
Notes

Introduction

1. *Statement for the Record, Worldwide Threat Assessment of the U.S. Intelligence Community, Senate Select Committee on Intelligence* (statement of James Clapper, Director of National Intelligence), March 12, 2013, <https://www.dni.gov/index.php/newsroom/testimonies/194-congressional-testimonies-2013/816-statement-for-the-record-worldwide-threat-assessment-of-the-u-s-intelligence-community>.
2. Video of Clapper's appearance before the Senate Select Committee on Intelligence is available online: Senate Select Committee on Intelligence, March 12, 2013, <https://www.c-span.org/video/?311436-1/senate-intelligence-cmte-hearing-worldwide-threats-us>; James Clapper, *Remarks as Delivered, Worldwide Threat Assessment*, Senate Select Committee on Intelligence, March 12, 2013, <https://www.dni.gov/files/documents/Intelligence%20Reports/WWTA%20Remarks%20as%20delivered%2012%20Mar%202013.pdf>.
3. Ibid.
4. *Statement for the Record, Worldwide Threat Assessment of the U.S. Intelligence Community* (James Clapper).
5. Ibid.
6. Ibid.
7. Mariano-Florentino Cuéllar, *Governing Security: The Hidden Origins of American Security Agencies* (Stanford, CA: Stanford Law Books, 2013), 127.
8. *National Security Strategy of the United States* (Washington, DC: Government Printing Office, 2017).
9. U.S. General Accounting Office (GAO), *Critical Infrastructure Protection: Federal Efforts Require a More Coordinated and Comprehensive Approach for Protecting Information Systems*, GAO-02-474 (Washington, DC: GAO, 2002), 27.
10. John D. Moteff, *Critical Infrastructures: Background, Policy, and Implementation*, prepared by the Congressional Research Service (Washington, DC: Library of Congress, 2003), 32.
11. Figures tabulated from the U.S. Office of Management and Budget, "Appendix: Homeland Security Mission Funding by Agency and Budget Account," in

Analytic Perspectives: Budget of the U.S. Government: Fiscal Year 2017 (Washington, DC: Government Printing Office, 2016).

12. Ibid.

13. Ibid.

14. Lisa Benton-Short, *The National Mall: No Ordinary Public Space* (Toronto: University of Toronto Press, 2016); Martin Kaste, “Thanks to Sept. 11 Security ‘Inertia,’ Restrictions Still Shape Public Spaces,” *NPR*, September 11, 2016, <http://www.npr.org/2016/09/11/493292448/thanks-to-sept-11-security-inertia-restrictions-still-shape-public-spaces>; Anthony DePalma, “Security Planters: Hard Reminders of Stark Realities,” *New York Times*, June 7, 2005.

15. U.S. Department of Homeland Security, *Privacy Impact Assessment Update for TSA Advanced Imaging Technology*, December 18, 2015, <https://www.dhs.gov/sites/default/files/publications/privacy-tsa-pia-32-d-ait.pdf>; Massport, “Security Information,” n.d., <http://www.massport.com/logan-airport/at-the-airport/security-information>.

16. Hanson O’Haver, “How ‘If You See Something, Say Something’ Became Our National Motto,” *Washington Post*, September 23, 2016.

17. Manny Fernandez, “A Phrase for Safety after 9/11 Goes Global,” *New York Times*, May 10, 2010.

18. For a detailed discussion, see chapter 4.

19. U.S. Department of Homeland Security, *Privacy Impact Assessment Update for the Enhanced Cybersecurity Services (ECS)*, November 20, 2015, <https://www.dhs.gov/sites/default/files/publications/privacy-pia-28-a-nppd-ecs-november2015.pdf>.

20. National Science and Technology Council, *Biometrics in Government Post-9/11: Advancing Science, Enhancing Operations* (Washington, DC, 2008), 34–35, <https://fas.org/irp/eprint/biometrics.pdf>; Ronald D. White, “Port Security Goes from an Afterthought to a Priority,” *Los Angeles Times*, September 9, 2011.

21. Paul Edwards, “Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems,” in *Modernity and Technology*, ed. Thomas J. Misa, Philip Brey, and Andrew Feenberg (Cambridge, MA: MIT Press, 2003), 185.

22. See Tarleton Gillespie, *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media* (New Haven, CT: Yale University Press, 2018).

23. This is a reworking of Torin Monahan’s framing of how to approach questions concerning surveillance. Torin Monahan, “Questioning Surveillance and Security,” in *Surveillance and Security: Technological Politics and Power in Everyday Life*, ed. Torin Monahan (New York: Routledge, 2006), 1–26.

24. The choice of *publics*—plural—is deliberate: it highlights the ways in which infrastructures construct and impact different communities in different ways. More generally, the public is always comprised of multiple publics. On infrastructure publics, see Stephen J. Collier, James Christopher Mizes, and Antina

- Von Schnitzler, "Preface: Public Infrastructures/Infrastructural Publics," *Limn*, no. 7 (July 2006); Christopher A. Le Dantec and Carl DiSalvo, "Infrastructure and the Formation of Publics in Participatory Design," *Social Studies of Science* 43 no. 2 (2013): 241-264. On publics more generally see John Dewey, *The Public and Its Problems: An Essay in Political Inquiry* (New York: Henry Holt, 1927).
25. Bruce Schneier, "Beyond Security Theater," *Schneier on Security*, November 2009, https://www.schneier.com/essays/archives/2009/11/beyond_security_thea.html; Bruce Schneier, "In Praise of Security Theater," *Schneier on Security*, January 2007, https://www.schneier.com/essays/archives/2007/01/in_praise_of_securit.html.
26. For example, see Stephen Graham, *Cities under Siege: The New Military Urbanism* (Brooklyn: Verso, 2011); Stephen Graham, ed., *Cities, War, and Terrorism: Towards an Urban Geopolitics* (Malden, MA: Blackwell, 2004).
27. On disaster capitalism, see Naomi Klein, *Shock Doctrine: The Rise of Disaster Capitalism* (New York: Metