider, for instance, a recent rulemaking proceeding over the design of the Federal Reserve’s large-value payment system, Fedwire. Each day, Fedwire facilitates payment of over \$4 trillion between the banks and other financial institutions that hold money in accounts at

173. See *infra* Part IV.A.3.

174. See *supra* Part II.B.3.

175. See David Zaring, The Government’s Economic Response to the Coronavirus Crisis 30–34 (July 28, 2020) (unpublished manuscript), <https://ssrn.com/abstract=3662049>.

176. Cohen, *supra* note 52, at 42.

the Federal Reserve.¹⁷⁷ Currently, Fedwire allows those institutions to overdraft on their account balances, leaving the Fed on the hook in the event of default.¹⁷⁸ To reduce its risk, the Fed can monitor account holders' creditworthiness, charge fees, or demand collateral.¹⁷⁹ At first, the Fed proposed to curb overdrafts through limits built into the Fedwire system, making it functionally impossible for institutions to run up their overdraft debts.¹⁸⁰ But the pushback from Fedwire's users was swift: they worried about the automated prohibition on overdrafts leading to gridlock in the interbank payment system.¹⁸¹ In some situations, this gridlock might exacerbate a liquidity crisis.¹⁸² The Fed evidently agreed and has backed away from its governance-by-design proposal.

Taken from a broader perspective, the tradeoff between discretion and automation is likely to be less problematic in financial markets than in other contexts. In the context of cyberspace regulation, a generation of scholars has lamented the costs of automatic governance by code because of its effects on the values of public discourse and free social life.¹⁸³ But rigid regulation in the financial markets has lower stakes because the values involved are instrumental ones. Further, the parties most likely to be affected are not individual citizens whose power is negligible but rather large financial institutions who can push back against excessive rigidity through interest-group action. As a result, the ability of agencies to tame certain forms of line-

177. See *Fedwire Funds Service - Annual Statistics*, FED. RSRV. BANK SERVS., <https://www.frbservices.org/resources/financial-services/wires/volume-value-stats/annual-stats.html> [<https://perma.cc/V8HX-RCBH>].

178. Policy on Payment System Risk and Expanded Real-Time Monitoring, 83 Fed. Reg. 20,074, 20,074 (2018) (“[T]he Reserve Banks could face direct risk of loss should institutions be unable to settle their daylight overdrafts in their Federal Reserve accounts before the end of the day.”).

179. See *id.* For an ethnographic account of hand-wringing at the Bank of Japan regarding daylight overdrafts when it began operating a payment system similar to Fedwire, see Annelise Riles, *Real Time: Unwinding Technocratic and Anthropological Knowledge*, 31 AM. ETHNOLOGIST 392 (2004).

180. See Policy on Payment System Risk and Expanded Real-Time Monitoring, 83 Fed. Reg. at 20,074–76.

181. See Letter from Alaina Gimbert, Senior Vice President & Assoc. Gen. Couns., The Clearing House Payments Co., to Ann E. Misback, Sec’y, Bd. of Governors of the Fed. Rsrv. Sys. (July 6, 2018), https://www.federalreserve.gov/SECRS/2018/July/20180726/OP-1607/OP-1607_070618_132121_420589738959_1.pdf [<https://perma.cc/7N4S-828F>].

182. *Id.* at 2.

183. See, e.g., Mulligan & Bamberger, *supra* note 157, at 701 (arguing that “governance-by-design has taken us down the path towards governance dystopia”).

level discretion through reengineering efforts is likely to be valuable without running amok.

2. The Durability of Infrastructure

A second important quality of design changes to financial market infrastructure is that they are likely to be durable. The infrastructural changes described in Part II, for instance, are between one and five decades old at this point, but they continue to shape the path of market infrastructure development. The DTC now operates as the near-universal standard for securities settlement in the United States;¹⁸⁴ CLS Bank intermediates the lion's share of foreign exchange transactions between the jurisdictions it serves;¹⁸⁵ and the 2005–06 data reforms laid the groundwork for the transformation of the credit derivatives markets post-2008.¹⁸⁶

The durability of these systems can be chalked up to a combination of network effects, organizational embeddedness, and regulatory linkages. Network effects arise because market participants have incentives to use the transactional infrastructure that gives them access to large numbers of other market participants.¹⁸⁷ In the context of trading, larger networks tend to redound to greater market liquidity;¹⁸⁸ in the context of clearing and settlement, they tend to create benefits from transactional netting.¹⁸⁹ While economists debate the conditions under which these incentives contribute to inefficient lock-in, in all cases network effects bind market participants to dominant infrastructure.¹⁹⁰ So, too, does the organizational embeddedness of technical systems. Because technical systems require highly specialized knowledge to operate or participate in, that knowledge often

184. See Tony Porter, *Technical Systems and the Architecture of Transnational Business Governance Interactions*, 8 REGUL. & GOVERNANCE 110, 121 (2014) (characterizing the DTC as holding an “effective monopoly” over corporate securities settlement in the United States).

185. See Morten Linnemann Bech & Henry Holden, *FX Settlement Risk Remains Significant*, BIS Q. REV., Dec. 2019, at 48, 48 graph A.1 (documenting the extent of CLS's market share).

186. See Dan Awrey, *Split Derivatives: Inside the World's Most Misunderstood Contract*, 36 YALE J. ON REGUL. 495, 527–29 (2019) (describing how the reforms facilitated a range of back-office developments in subsequent years).

187. See, e.g., Joseph Farrell & Paul Klemperer, *Coordination and Lock-In: Competition with Switching Costs and Network Effects*, in 3 HANDBOOK OF INDUSTRIAL ORGANIZATION 1967 (2007) (describing the network effects tending to arise from access to markets with larger numbers of participants).

188. See *id.*

189. See LEE, *supra* note 60, at 61.

190. See Farrell & Klemperer, *supra* note 187.

becomes institutionalized within particular organizational roles and departments and routinized into organizational processes.¹⁹¹ Today, entire bank departments owe their existence to the task of processing trades through the DTC, CLS Bank, and their infrastructural peers.¹⁹² Such institutionalization tends to further entrench a given system. Finally, similar linkages between financial market infrastructure design and regulatory regimes tend to add inertia as well. Because regulatory rules often fit particular technical systems, regulators and compliance professionals alike are loath to let dynamism lead to misalignment.¹⁹³

These forces of durability will increase the usefulness of reengineering in situations where they wish to insulate policies against change. When agencies pursue regulatory projects, those efforts are always contingent. As Chris Brummer has highlighted, they can be undermined by a variety of forces, from technological dynamism to shifting market structure.¹⁹⁴ They also face the threat of what J.B. Ruhl and Jim Salzman have called “regulatory exit”—the “intentional, significant reduction” in a regulatory program’s vitality by agency action.¹⁹⁵ Though some exits are planned by the authors of a program in the first place, others represent direct affronts to the policy goals that animate the programs. These unplanned exits may come through formal repudiation in the pages of the Federal Register; they may also come through informal means, such as “slashing agency budgets, reassigning staff, declining to enforce a regulatory program, or seeking delays in the courts.”¹⁹⁶ Because agency staff typically wish to see their work live on after their departure, they often seek ways to “insulate or

191. See Mulligan & Bamberger, *supra* note 157, at 743 (describing how technical systems “often become[] embedded in organizations and social structures, and in the practices of a culture, community, or profession and then fade[] into the background”); Porter, *supra* note 184 (describing the integration of the financial markets’ technical systems into organizational routines and professional identity).

192. See, e.g., *Broker-Dealers*, BNY MELLON, <https://www.bnymellon.com/us/en/solutions/broker-dealers/overview.html> [<https://perma.cc/9C9Y-4KXK>]; *State Street Global Services*, STATE ST., <https://www.statestreet.com/solutions/by-capability/ssgs.html> [<https://perma.cc/E2FV-JMNZ>]. For an ethnographic account of these departments, see KAREN HO, *LIQUIDATED: AN ETHNOGRAPHY OF WALL STREET* 73–121 (2009), which describes the “back office” departments of Wall Street firms.

193. See Ho, *supra* note 192 (arguing that regulatory governance regimes tend to be complementary to, and integrated with, technical systems in the financial sector).

194. See Chris Brummer, *Disruptive Technology and Securities Regulation*, 84 *FORDHAM L. REV.* 977, 1020–35 (2015) (analyzing how disruptive information and communications technology can undermine otherwise-settled regulatory practices and regimes).

195. See J.B. Ruhl & James Salzman, *Regulatory Exit*, 68 *VAND. L. REV.* 1295, 1302 (2015).

196. Sarah E. Light, *Regulatory Horcruxes*, 67 *DUKE L.J.* 1647, 1650 (2018).

harden” their favored projects against exit by their successors.¹⁹⁷ Due to the durability provided by network effects, organizational embeddedness, and regulatory linkages, infrastructural reengineering is likely to be effective at providing just such insulation.

Of course, there are downsides to this kind of entrenchment, too. Embedding regulatory values into market infrastructure may lead to harmful protectionism by dominant players in transactional networks. Reengineering efforts risk producing this effect because they may give rise to strong industry coalitions. These coalitions—take, for instance, the broker-dealers and custodians that control the DTC—may gain positional power due to their newfound centrality in financial intermediation chains, and they also may hold sway with regulators due to their value as partners in the reengineering effort.

As Kathryn Judge has written, when intermediaries possess such advantages, they generally seek to “affect the processes through which institutions evolve in self-serving ways.”¹⁹⁸ Because the (newly) existing infrastructure design will favor their business models, they will take concerted action to maintain the (new) status quo. In her account of this process of “intermediary influence,” Judge shows how securities firms with control over the NYSE successfully resisted efficiency-enhancing changes to tick size for many years through effective collective action.¹⁹⁹ A similar process of intermediary entrenchment has played out over multiple decades in the case of the DTC. While scholars and policymakers intermittently lament flaws with the DTC model from the perspective of intermediary risk, corporate voting, and more, the model has gone untouched by serious competitive disruption or regulatory upheaval since its creation half a century ago.

Does the DTC’s problematic entrenchment reveal that it was a fundamental mistake to prod its construction? Though this is perhaps the view of some commentators,²⁰⁰ I do not think so. The myriad problems that converged in the Paperwork Crisis were themselves longstanding, as evidenced by the 1930s SEC’s interest in resolving them, and later in the early-1960s SEC’s similar interest.²⁰¹ The infrastructural solution mitigated these problems for the long haul. Indeed, the DTC, along with CLS Bank and other important infrastructure

197. *See id.*

198. Judge, *supra* note 77, at 577.

199. *See id.* at 594–96.

200. *See, e.g.,* David C. Donald, *Heart of Darkness: The Problem at the Core of the U.S. Proxy System and Its Solution*, 6 VA. L. & BUS. REV. 41, 82–94 (2011).

201. *See supra* Part II.B.1.

institutions, continued normal business even amid the stress of the Global Financial Crisis, becoming widely lauded as the few large, systemically important “dog[s] that didn’t bark.”²⁰² While scholars might debate whether this or that design would have been better to promote in the late 1960s, the general effort to produce the DTC was a valuable one. Similarly, though CLS Bank and ongoing derivatives reforms have undoubtedly strengthened the competitive positions of their insiders, this fact alone cannot motivate a wholesale indictment of those efforts. Instead, in any particular case, regulators and scholars must balance the weight of entrenchment against the governance benefits of reengineering.

B. THE CHALLENGE OF PRIVATE-SECTOR ENLISTMENT

The prior Part looked at the characteristics that make reengineering useful as a technique of governance and the tradeoffs those characteristics produce. This Part turns to process considerations. In particular, it highlights a second set of reasons regulators might wish to consider reengineering efforts: they can leverage private-sector capacity to serve public-law goals.

Across the cases presented in Part II, regulators relied heavily on private actors for both idea formation and blueprint implementation. They drew on extensive industry knowledge and detailed understandings of market dynamics.²⁰³ In the case of what became the DTC, William O. Douglas first developed the idea based on a proposal circulating in the stock-brokerage industry.²⁰⁴ Eventually, the DTC was built by a consortium of brokerage houses in cooperation with a team within the NYSE.²⁰⁵ Similarly, CLS Bank’s development occurred at the behest of central banks around the world, but the effort was carried out by a private-sector “G20” of the world’s largest foreign exchange dealer banks and eventually implemented through a technology

202. Gordon, *supra* note 156, at 148; *see also* SCOTT & GELPERN, *supra* note 54, at 792 (noting that the infrastructure of financial markets “performed well during the financial crisis that began in 2007”).

203. The value of such detailed and “context-specific” industrial knowledge is discussed in Cristie L. Ford, *New Governance, Compliance, and Principles-Based Securities Regulation*, 45 AM. BUS. L.J. 1, 27–28 (2008). *See also* Lisa Schultz Bressman & Robert B. Thompson, *The Future of Agency Independence*, 63 VAND. L. REV. 599, 614–15 (2010) (justifying agency independence on the ground that it facilitates invaluable public-private collaboration).

204. *See* Douglas, *supra* note 101, at 6 (stating that the central depository trust idea “emanate[d] from the brokerage business itself” and “was suggested [in the United States] at least as [early] as 1932”).

205. *See* Donald, *supra* note 200, at 54–59.

services contract with IBM.²⁰⁶ And with credit derivatives reform, the idea took shape due to an “early warning” provided by an industry actor, who told the president of the New York Fed about the risks posed by the dated practices of the derivatives post-trade process.²⁰⁷ In light of those risks, the Fourteen Families engaged in coordination and standardization efforts over the course of multiple years to meet regulators’ requirements for transparent post-trade practices.²⁰⁸

The advantages to regulators of working with private actors to achieve public ends come not only in the forms of local knowledge and specialized expertise but also in the simple form of resources. While public monitoring and enforcement require large budget allocations,²⁰⁹ the act of leveraging private-sector capacity only costs the regulator the price of the leverage.²¹⁰ By using the ability to both coordinate and coerce industry actors to make infrastructural changes, regulators who lead reengineering efforts are able to take action even if they are severely under-resourced in the budgetary sense.²¹¹

In each of these regards, reengineering efforts resemble other methods of financial regulation that enlist private-sector actors to do the work of the state, from self-regulation to gatekeeping regimes.²¹² Like those better-studied methods of collaborative governance, reengineering will only succeed in contexts where regulators are able to work effectively across the public-private divide without succumbing to capture or capriciousness. On this front, it is essential to evaluate whether the legal and bureaucratic structures through which the

206. See Schaller, *supra* note 134.

207. NOAM SCHEIBER, *THE ESCAPE ARTISTS: HOW OBAMA’S TEAM FUMBLE THE RECOVERY* 210 (2012) (citing an interview with a New York Fed official). That this industry actor, a Goldman Sachs partner named Gerald Corrigan, had only recently passed through the revolving door from the Federal Reserve to Goldman perhaps suggests why his warnings were both credible and effective. *See id.*

208. See U.S. GOV’T ACCOUNTABILITY OFF., *supra* note 146, at 18–25.

209. See Rory Van Loo, *The New Gatekeepers: Private Firms as Public Enforcers*, 106 VA. L. REV. 467, 509–10 (2019).

210. Cf. William E. Kovacic & David A. Hyman, *Regulatory Leveraging: Problem or Solution?*, 23 GEO. MASON L. REV. 1163, 1165–66 (2016) (discussing private sector leveraging).

211. Cf. Van Loo, *supra* note 209, at 510–11 (describing how regulators “can dramatically expand the administrative state’s regulatory workforce” by conscripting large firms to police their suppliers); Lesley K. McAllister, *Regulation by Third-Party Verification*, 53 B.C. L. REV. 1, 23 (2012) (identifying similar advantages to third-party verification regimes).

212. See, e.g., Bressman & Thompson, *supra* note 203, at 637–38 (describing SEC reliance on self-regulation); Stavros Gadinis & Colby Mangells, *Collaborative Gatekeepers*, 73 WASH. & LEE L. REV. 797, 802–03 (2016) (evaluating the enlistment of financial institutions as quasi-gatekeepers in anti-money laundering regimes).

agencies are “regulating architecture to regulate behavior”²¹³ are sufficient to prevent those unwanted outcomes.

1. The Utility of Coordination

For a reengineering effort to succeed, regulators must usually facilitate private-sector coordination of some kind. Coordination occurs when industry actors undertake a joint course of action to solve a shared problem.²¹⁴ Regulatory facilitation of industry coordination is a common enterprise, and it occupies a core place in discourse about the public-private interface.²¹⁵ It was instrumental to the reengineering efforts profiled in Part II.

At the most basic level, industry coordination can serve public purposes by bringing local industry knowledge and concerted industry action to bear on a given problem. Regulators can facilitate this through simple acts like convening key industry actors together in one location and setting an agenda for them.²¹⁶ The value of even small coordinating actions like this can be seen in the cases. For instance, in 2005, when the New York Fed realized that the credit derivatives market’s antiquated back-office systems could cause major problems, they called an ad-hoc meeting with the Fourteen Families.²¹⁷ Gathering in the New York Fed’s dining room, the representatives of the Families discussed how best to mutually adopt new, digital post-trade

213. Lessig, *supra* note 20, at 668.

214. Cf. Richard H. McAdams, *Beyond the Prisoners’ Dilemma: Coordination, Game Theory, and the Law*, 82 S. CAL. L. REV. 209, 219 (2009) (“[G]enerally, the problem of coordination arises where two or more individuals can reach some mutually desired outcome—or avoid some mutually undesired outcome—only by combining their actions in a certain way, but where more than one possible combination will suffice. The presence of multiple ways to combine actions requires that individuals coordinate on the same combination.” (emphasis omitted)).

215. See, e.g., Annelise Riles, *Is New Governance the Ideal Architecture for Global Financial Regulation?*, in *CENTRAL BANKING AT A CROSSROADS: EUROPE AND BEYOND* 245 (Charles Goodhart, Daniela Gabor, Jakob Vestegaard & Ismail Ertürk eds., 2014) (describing and evaluating the coordinating role of financial regulatory agencies in the post-Crisis environment); Robert B. Ahdieh, *The Visible Hand: Coordination Functions of the Regulatory State*, 95 MINN. L. REV. 578, 633–37 (2010) [hereinafter Ahdieh, *Visible Hand*] (describing the roles of various agencies in facilitating coordination); Robert B. Ahdieh, *Law’s Signal: A Cueing Theory of Law in Market Transition*, 77 S. CAL. L. REV. 215, 302 (2004) (highlighting the importance of coordination to securities market development).

216. See Ahdieh, *supra* note 215, at 293 (discussing the power of convening industry actors).

217. See GEITHNER, *supra* note 146, at 103; U.S. GOV’T ACCOUNTABILITY OFF., *supra* note 146, at 19.

technology.²¹⁸ The regulators invoked no formal legal mechanism to call the meeting or motivate action.²¹⁹ Instead, they aimed to bring awareness to a shared problem and used a mix of “moral suasion”²²⁰ and calls to the enlightened self-interest of the banks to do so.²²¹ As Timothy Geithner, then the president of the New York Fed, put it, the dealers “had a mutual interest in upgrading their derivatives infrastructure, so we managed to persuade them to upgrade it.”²²² Within a year, the banks had coordinated on a solution: they reduced trade-confirmation backlogs and increasingly adopted technical standards for computerized trade-tracking,²²³ all of which helped dampen the catastrophe of the Global Financial Crisis.²²⁴

In addition to the simple power of convening industry actors in one place and setting an agenda for them, regulators can also gain value from creating focal points around specific infrastructural solutions to industry problems.²²⁵ The cases exemplify the value of this practice. For instance, when it was becoming clear that the securities clearing and settlement system would be overwhelmed by the rising trading volumes of the 1960s, the SEC published a prominent report summarizing the state of the market’s operations and challenges.²²⁶ Through that report, the SEC raised the profile of one way to implement something like the depository trust institution that William O. Douglas had first put on the table in the 1930s.²²⁷ The SEC’s move was not to mandate adoption of a depository trust or even to clearly

218. *See id.*; SCHEIBER, *supra* note 207, at 211 (describing the scene of the meeting of the Fourteen Families).

219. The New York Fed only supervised two of the fourteen institutions. *See* GEITHNER, *supra* note 146, at 103. The others were supervised by the other regulators at the New York Fed-convened table. *See id.*

220. *See Systemic Risk and the Financial Markets: Hearing Before the H. Comm. on Fin. Servs.*, 110th Cong. 11 (2008) (statement of Ben S. Bernanke, Chairman, Board of Governors of the Federal Reserve System).

221. *See* GEITHNER, *supra* note 146, at 103–04.

222. *See id.*

223. *See* U.S. GOV’T ACCOUNTABILITY OFF., *supra* note 146, at 18–25.

224. *See supra* Part II.B.3.

225. A focal point arises when one solution to a coordination problem gains salience, thereby creating momentum in support of its adoption among the coordinating parties. *See* McAdams, *supra* note 214, at 231–35. Regulators can use the power of their bully pulpit to create such focal points for industry actors. *Cf.* Peter Conti-Brown & David A. Wishnick, *Technocratic Pragmatism, Bureaucratic Expertise, and the Federal Reserve*, 130 YALE L.J. 636, 664–65, 692 (2021) (highlighting the discursive powers of the Fed).

226. SEC, REPORT OF SPECIAL STUDY OF SECURITIES MARKETS, H.R. DOC. NO. 88-95, at 430 (1963).

227. *See generally id.*

threaten regulatory consequences for failing to adopt it. Rather, the SEC brought awareness to one solution to the paperwork problem and gave it a “best practices”-like imprimatur of SEC blessing.²²⁸ By creating a focal point, the SEC catalyzed the effort to build what eventually became the DTC.²²⁹ This kind of approach is epistemically modest, in that it still relies on the local knowledge and expertise of industry players to guide infrastructural evolution, but it places a public force into the process.

2. The Necessity of Coercion

The tools of coordination are useful, but coordination can only go so far. At root, coordination is a non-interventionist regulatory stance. It “emphasize[s] the shaping of expectations rather than the alteration of incentives,” aims to disseminate “information and knowledge,” and “focus[es] on the dynamics of groups.”²³⁰ When engaging in coordination, regulators act as public supporters of private ordering by removing cognitive and transactional barriers to mutual advancement. But to get off the ground in the first place, coordination efforts often need a source of external motivation. In such cases, regulators will need to coerce reengineering efforts into being, not merely to coordinate them.

The fundamental limit to coordination is that it fails to address the divergence between even enlightened industry interests and the policy interests often at stake in situations where reengineering is being considered. Take, for instance, a potential reengineering effort that aims at reducing systemic risk: “the risk of socially unbearable macroeconomic consequences” arising from the bankruptcy, distress, or breakdown of individual financial firms or infrastructure institutions.²³¹ It is fundamental that private actors do not have incentives to optimally limit systemic risk. “Without regulation, the externalities caused by systemic risk would not be prevented or internalized because the motivation of market participants ‘is to protect themselves but not the system as a whole’”²³² These same incentives are at play when it comes to market infrastructure design. No amount of convening, “moral suasion,” or calls for “enlightened” self-interest will

228. On the general use of best practices, see generally David Zaring, *Best Practices*, 81 N.Y.U. L. REV. 294 (2006).

229. See *supra* Part II.B.1.

230. Ahdieh, *Visible Hand*, *supra* note 215, at 582.

231. See Levitin, *supra* note 12, at 446.

232. Schwarcz, *supra* note 123, at 206.

make industry actors care about the negative societal spillovers of systemic risk.²³³

To make optimal use of reengineering where externalities are at stake, private-sector coordination needs motivation by a bit of muscle. The tools regulators have available for this purpose are threats and mandates.

Threats. Agency threats come in many shapes and sizes. Some involve informal statements that, absent “voluntary” industry action, an agency will write a new rule or impose legal sanctions through enforcement.²³⁴ Others involve threats to industry members’ reputations.²³⁵ And some involve the threat of new legislation from Congress.²³⁶

Regulators used threats to prod along the infrastructural reengineering efforts described in Part II. One particularly stark example involved then-SEC Chairman William O. Douglas after the Whitney securities theft scandal.²³⁷ At the time, the SEC lacked any direct statutory authority to mandate reengineering of the securities settlement system used on Wall Street.²³⁸ But recall that Douglas thought that a redesigned settlement system would prevent securities theft and also, as the Commission put it, “obviate the need” for new regulations at the same time.²³⁹ At first, he used soft tactics, calling on the brokerage industry to “work together” with the SEC to “make this segment of capitalism work” by “launch[ing] a joint program” to develop a central depository trust.²⁴⁰ But when the industry did not move quickly to pursue Douglas’s idea, he turned to negotiation and threat. Specifically, he treated the SEC’s report on the Whitney scandal as a bargaining chip. He proposed that the SEC would withhold portions of the report from public view for a few months “on [the] condition that the

233. See generally Allen, *supra* note 123, at 1093–97 (discussing the negative spillovers of financial instability).

234. See Tim Wu, *Agency Threats*, 60 DUKE L.J. 1841, 1844 (2011) (describing public and private threats, either “explicit or implicit,” to undertake “either new rulemaking or enforcement of an existing rule”); see also Daniel Schwarcz & David Zaring, *Regulation by Threat: Dodd-Frank and the Nonbank Problem*, 84 U. CHI. L. REV. 1813, 1817 (2017) (describing the Dodd-Frank Act’s systemically important financial institution regime as relying on the threat of onerous regulation to gain voluntary compliance with the policy norm of financial institution de-risking).

235. See Kishanthi Parella, *Reputational Regulation*, 67 DUKE L.J. 907, 914 (2018) (identifying how threats of reputational harm motivate industry action).

236. See discussion *supra* Part I.C.2.

237. See *supra* Part II.B.1.

238. The authority to do so would not come until 1975. See *supra* Part II.B.1.

239. See *supra* text accompanying note 100.

240. Douglas, *supra* note 101, at 7, 10.

President of the [NYSE] and others would use their best efforts to bring about the adoption” of a central depository institution.²⁴¹ When the NYSE still failed to take up the proposal, Douglas ultimately made good on his threat and publicized the SEC’s report.²⁴² Douglas also threatened that if the industry still dallied, the Commission “might find it necessary to recommend to the Congress a program of legislative action” to force the central depository into existence.²⁴³ Fortunately for the industry, Douglas was at that point nominated for the Supreme Court.²⁴⁴ His successor (the famed legal realist Jerome Frank) lacked either the interest or the will to carry through on Douglas’s threats, and the reengineering plan went dormant until the 1960s.²⁴⁵

A more successful use of threats spurred the construction of CLS Bank. Recall that the design of the foreign exchange payment system led to recurring episodes of instability in the banking system throughout the 1970s, 1980s, and early 1990s.²⁴⁶ Though regulators had tried to spur private-sector action using coordination tools, nothing came of it until an international consortium of regulators including the Fed announced they would soon take affirmative measures to “induce private sector progress” in reducing settlement risk.²⁴⁷ This announcement was perceived as “a very clear threat . . . on the part of the major central banks” that the private sector “had a certain amount of time to come up with a satisfactory solution to FX settlement risk, or else the central banks would themselves ‘seek’ a solution.”²⁴⁸ The top-down options that were “in the wind” during the period included “tough risk

241. Memorandum from Francis T. Greene, Assistant Dir., Trading & Exch. Div., SEC, Conference on Monday, August 8, 1938, Relative to Proposals of the New York Stock Exchange and This Commission for the Safeguarding of Customers’ Funds and Securities 2 (Aug. 25, 1938), http://www.sechistorical.org/collection/papers/1930/1938_0825_SafeguardingConferenceT.pdf [<https://perma.cc/G76X-WUJA>]; *see also id.* (“It was made clear by Chairman Douglas that should the efforts of the Administration of the Stock Exchange to bring about the adoption of a program revolving about a central depository and ultimately a trust institution be unsuccessful, the Commission would promptly release the Whitney Report discussing all of the proposals which might thus become necessary.”).

242. *See* SEC WHITNEY REPORT VOL. 1, *supra* note 98.

243. Memorandum from Francis T. Greene, *supra* note 241.

244. *William O. Douglas*, ENCYC. BRITANNICA, <https://www.britannica.com/biography/William-O-Douglas> [<https://web.archive.org/web/20210205225558/https://www.britannica.com/biography/William-O-Douglas>] (Jan. 15, 2021).

245. *See supra* Part I.C.

246. *See supra* Part II.B.2.

247. *See* Schaller, *supra* note 134, at 44, 47–48.

248. Lacker, *supra* note 135, at 229.

control” imposed through traditional regulatory methods, and for “the central banks themselves to construct their own jointly-operated, centralized [payment-versus-payment] system.”²⁴⁹

As intended, these threats from the Fed and other central banks provided “a wake-up call for the industry.”²⁵⁰ To stave off stronger regulatory intervention, leading global banks quickly made plans to build their own private version of the payment-versus-payment system idea.²⁵¹

These instances of threat-based motivation are undoubtedly significant in the history of infrastructural reengineering. But they are being overtaken by instances where regulators rely on explicit statutory grants of authority to mandate infrastructural change.

Mandates. Statutorily authorized mandates are likely to be more effective, not to mention more legitimate, than threats. The most important sources of statutory authority for our purposes are found in the Securities Acts Amendments of 1975 ('75 Amendments) and the Dodd-Frank Act of 2010.²⁵² These laws enable financial regulators to facilitate and mandate infrastructural reengineering; I will call them the sources of “reengineering authority.” They are the main statutory tools that regulators should consider invoking to mandate private-sector involvement in any reengineering effort.

First, the SEC can use wide-ranging authority in the '75 Amendments to “play an active role in structuring the public securities markets.”²⁵³ These laws enable the SEC to facilitate technological change in the “communication and data processing facilities” that undergird the securities trading venues and post-trade systems.²⁵⁴

A second set of statutory tools to prompt infrastructural reengineering can be found in the Dodd-Frank Act. While the '75 Amendments focus on securities market infrastructure and empower the SEC alone, the Dodd-Frank Act grants authority to the Fed, SEC, and CFTC

249. *Id.*

250. Schaller, *supra* note 134, at 44.

251. *See id.* at 47–48.

252. For these amendments, see Pub. L. No. 94-29, 89 Stat. 97 (1975) (amending 15 U.S.C. §§ 77–78).

253. Roberta S. Karmel, *Should Securities Industry Self-Regulatory Organizations Be Considered Government Agencies?*, 14 STAN. J.L. BUS. & FIN. 151, 160 (2008).

254. 15 U.S.C. § 78k-1 (directing the SEC “to carry out the objectives” of “linking . . . all markets for qualified securities through communication and data processing facilities”); *see also* Jonathan R. Macey & David D. Haddock, *Shirking at the SEC: The Failure of the National Market System*, 1985 U. ILL. L. REV. 315, 332 (stating that the '75 Amendments establish that “the SEC must implement communications technology to facilitate trading activity among multiple markets”).

over a wide range of market infrastructure. Most prominently, Dodd-Frank mandated the construction of central clearinghouses for certain derivatives contracts that had been cleared on a bilateral basis.²⁵⁵ In addition, Dodd-Frank requires the CFTC and SEC to develop standardized data formats for trade reporting in various derivatives markets.²⁵⁶ Finally, Dodd-Frank also contains a sweeping source of authority to regulate the design and operation of any market infrastructure that the group of agency leaders composing the Financial Stability Oversight Council (FSOC) deems to be “systemically important.”²⁵⁷ Specifically, Dodd-Frank authorizes the regulators to “promote uniform standards for the . . . conduct of systemically important” financial activities—language that is broad enough to authorize a range of reengineering endeavors.²⁵⁸

Taken together, these sources of reengineering authority enable regulators to coerce the private sector into acting, even when doing so is not in their self-interest. Notably, the absence of this kind of coercive power inhibited pre-Crisis reforms.²⁵⁹ To remedy this problem, the drafters of Dodd-Frank gave the constituent agencies of the financial regulatory state “adequate authority to compel corrective actions,” rather than merely exhort them.²⁶⁰ Given the incentives at work in most important reengineering projects, the Dodd-Frank power to compel beneficial updates to market infrastructure is crucial.

255. See Griffith, *supra* note 11, at 1309–24.

256. See Certain Swap Data Repository and Data Reporting Requirements, 84 Fed. Reg. 21,044 (May 13, 2019) (to be codified at 17 C.F.R. pts. 23, 43, 45, 49).

257. 12 U.S.C. § 5461. The FSOC is an “agency-of-agencies,” populated by the heads of financial regulatory agencies across the administrative state and tasked with maintaining the stability of the financial system. Jacob E. Gersen, *Administrative Law Goes to Wall Street: The New Administrative Process*, 65 ADMIN. L.J. 689, 698 (2013).

258. *Id.* § 5461(b); see also *id.* § 5464(a)(1) (stating that the agencies “shall prescribe risk management standards” governing covered activities of “designated financial market utilities” and governing “the conduct of designated activities by financial institutions”).

259. See U.S. DEP’T OF THE TREASURY, FINANCIAL REGULATORY REFORM: A NEW FOUNDATION 51 (2009), https://www.treasury.gov/initiatives/Documents/FinalReport_web.pdf [<https://perma.cc/V33L-ZEEX>] (“Progress in strengthening payment and settlement arrangements is inherently difficult because improvements in such arrangements require collective action by market participants. Existing federal authority over such arrangements is incomplete and fragmented. In such circumstances, the Federal Reserve and other regulators have been forced to rely heavily on moral suasion to encourage market participants to take such collective actions.”).

260. *Id.* at 52.

C. REENGINEERING IN SYSTEMIC CONTEXT

The prior Parts examined the first-order utility of reengineering as a regulatory technique and the public-private interaction it entails. This Part steps back to consider reengineering in systemic context.

Individual reengineering efforts tend to be market-specific interventions. The DTC only addressed securities theft in the corporate securities markets;²⁶¹ CLS Bank only addressed Herstatt risk arising from trades in particular foreign exchange markets;²⁶² and the digitization efforts of the Fourteen Families may have improved data quality in the credit derivatives markets, but they left many other markets in the dark.²⁶³ Reengineering is potentially useful, in other words, at regulating particular financial *activities*,²⁶⁴ and doing so within the confines of today's existing regulatory regime. By contrast, it cannot address the deep problems of our crisis-prone financial sector at a fundamental level.²⁶⁵

But that does not mean that reengineering efforts will lack systemic implications. Rather, as this Part argues, reengineering efforts hold the capacity to support some approaches to sector-wide governance while also running the risk of creating new problems along the way. Regulators considering reengineering efforts in the future must contend with both of these dynamics.

261. Cf. Porter, *supra* note 184, at 121 (noting that the Fedwire infrastructure handles settlement in government securities markets).

262. See Bech & Holden, *supra* note 185 (documenting the range of currency pairs not currently supported by CLS).

263. See *supra* Part II.B.3.

264. Cf. Jeremy C. Kress, Patricia A. McCoy & Daniel Schwarcz, *Regulating Entities and Activities: Complementary Approaches to Nonbank Systemic Risk*, 92 S. CAL. L. REV. 1455 (2019) (evaluating the efficacy of activity-based regulation in comparison with entity-based regulation).

265. For proposals that do aim to achieve such a fundamental restructuring, see WILMARTH, *supra* note 124, which argues for the reinstatement of a modernized version of the Glass-Steagall Act; Saule T. Omarova, *The People's Ledger: How to Democratize Money, Finance, and the Economy*, 75 VAND. L. REV. (forthcoming 2021–22), and Ricks et al., *supra* note 38, which explore the implications of widespread availability of access to Fed bank accounts; and Adam J. Levitin, *Safe Banking: Finance and Democracy*, 83 U. CHI. L. REV. 357, 417 (2016), which argues for a separation of lending and safe-keeping activities in favor of “an absolutist version of 100% reserve banking.” For commentary on the deep problems left unaddressed post-2008 and the potential for fundamental reform, see Adam J. Levitin, *The Politics of Financial Regulation and the Regulation of Financial Politics: A Review Essay*, 127 HARV. L. REV. 1991 (2014).

1. Reengineering as a Complementary Technique

To address problems in each of Part II's cases, regulators had a range of regulatory tools available to them. And just as agencies often mix policymaking forms like rulemaking and adjudication to achieve their statutory goals,²⁶⁶ so too can agencies mix and layer different governance approaches. Take securities theft: Over decades, the SEC experimented with a mix of industry self-regulation, administrative enforcement, and eventually the infrastructural effort of pressuring industry participants to create the DTC.²⁶⁷ And in the case of Herstatt risk, the Fed pursued a similar multi-tool approach.²⁶⁸ It supported the adoption of Basel-style capital requirements, continued with workaday bank supervision, and pushed for the construction of CLS Bank.²⁶⁹ In both cases, reengineering efforts did not foreclose the use of other regulatory tools; they complemented them.

In general, reengineering efforts are likely to complement other approaches to financial regulation in a few ways. First, as in the two cases just described, a reengineering effort resulting in structural constraints on particular activities might increase the efficacy of other regulatory tools. Consider the work of a Fed supervisor pre- and post-CLS Bank. In the pre-CLS Bank days, a supervisor of a bank with significant foreign exchange exposures would have had to scrutinize its settlement risk profile. As noted above, this would have been an ongoing task with high variable costs, and the task would have been made difficult by the dynamic market environment. But in the post-CLS Bank world, the same supervisor can look to CLS to achieve the goal of controlling settlement risk. This not only reduces the variable costs of addressing settlement risk; it also frees up the supervisor's (and the supervisory agency's) resources to deal with other matters while CLS Bank does important work, automatically and in the background.²⁷⁰

Second, when reengineering efforts make rule violations and financial risks more visible, they make those violations and risks more susceptible to both private and public discipline. As a result, any increase in surveillance caused by reengineering will complement other regulatory approaches. In the case of the derivatives back-office

266. See M. Elizabeth Magill, *Agency Choice of Policymaking Form*, 71 U. CHI. L. REV. 1383, 1399 (2004) (discussing how agencies rely on adjudication, rulemaking, or a combination of the two).

267. See *supra* Part II.B.1.

268. See *supra* notes 127–31 and accompanying text.

269. See *supra* Part II.B.2.

270. See *supra* Part II.B.2.

reforms, for instance, a shift in visibility led to private discipline.²⁷¹ When the Fourteen Families came to understand the risks that their trading practices were producing, they quickly sought to increase their use of netting arrangements to reduce the magnitude of their counterparty risks.²⁷² Though these efforts were hardly sufficient to stop a world-historical financial crisis from taking place, they did help contain what would have been an even worse meltdown in the OTC derivatives markets. Similarly, when regulators prompt the adoption of improved data standards or the construction of trade reporting infrastructure, the resulting increase in market visibility will complement public discipline. Regulators and supervisors who have access to real-time, machine-readable trade data will be in much better positions when it comes to risk regulation and conduct policing than their peers were in prior days.

2. Centralization and the Stakes of Catastrophe

Of course, reengineering efforts will not *only* be complementary to other regulatory programs. Sometimes, they may make other aspects of the regulatory task more difficult; sometimes, they may create new problems altogether.

The most striking new problems that may result from reengineering efforts arise from increased centralization of market activities. Both the DTC and CLS Bank exemplify this. Though they each did much to address preexisting problems that had eluded simple regulatory solutions for years, they also produced new risk of their own. For these two systems, much of it falls under the umbrella of operational risk.²⁷³ If one of these systems were to be unavailable for even a short period of time, they could destabilize every one of their participants. This genre of centralized operational risk is not hypothetical. In 1987, telecommunications breakdowns in post-trade networks deepened the Black Monday crash.²⁷⁴ Recent Fedwire outages have caused

271. See *supra* Part II.B.3.

272. See *supra* Part II.B.3.

273. Operational risk includes “the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.” Christina Parajon Skinner, *Misconduct Risk*, 84 FORDHAM L. REV. 1559, 1592 (2016) (quoting BASEL COMM. ON BANKING SUPERVISION, INTERNATIONAL CONVERGENCE OF CAPITAL MEASUREMENT AND CAPITAL STANDARDS: A REVISED FRAMEWORK ¶ 644 (2004), <http://www.bis.org/publ/bcbsl07.pdf> [<https://perma.cc/MX9R-TDAR>]).

274. See DIANA B. HENRIQUES, A FIRST-CLASS CATASTROPHE: THE ROAD TO BLACK MONDAY, THE WORST DAY IN WALL STREET HISTORY (2017); Ben S. Bernanke, *Clearing and Settlement During the Crash*, 3 REV. FIN. STUD. 133, 146–47 (1990) (describing how

minor trouble across markets.²⁷⁵ A similar breakdown—or cyber-intrusion—into a centralized financial market infrastructure today could create or deepen another crisis.²⁷⁶ Similarly, as thousands of law review pages attest, reengineering efforts that centralize clearing have the effect of concentrating financial risks.²⁷⁷

The stakes of centralization are such that the drafters of the Dodd-Frank Act addressed them directly. In title VIII of the Act, Congress gave the FSOC the power to designate “financial market utilities” or “payment, clearing, or settlement activities” as systemically important via supermajority vote.²⁷⁸ Such a vote subjects designated entities and activities to heightened regulation and supervision, even over the objection of their “home” agency.²⁷⁹ Under the scrutiny of their home regulators, along with the FSOC and the Fed, these “systemically important financial market utilities” (SIFMUs) become subject to mandatory reforms to their internal processes and to invasive supervision designed to reduce the chances of financial catastrophe.²⁸⁰

These risk-management and oversight measures are, of course, hardly costless. And the harm that could be done if they were to fail is potentially enormous.²⁸¹ This raises the question: has the centralization of clearing and settlement processes through reengineering efforts been worth the trade? On this front, it is both striking and ironic that by my count, regulators have had a guiding hand in the creation of over half of the SIFMUs subject to heightened supervision today.²⁸²

technological and financial problems in post-trade operations exacerbated the market crash and increased the risk of widespread financial crisis).

275. See Ann Saphir, *Fedwire Resumes Operations After Hours-long Disruption*, REUTERS (Feb. 24, 2021, 12:15 PM), <https://www.reuters.com/article/us-usa-fed-fedwire-idUSKBN2A0211> [<https://perma.cc/H5AG-6KG8>].

276. On cyber-intrusions, see Darrell Duffie & Joshua Younger, *Cyber Runs*, (Hutchins Ctr. on Fiscal & Monetary Pol’y at Brookings, Working Paper No. 51, 2019), <https://www.brookings.edu/wp-content/uploads/2019/06/WP51-Duffie-Younger-2.pdf> [<https://perma.cc/T3DD-EKMJ>].

277. See, e.g., Roe, *supra* note 13; Yadav, *supra* note 137 (reflecting on a decade of debate).

278. 12 U.S.C. § 5463(a). The Secretary of the Treasury, acting as FSOC chairperson, must be a part of the supermajority. *Id.*

279. *Id.* §§ 5464, 5466–5467.

280. See *id.*

281. See DAVID SKEEL, *THE NEW FINANCIAL DEAL: UNDERSTANDING THE DODD-FRANK ACT AND ITS (UNINTENDED) CONSEQUENCES* 72 (2010).

282. In addition to the DTC and CLS Bank, see *supra* Parts II.B.1–2, regulators have been moving forces behind the creation or expansion of two systemically important derivatives clearinghouses, see, e.g., Yadav, *supra* note 142, and the precursor to the

Because the systemic risks posed by the SIFMUs involve low-probability, high-stakes scenarios, it is a matter of abundant speculation whether the centralization of post-trade infrastructure has ultimately been a good or bad deal.²⁸³ At the very least, the creation of new, systemically risky entities cannot be anything approaching a “final act of policy” that allows regulation to leave the scene.²⁸⁴ Instead, it trades one set of problems for another. In light of this dynamic, regulators considering new reengineering efforts should clearly be wary of creating new SIFMUs, and indeed should be especially attendant to ways of de-risking the existing ones. The next Part turns to a few ideas along those lines.

IV. FUTURE PROSPECTS

So far, this Article has examined the potential utility of reengineering efforts and developed a framework for evaluating the tradeoffs they tend to pose. This Part looks to the future. It applies the framework developed in Part III to evaluate current and potential future reengineering initiatives, and it explores how regulatory mentalities should shift to best capitalize on those possibilities.

A. THREE INITIATIVES

1. T+1: A Structural Constraint on Systemic Risk

Earlier, the case of CLS Bank demonstrated how regulators can employ reengineering to combat systemic risk.²⁸⁵ Regulators should more aggressively pursue similar systemic risk-reductions today. This Part explores one promising idea involving the NSCC. The idea exemplifies the value of mechanical enforcement discussed in Part III.A,²⁸⁶ and it does so in service of reducing centralized systemic risk.²⁸⁷

Recall from Part I.B that the NSCC is the central counterparty clearinghouse for the corporate securities markets. After market participants trade with one another, the NSCC steps into the middle, becoming “the seller to every buyer and the buyer to every seller” of

Fixed Income Clearing Corporation, see Jeffrey F. Ingber, *The Development of the Government Securities Clearing Corporation*, 23 *ECON. POL'Y REV.* 33, 33 (2017).

283. For a summary of a decade's worth of debate on derivatives CCPs, for instance, see Yadav, *supra* note 142.

284. This phrase comes from Annelise Riles's discussion of the Bank of Japan payment system. See RILES, *supra* note 8.

285. See *supra* Part II.A.2.

286. See *supra* Part III.A.1.

287. Cf. *supra* Part III.C.2 (discussing the centralized risks posed by SIFMUs).

those trades.²⁸⁸ As a result of this role, the NSCC is a quintessential “too big to fail” institution.²⁸⁹ It is both a debtor and a creditor of every major securities dealer and intermediary in the country. If one or more of those firms were to default on debts to the NSCC, the NSCC itself would be on the hook to cover the shortfall.²⁹⁰ It would do so by using its own resources and by drawing on the resources of other securities firms that participate in the clearing network. Such an event would put pressure on those firms and could lead to the deepening of an incipient financial crisis.²⁹¹ Its negative spillover effects could be many, including a contraction of credit and a widespread reduction in economic prospects.²⁹² For these reasons, financial regulators have designated the NSCC as “systemically important.”²⁹³

To reduce the risk that the NSCC fails, regulators have a range of options at their disposal. First, they can impose new risk management requirements.²⁹⁴ Second, they can supervise the institution with greater intensity.²⁹⁵ A third possibility, complementary to the other two, is to impose a structural constraint on the extent of NSCC risk-taking.

Today, the SEC indeed may reengineer the NSCC to do just that. The opportunity involves what is known as the “settlement cycle”—the time it takes from trade to ultimate settlement.²⁹⁶ This cycle recently gained notoriety for a strange reason: when the retail broker Robinhood halted trading in volatile “meme” stocks in January 2021,

288. See discussion *supra* notes 56–60; FIN. STABILITY OVERSIGHT COUNCIL, U.S. DEP'T OF THE TREASURY, 2012 ANNUAL REPORT 179 (2012), <https://www.treasury.gov/initiatives/fsoc/Documents/2012%20Annual%20Report.pdf> [<https://perma.cc/YZ7X-VBTE>] (“NSCC plays a prominent role in providing clearance, settlement, and CCP services for nearly all broker-to-broker equity and corporate and municipal debt trades executed on major U.S. exchanges and other equity trading venues.”).

289. See, e.g., Felix B. Chang, *The Systemic Risk Paradox: Banks and Clearinghouses Under Regulation*, 2014 COLUM. BUS. L. REV. 747, 751 (“Additionally, the very nature of clearinghouses ensures that they will be too big to fail . . .”).

290. For the mechanics of this process at clearinghouses generally, see Paolo Saguato, *The Ownership of Clearinghouses: When “Skin in the Game” Is Not Enough, the Remutualization of Clearinghouses*, 34 YALE J. ON REGUL. 601, 618–23 (2017).

291. Cf. SKEEL, *supra* note 281 (discussing the consequences of clearinghouse failures and the necessity of avoiding them).

292. See FIN. STABILITY OVERSIGHT COUNCIL, *supra* note 288, at 182.

293. See *id.* at 179–83.

294. See 12 U.S.C. § 5464.

295. See *id.* § 5466.

296. See Rogers, *supra* note 92, at 1437.

its CEO laid blame on the settlement cycle's pace.²⁹⁷ But its import here has little to do with retail brokerage. Rather, from a systemic risk perspective, the settlement cycle matters because it directly controls the extent of the financial risk the NSCC itself bears at any given time.²⁹⁸ Each day that a trade remains unsettled, the NSCC is exposed to the risk of counterparty default.²⁹⁹ The current timeline for settlement is two days—the so-called “T+2” settlement cycle.³⁰⁰ A shift from the current cycle to a T+1 cycle would cut the NSCC's exposure by a day's worth of trades, thereby vastly reducing the risk it bears and the risk it poses to the stability of the financial system.³⁰¹ A switch to T+0 would reduce NSCC's exposure even further by limiting it to risks carried on an intraday basis.

If a speed-up of the settlement timeline would reduce the NSCC's systemic riskiness, why hasn't the SEC gone forward with it to date? It is not for lack of awareness. The SEC has long been aware of the technological possibility of a T+1 or T+0 settlement cycle,³⁰² and in 2015, a group of independent advocates on the SEC Investor Advisory Committee argued to the SEC that faster settlement would serve the public

297. Specifically, the CEO suggested that extremely high collateral demands made by the NSCC led to Robinhood's trading halts. See Annie Massa, *Robinhood Says Stock Settlement Times Are a Wall Street Risk*, BLOOMBERG (Feb. 2, 2021), <https://www.bloomberg.com/news/articles/2021-02-02/robinhood-saga-renews-wall-street-group-s-move-to-limit-risks> [<https://perma.cc/88K3-98R9>]. In my view, that account is incomplete, at best. Robinhood itself could have engaged in better liquidity planning to accommodate its business model, or it could have altered its business model to reduce liquidity risk. Cf. James Surowiecki, *Why Robinhood's PR Nightmare Keeps Getting Worse*, MARKER (Feb. 22, 2021), <https://marker.medium.com/robinhood-demonstrates-how-not-to-communicate-in-a-crisis-3b31c0e60cbc> [<https://perma.cc/V6EE-SR8Q>] (discussing Robinhood's liquidity problems in late January 2021). It makes more sense to blame Robinhood for its trading halts than NSCC collateral requirements.

298. See T+2 Settlement Cycle Adopting Release, *supra* note 57, at 17–18 (stating that a shortened settlement cycle “should reduce systemic risk”).

299. *Id.*

300. *Id.* at 2.

301. See DEPOSITORY TR. CLEARING CORP., *ADVANCING TOGETHER: LEADING THE INDUSTRY TO ACCELERATED SETTLEMENT* 2, 5, 9 (2021) (arguing that a shortened settlement cycle would reduce risk to the NSCC and reduce Members' expected margin requirements).

302. See SEC. INDUS. ASS'N, *T+1 BUSINESS CASE FINAL REPORT* 11 (2000), <https://www.sifma.org/wp-content/uploads/2017/05/t1-business-case-final-report.pdf> [<https://perma.cc/YKZ9-FPUM>] (stating that technology could enable a shift to T+1 settlement in 2000); see also JP Koning, *The Siren Call of T+0, or Real-Time Settlement*, MONEYNESS (Sept. 27, 2017), <http://jpkoning.blogspot.com/2017/09/the-siren-call-of-t0-or-real-time.html> [<https://perma.cc/SNM7-6AJ5>] (noting that NYSE trades settled on a T+1 timeline for many years prior to 1933).

interest.³⁰³ Further, many markets in the United States currently settle on a faster timeline, including the markets for Treasury securities and mutual fund shares.³⁰⁴ Based on these precedents, the SEC could adopt existing models to speed up securities settlement today.

The better explanation is that the SEC has decided to let the securities industry lead on its own. Since the move to a T+2 cycle in 2017, no member of the Commission or its staff has publicly pushed for faster settlement.³⁰⁵ Indeed, even amid public debate and early industry explorations of T+1 in the wake of January 2021's strange meme stock episode,³⁰⁶ the SEC has so far stayed silent. This hands-off approach follows the pattern of many past SEC uses of the '75 Amendments' reengineering authority. As Yuliya Guseva has written, the SEC has only engaged this authority "following *clearly expressed* market concerns and consensus" among industry participants.³⁰⁷ For instance, when considering the eventual shift to T+2, the SEC "did not choose sides" but rather "allowed the industry to move naturally."³⁰⁸

This approach of letting the industry decide when and how to update the settlement cycle is wrongheaded. As we saw in Part III.B, when it comes to systemic risk, the incentives of private actors are out of alignment with the public interest. Though the firms that mutually own and operate the NSCC of course would not like to see it fail, they nevertheless do not internalize the damage that an NSCC failure would inflict on the public at large.³⁰⁹ Not only could an NSCC failure require a bailout from the Fed, but it would also roil the markets and

303. See INV. ADVISORY COMM., RECOMMENDATION OF THE INVESTOR ADVISORY COMMITTEE: SHORTENING THE TRADE SETTLEMENT CYCLE IN THE U.S. FINANCIAL MARKETS (2015), <https://www.sec.gov/spotlight/investor-advisory-committee-2012/settlement-cycle-recommendation-final.pdf> [<https://perma.cc/6HM3-6TBT>] ("[A] move to shorter settlement cycles will protect . . . investors . . .").

304. See *id.* ("[M]atching the settlement period that already exists for Treasuries and many mutual funds, would greatly reduce systemic risk . . .").

305. The closest any Commissioner has come has been Hester Peirce, who noted that a shorter settlement cycle "could yield . . . benefits" but then warned against undue enthusiasm for real-time settlement schemes. Hester M. Peirce, Comm'r, Sec. Exch. Comm'n, Address at the George Washington University Law School Regulating the Digital Economy Conference: Atomic Trading (Feb. 22, 2021), <https://www.sec.gov/news/speech/peirce-atomic-trading-2021-02-22> [<https://perma.cc/BS4G-KHE3>].

306. See DEPOSITORY TR. CLEARING CORP., *supra* note 301.

307. Yuliya Guseva, *Destructive Collectivism: Dodd-Frank Coordination and Clearinghouses*, 37 CARDOZO L. REV. 1693, 1729–30 (2016).

308. *Id.* at 1730.

309. Cf. Saguato, *supra* note 290, at 631–32 (discussing situations in which clearinghouses are "unable to contain and internalize" the costs of their failures); *id.* at 613 (noting that NSCC is a member-owned mutual firm).

contribute to broader panic in a crisis situation.³¹⁰ To prevent these negative spillovers to the public, the NSCC should not be left to its own devices. Rather, because of the value to the public of reducing the NSCC's systemic riskiness—not to mention reducing the need for SEC oversight and supervision—the SEC should consider coercing an effort to shorten the settlement cycle.

To place pressure on the industry and ensure it neither stalls nor slow-walks a beneficial change, the SEC should make more aggressive use of the powers contained in the '75 Amendments. First, the SEC should use its statutory authority to reconvene an expert body called the Market Transactions Advisory Committee (MTAC), which has been dormant since the 1990s.³¹¹ The MTAC would be a fifteen-member committee, organized and operated pursuant to the Federal Advisory Committee Act.³¹² It would enable SEC commissioners to leverage subject-matter expertise from outside the agency but without having to rely too heavily on the expertise of interested industry participants.³¹³ And it could be charged by the SEC with reporting on a wide range of matters related to securities transfer procedures.³¹⁴ The Commission should use this power to task the MTAC with studying the question of settlement cycle speed. Specifically, a revived MTAC should have the remit of gathering evidence on the feasibility, costs, and benefits of reengineering a faster securities post-trade process. With that power in hand, the MTAC could engage with technology vendors, investor advocates, and public-interest groups to assess how best to de-risk securities clearing and settlement. In so doing, it would bring an independent and well-informed perspective to bear on a

310. Cf. Baker, *supra* note 73, at 109–10 (describing the expansion of the Federal Reserve's "safety net" to include clearinghouses that have been designated as systemically important by the FSOC).

311. See 15 U.S.C. § 78q-1(f)(4) (describing the MTAC formation process and substantive ambit); see also Charles W. Mooney, Jr., *The Roles of Individuals in UCC Reform: Is the Uniform Law Process a Potted Plant? The Case of Revised UCC Article 8*, 27 OKLA. CITY U. L. REV. 553, 564–72 (2002) (describing the origins and products of the original MTAC). Note that while I characterize the MTAC provision as a part of the '75 Amendments, it was, to be precise, an amendment to the Amendments. See *id.*

312. See 15 U.S.C. § 78q-1(f)(4)(B) (describing the composition of the committee).

313. Brian D. Feinstein & Daniel J. Hemel, *Outside Advisers Inside Agencies*, 108 GEO. L.J. 1139, 1148 (2020) (describing the service provided by FACA committees).

314. See 15 U.S.C. § 78q-1(f)(4)(A) ("The Advisory Committee shall be directed to consider and report to the [SEC] on such matters as the [SEC], after consultation with the Secretary of the Treasury and the Board of Governors of the Federal Reserve System, determines, including [matters related to the laws governing securities transfer].").

topic that is simultaneously technical and of significant public importance.³¹⁵

If the SEC does not take up this effort, the Federal Reserve should use its title VIII authority to step into the void. Pursuant to that authority, the Fed has the power to backstop the SEC's oversight of the NSCC. If the SEC's requirements are "insufficient to prevent or mitigate . . . risks" to financial stability, then the Fed can force remedial evaluation.³¹⁶ The SEC would then be required by law to revisit its own approach to NSCC risk management.³¹⁷ While it is possible that the implementation costs of speeding the settlement cycle could exceed the benefits, that judgment could be made only *after* a public-interested regulator has taken a wide range of technical options under consideration. Federal Reserve leadership on this question would represent an improvement on the SEC's current approach of deference to industry members. That approach is a clear abdication of the congressional mandate found in the '75 Amendments and the Dodd-Frank Act and a failure in light of the basic mismatch between the NSCC's interests and the public interests that Congress has entrusted to the SEC.³¹⁸

2. The CAT: Cross-Venue Surveillance in the Securities Market

The problem of market manipulation—whether through front-running, spoofing, insider trading, or otherwise—threatens to undermine the integrity of the securities markets.³¹⁹ As one might expect, the market manipulators who engage in these tactics usually aim to cloak their actions in secrecy. One goal of the SEC's CAT effort, first mentioned in the Introduction, is to bring emerging forms of market manipulation out of the shadows. Though it exemplifies the potential utility of architectural regulation, it has largely been a failure in terms of process.

315. Cf. Omarova, *supra* note 40, at 488–89 (describing the value of independent experts in terms of bringing "political visibility and social salience" to issues that are frequently off the public radar).

316. 12 U.S.C. § 5464(a)(2)(B).

317. See *id.* § 5464(a)(2)(D) (requiring the SEC to respond to any Federal Reserve challenge "with a detailed analysis as to why existing prudential requirements are sufficient, or submit an explanation describing the actions to be taken in response" to the Federal Reserve challenge).

318. See discussion *supra* Part III.B.2. See generally 12 U.S.C. §§ 5461(a)(4)(C)–(D), 5464(b)(3)–(4) (stating the purposes of the Dodd-Frank market infrastructure oversight provisions, including the purposes of "reduc[ing] systemic risks" and "support[ing] the stability of the broader financial system").

319. "Market integrity" refers to the goals of fairness, orderliness, and pricing that accurately reflects a security's fundamental value. See, e.g., Roberta S. Karmel, *IOSCO's Response to the Financial Crisis*, 37 J. CORP. L. 849, 897 (2012).

The surveillance functions for which the SEC aims to build the CAT are as old as the markets themselves. The earliest form of market surveillance was informal and peer-based. As with the lobstermen famously profiled by James Acheson³²⁰ and the goldminers of Jackass Gulch recently described by Gillian Hadfield,³²¹ the traders of the NYSE and other exchanges kept tabs on each other with a watchful eye. This “crowd monitoring” relied on the physical architecture of the trading floor.³²² Participants were, as one NYSE official put it, “not over in a closet or up on a pillar [but rather] . . . standing down on the floor . . . so that there is almost—you might say—a check-up on [them] every single minute.”³²³ Reports of participants ratting each other out for prohibited actions are numerous.³²⁴ The rules of the floor were supported by the mutual surveillance of the crowd.

As market activity grew over the course of the twentieth century, the private stock exchanges and the SEC increasingly turned to “programmatically” surveillance methods.³²⁵ For instance, by 1992, the NYSE’s Intermarket Surveillance Information System was already producing a massive audit trail—“a sequential reconstruction of trading in each stock, identifying the time of trade, the buying and selling member firms, the Floor brokers who represented the orders involved, and whether the trade was for a member firm proprietary account.”³²⁶ Analysts would sit at “sophisticated computer workstations” to “quickly reconstruct market activity” if something looked amiss.³²⁷ The SEC, for its part, has long acted as “an additional independent monitor for all securities transactions.”³²⁸ The Commission not only oversees the surveillance activities of operators like the NYSE; it also ingests a range of private data feeds to sift through when

320. See JAMES M. ACHESON, *THE LOBSTER GANGS OF MAINE* 73–75 (1988) (describing the mutual monitoring of lobster-fishing boundaries by the lobstermen themselves).

321. See GILLIAN K. HADFIELD, *RULES FOR A FLAT WORLD* 21–22 (2017) (describing mutual monitoring among gold miners during the California Gold Rush).

322. WALTER MATTLI, *DARKNESS BY DESIGN* 67 (2019).

323. *Id.* at 65.

324. See *id.* at 66–67 (detailing a trading story from Robert Seijas).

325. Cf. Rory Van Loo, *The Missing Regulatory State: Monitoring Business in an Age of Surveillance*, 72 *VAND. L. REV.* 1563, 1573–74 (2019) (discussing systematic and routine information collection in business contexts under the heading of “programmatically” monitoring).

326. James L. Cochrane, Brian McNamara, James E. Shapiro & Michael J. Simon, *The Structure and Regulation of the New York Stock Exchange*, 18 *J. CORP. L.* 57, 66 (1992).

327. *Id.*

328. Jonathan Macey & Hideki Kanda, *The Stock Exchange as a Firm: The Emergence of Close Substitutes for the New York and Tokyo Stock Exchanges*, 75 *CORNELL L. REV.* 1007, 1037 (1990).

it seeks to uncover problematic conduct or engage in a market crash post-mortem.

Over the past two decades, however, this system of surveillance has broken down. The cause of the breakdown is the increasing decentralization and fragmentation of trading activity across many trading venues.³²⁹ As Yesha Yadav has recently written, this fragmentation “generates enormous logistical and institutional costs for exchanges seeking to monitor, surveil, and discipline” wayward traders.³³⁰ Impermissible actions that surveillance might have caught in the days of centralized trading now go undetected.³³¹

A range of regulatory interventions might remedy this situation. Yadav, for instance, has proposed a change in liability regime to address the problem of weak oversight.³³² The CAT represents a technological complement to such proposals. In essence, the CAT aims to recreate what has been lost through the fragmentation of the stock market and, further, to deepen the granularity of data that the SEC receives. The plan for the CAT is to become the “ultimate unraveler of the mysteries of the stock market: a vast database [to] enable regulators to look at who has been trading what in the sub-second trading world that exists today. And not just trades that take place: every bid and offer . . . [whether] executed or not.”³³³ When it is completed, it will gather this information, in standardized formats, from every regulated securities and SEC-regulated trading venue, requiring alterations in underlying data structures or translational systems across numerous operators.³³⁴

But the CAT blueprint has taken exceedingly long to even begin constructing. And the slow pace of the project highlights the inherent risks of failing to effectively manage a reengineering effort’s core public-private relationships. Recall from Part III.B that the ’75

329. Yesha Yadav, *Oversight Failure in Securities Markets*, 104 CORNELL L. REV. 1799, 1804 (2020).

330. *Id.*

331. *Id.*; see also Frank Pasquale, *Law’s Acceleration of Finance: Redefining the Problem of High-Frequency Trading*, 36 CARDOZO L. REV. 2085, 2114–16 (2015) (describing the SEC’s frustrations on this front).

332. See Yadav, *supra* note 329, at 1809 (proposing a liability regime for trading venue operators).

333. Bob Pisani, *It’s Google Vs. Amazon To Create the Biggest Database in History*, CNBC: TRADER TALK, <https://www.cnbc.com/2016/04/26/its-google-vs-amazon-to-create-the-biggest-data-base-in-history.html> [https://perma.cc/H3UU-7YJC] (Apr. 27, 2016, 7:31 AM).

334. See Consolidated Audit Trail, 77 Fed. Reg. 45,722, 45,765 (Aug. 1, 2012) (detailing proposed Rule 613(c)(3) and comments to the proposed rule).

Amendments gave the SEC wide-ranging authority to coerce industry actors into reengineering their own infrastructure. The importance of using these provisions with a real enforcement threat behind them is exemplified by the SEC's struggle to get the CAT project off the ground. Almost nine years after its kick-off, the CAT remains in a state of partial completion.³³⁵ The story is one of delay after delay: a four-year search for a database provider, insufficient plans rejected by the SEC, and the longest hiring process for a chief information security officer "in history."³³⁶ As presidential administrations changed over from Obama to Trump to Biden, and the SEC switched from majority-Democrat to majority-Republican and back again, one constant has been the CAT: a potentially valuable system to help the SEC carry out its statutory duties to police market integrity, but a policy albatross and a procedural quagmire.³³⁷

A large portion of these delays can be chalked up to failed incentives. To date, not one fine has been issued by the SEC for industry slowness, and the SEC has indicated that it will continue to let construction delays slide.³³⁸ In the future, regulators using the '75 Amendments should be sure to back up their calls for action with real threats of civil penalties for failure to act.

3. Data Standardization: Primitives for Systemic Oversight

A third example of potentially valuable reengineering can be found in the realm of systemic oversight. To prevent crises before they happen (and to contain them once they begin to unfold), financial regulators are increasingly working to develop the "robust ability to

335. See Hayley McDowell, *US Consolidated Audit Trail Timeline Disrupted Due to COVID-19*, TRADE (Apr. 21, 2020), <https://www.thetradenews.com/us-consolidated-audit-trail-timeline-disrupted-due-covid-19> [<https://perma.cc/V82T-L7YJ>] (describing delayed milestones); Andrew Ramonas, *SEC on Course To Fix "Worst Executed" Audit Trail, Clayton Says*, BLOOMBERG L. (Nov. 19, 2019, 10:10 AM), <https://news.bloomberglaw.com/privacy-and-data-security/sec-on-course-to-fix-worst-executed-audit-trail-clayton-says> [[https://perma.cc/5D\]3-5B3Y](https://perma.cc/5D]3-5B3Y)] (reporting the SEC's plan to ensure a working CAT by 2022).

336. James Rundle & Anthony Malakian, *CAT's Tale: How Thesys, the SROs and the SEC Mishandled the Consolidated Audit Trail*, WATERSTECHNOLOGY (Feb. 14, 2019), <https://www.waterstechnology.com/regulation/4152906/cats-tale-how-thesys-the-sros-and-the-sec-mishandled-the-consolidated-audit-trail> [<https://perma.cc/SB44-AWSL>].

337. See Ramonas, *supra* note 335 (noting that then-current SEC Chairman Jay Clayton has called the CAT "one of the worst conceived, worst executed projects I've seen," but has also doubled down on its completion).

338. See Rundle & Malakian, *supra* note 336 (noting that, despite delays, "an enforcement action from the SEC failed to materialize").

monitor the economy and quickly detect mounting risks.”³³⁹ This oversight ability requires an essential input: useful data.³⁴⁰ Specifically, to effectively monitor the financial system as a whole, regulators need access to financial data that are detailed, comprehensive, rapidly-updated, and machine-readable.³⁴¹ While many useful sources of data exist today, regulators should work to identify ways of producing and centralizing that data more effectively.³⁴²

The necessity of wide-ranging data was revealed in the Global Financial Crisis, when regulators were caught off-guard by their ignorance of important market activities and counterparty relationships.³⁴³ For instance, they lacked information about major dependencies between firms transacting in crucial short-term funding markets.³⁴⁴ They also lacked awareness of the systemic importance of some firms operating outside the traditional regulatory perimeter.³⁴⁵

339. Patricia A. McCoy, *Countercyclical Regulation and Its Challenges*, 47 ARIZ. ST. L.J. 1181, 1219 (2015). For discussion of the distinct practices of prevention and containment, see generally Anna Gelpern, *Financial Crisis Containment*, 41 CONN. L. REV. 1051 (2009).

340. See McCoy, *supra* note 339 (describing the issue of information deficit post-2008).

341. See Mark D. Flood, H.V. Jagadish & Louiqa Raschid, *Big Data Challenges and Opportunities in Financial Stability Monitoring*, 20 FIN. STABILITY REV. 129, 129 (2016) (arguing in favor of adopting novel means to adapt to “the ubiquity of data in financial markets”); see also OFF. OF FIN. RSCH., U.S. DEP’T OF THE TREASURY, 2013 ANNUAL REPORT 71 (2013), <https://www.financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2013.pdf> [<https://perma.cc/G8TH-NKWC>] (“Comprehensive, timely, and granular data are essential to the . . . ability to conduct the . . . financial stability monitoring, analysis, and research . . .” (emphasis omitted)).

342. See, e.g., Henry T.C. Hu, *Disclosure Universes and Modes of Information: Banks, Innovation, and Divergent Regulatory Quests*, 31 YALE J. ON REGUL. 565, 647 (2014) (“Massive amounts of data relating to banks and individual financial transactions are available to a spectrum of governmental bodies.”); cf. Berner & Judge, *supra* note 141, at 5–7 (“In this environment, policymakers inevitably operate with an incomplete understanding of how the financial system works and how it will respond to regulatory intervention.”). For a discussion of ongoing efforts and their place within the financial regulatory state, see generally Dan Awrey & Kathryn Judge, *Why Financial Regulation Keeps Falling Short*, 61 B.C. L. REV. 2295, 2340–42 (2020).

343. See, e.g., Michael S. Barr, *The Financial Crisis and the Path of Reform*, 29 YALE J. ON REGUL. 91, 99–100 (2012) (“Before Dodd-Frank, 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. In fact, regulators and market participants did not even have enough data to understand how interconnected the market was.”).

344. *Id.*; see Saguato, *supra* note 13, at 113–14, 120–25 (describing repo market opacity and proposing enhanced visibility for the market).

345. See, e.g., Patricia A. McCoy, *Systemic Risk Oversight and the Shifting Balance of State and Federal Authority over Insurance*, 5 U.C. IRVINE L. REV. 1389, 1406 (2015)

Taken as a whole, during the Crisis, “[t]he lack of high-quality, consistent, and accessible data was a key source of risk.”³⁴⁶

While regulators have undertaken efforts to shore up the data picture, today’s sources still overlook key areas of financial activity.³⁴⁷ They also suffer from design flaws related to the intermittent nature of their transmission, the low level of detail they contain, and the poor quality of their presentation.³⁴⁸ For example, the recent market turmoil sparked by the COVID-19 pandemic raised questions about regulators’ access to necessary data about leveraged lending to corporate borrowers across economic sectors.³⁴⁹ These loans—which are extended to corporations with high levels of debt and often bundled into collateralized loan obligations (CLOs)—have grown significantly over the last few years.³⁵⁰ Though it has not yet come to pass in the current crisis, widespread defaults on these loans have been theorized as a potential trigger for deep distress among financial institutions who hold them on their balance sheets, risking a systemic event.³⁵¹

(describing the opacity of the American International Group’s systemic importance before its downfall).

346. OFF. OF FIN. RSCH., U.S. DEP’T OF THE TREASURY, 2012 ANNUAL REPORT 4 (2012), <https://www.financialresearch.gov/annual-reports/files/office-of-financial-research-annual-report-2012.pdf> [<https://perma.cc/42RM-27NK>].

347. See Saguato, *supra* note 13, at 120–25 (arguing for reforms to make the repo market more transparent); Pasquale, *supra* note 331, at 2113–17 (describing efforts among financial regulators to collect sufficient data to support effective supervision and enforcement).

348. See, e.g., Andrew F. Tuch, *The Remaking of Wall Street*, 7 HARV. BUS. L. REV. 315, 365–66 (2017) (noting that regulators lack sufficient information to oversee the growing importance of non-bank lenders); see also Daniel Carpenter & Patricia A. McCoy, *Keeping Tabs on Financial Innovation: Product Identifiers in Consumer Financial Regulation*, 18 N.C. BANKING INST. 195, 216 (2013) (highlighting the lack of linkage between different databases as a problem for financial regulation).

349. See Hannah Lang, *Virus Could Deal Blow to Leveraged Loans. What’s That Mean for Banks?*, AM. BANKER (Mar. 11, 2020, 2:26 PM), <https://www.americanbanker.com/news/virus-could-deal-blow-to-leveraged-loans-whats-that-mean-for-banks> [<https://perma.cc/3XF4-UHZG>] (discussing the worries of regulators that the pandemic could have spurred a rerun of the prior crisis).

350. See William W. Bratton & Adam J. Levitin, *A Tale of Two Markets: Regulation and Innovation in Post-Crisis Mortgage and Structured Finance Markets*, 2020 U. ILL. L. REV. 47, 97–104 (describing the rise of CLOs); Sung Eun (Summer) Kim, *Managing Regulatory Blindspots: A Case Study of Leveraged Loans*, 32 YALE J. ON REGUL. 89, 98–99 (2015) (examining CLOs in the context of other factors that have “played a role in expanding . . . leveraged loans”).

351. See Kim, *supra* note 350, at 110–12 (explaining that a “cross-default” scenario is a sufficiently foreseeable reason to regulate in the face of “inevitable downturns”). But see Christina Parajon Skinner, *Nonbank Credit*, 9 HARV. BUS. L. REV. 149, 152 (2019) (arguing that many leveraged lenders provide a countercyclical source of credit).

Yet, despite their growing systemic importance, leveraged loans currently exist in a relative data desert. At present, there is no central market infrastructure that collects transaction-by-transaction data in standardized, machine-readable formats for leveraged lending.³⁵² Further, many market participants fall outside the existing regulatory perimeter for entity-specific data collections.³⁵³ And while private data sources provide some information, these sources are often prepared monthly; they also only provide a sliver of insight into the interconnections and dependencies that regulators must understand to do their jobs.³⁵⁴

In many ways, the leveraged loan and CLO markets exist in a state of opacity comparable to the derivatives market in 2005.³⁵⁵ With no centralized infrastructure for trade-data collection, regulators are cobbling together existing data sources to develop a sense of market activity. But this approach leaves them prone to overlooking risks and relationships that pose destabilizing threats. In particular, as the Financial Stability Board recently stated, “limited information on indirect linkages between bank and non-banks [through the leveraged loan and CLO markets] makes it difficult to assess possible risks from spillovers and interconnectedness, and their systemic implications.”³⁵⁶ One lesson of the Global Financial Crisis is that no important market should be so opaque from the macroprudential perspective.

Though regulators could attempt to increase firm-specific data collections to address the problem, a less discretionary, more durable approach would be to pursue a reengineering effort, calling on industry actors to construct a trade repository for leveraged lending. By contrast to firm-provided data collections, a trade repository would collect relevant trade data as a mandatory byproduct of transacting in the first place. The attractiveness of the option would depend on the value of immediate, automated data delivery compared with the

352. See *Systemic Risk: Taking It to the House*, LOAN SYNDICATIONS & TRADING ASS'N (June 9, 2019), <https://www.lsta.org/news-resources/systemic-risk-taking-it-to-the-house> [<https://perma.cc/5ZP5-ZALT>].

353. See Parajon Skinner, *supra* note 351, at 155 n.32 (stating that “regulatory data on private funds is sparse”).

354. Cf. *CLOs: Not So Opaque*, LOAN SYNDICATIONS & TRADING ASS'N (June 20, 2019), <https://www.lsta.org/news-resources/clos-not-so-opaque> [<https://perma.cc/6XJP-3426>] (arguing that the availability of Thomson Reuters’s “Leveraged Loan Monthly” should allay policymakers’ concerns about the market’s opacity).

355. See *supra* Part II.B.3.

356. FIN. STABILITY BD., VULNERABILITIES ASSOCIATED WITH LEVERAGED LOANS AND COLLATERALIZED LOAN OBLIGATIONS 2 (2019), <https://www.fsb.org/wp-content/uploads/P191219.pdf> [<https://perma.cc/6XJP-3426>].

difficulty of enlisting industry actors to coordinate on the development of a new infrastructural system. In this, public benefits in terms of improved macroprudential supervision would trade off against private costs of construction and public costs of oversight. But here again, regulators should not wait for poorly incentivized private firms to act.

B. A PROACTIVE ROLE FOR REGULATORS

The ideas presented in the preceding Part represent the tip of the iceberg of possibilities for infrastructural reengineering,³⁵⁷ but they nevertheless offer a sense of how regulators should think about engaging in the practice. They also highlight the public-private dynamics that reengineering inevitably entails. If regulators hope to leverage the power of market technology, they will need to do much more than respond to private innovation; they must play a catalytic role in pressing for change.

Doing so may require an ideological shift within the agencies. Decades of practice and theory have made the roles of reaction and facilitation—of “keeping pace” and not “getting in the way”—central to the financial regulatory mindset.³⁵⁸ Indeed, today, leaders at the SEC, CFTC, and Fed continue to espouse those conceptions of their tasks. They express fears of “heel-dragging” in response to private technological innovation³⁵⁹ and hopes for “enabl[ing]” the development of private technologies.³⁶⁰ They even have built entire organizational sub-units devoted to celebrating the creativity of private innovators. For instance, the CFTC has created LabCFTC to serve as “the focal point for the CFTC’s efforts to promote responsible financial technology (fintech) innovation,” and the “hub for the agency’s

357. Regarding public-private reengineering efforts, see, for example, Charles W. Mooney, Jr., *Beyond Intermediation: A New (Fintech) Model for Securities Holding Infrastructures*, 22 U. PA. J. BUS. L. 286, 387–89 (2020), which calls for the reengineering of the central securities depository system. See also Berner & Judge, *supra* note 141, at 3–5 (exploring opportunities for greater data standardization); Saguato, *supra* note 13, at 88–89 (arguing for reforms to repo infrastructure); Hilary J. Allen, *Payments Failure*, 62 B.C. L. REV. 453 (2021) (exploring technological solutions to operational risk in the retail payments system). For purely public ideas, see sources cited *supra* note 38.

358. See sources cited *supra* note 1; cf. Coglianesi, *supra* note 19 (discussing the pace-keeping problem across the administrative state); Marchant, *supra* note 19, at 199 (same).

359. Hester Peirce, Comm’r, SEC, Address at the Securities Enforcement Forum: How We Howey 4 (May 9, 2019), <https://www.sec.gov/news/speech/peirce-how-we-howey-050919> [<https://perma.cc/WNP3-XUNU>].

360. See *LabCFTC Overview*, COMMODITY FUTURES TRADING COMM’N, <https://www.cftc.gov/LabCFTC/Overview/index.htm> [<https://perma.cc/WV5P-SKF6>] (listing LabCFTC’s goals).

engagement with the fintech innovation community.”³⁶¹ By contrast, they espouse less enthusiasm for affirmatively leading the process.

These views fit with dominant academic conceptions of the regulatory role, as well. The main narrative applied to the regulation-innovation relationship in the financial sector always begins with a novel financial product or market technology developed for private profit.³⁶² From the electronic trading venues currently ascendant to innovations driven by distributed ledger technology being championed across the financial sector, the narrative aptly captures important innovations—but only those developed by the “Wall Street ‘rocket scientists’”³⁶³ of the private sector. It has no place for regulatory leadership in infrastructural reengineering.

To remedy this regulatory and scholarly mismatch, we need a conception of regulators as affirmative catalysts for technological and institutional change. Scholarly insights from outside the field of financial regulation can inform the development of a new approach. In different domains, legal scholars have begun developing ideas about what it takes for successful “entrepreneurial administration” and about the role of the state as an affirmative driver of technological change.³⁶⁴ Future work in financial regulation should endeavor to build on these insights and apply them to the context of the financial sector.

Once the reality of regulatory leadership becomes apparent, a range of questions opens up. For instance, which institutional forms best support it? What does the role of regulator-as-catalyst require in terms of personnel? In addition to learning from the past efforts examined in this Article, financial regulators also have much to learn from innovation-generating regulatory approaches across the administrative state. But regardless of the specific shape it takes, a dynamic financial regulatory state will be able to actively lead efforts of technological change.

361. *LabCFTC*, COMMODITY FUTURES TRADING COMM’N, <https://www.cftc.gov/LabCFTC/index.htm> [<https://perma.cc/HW73-W37K>].

362. *See, e.g.*, sources cited *supra* note 37.

363. Hu, *supra* note 18, at 1613.

364. Philip J. Weiser, *Entrepreneurial Administration*, 97 B.U. L. REV. 2011, 2012 (2017); *see, e.g.*, Zachary Liscow & Quentin Karpilow, *Innovation Snowballing and Climate Law*, 95 WASH. U. L. REV. 387, 392–95 (2017) (“Most basically, innovation policy should be at the core of environmental policy—and likely other areas of policy as well.”).

CONCLUSION

Financial markets rely on complex infrastructural systems to intermediate transactions. Though many of these systems are constructed and operated by private-sector actors, they need not be designed to serve private interests, alone. To the contrary, financial regulators have the ability to reengineer infrastructural systems in service of public policy goals.

As this Article shows, the significance of this ability cuts against conventional understandings of the role of the state in financial-market evolution. It also highlights a range of possibilities for regulators to achieve policy goals through the governing force of market infrastructure design. But though the practice of infrastructural reengineering can be powerful, it is far from automatic, nor automatically beneficial. Regulators who attempt it must think creatively about how technology can be utilized to achieve regulatory priorities, must manage complex public-private interactions, and must take stock of the systemic consequences of infrastructural reengineering. They must also reimagine their own roles by embracing their ability to galvanize technological and institutional change. Only then will they be able to take full advantage of the ability to reengineer the infrastructure of the financial markets.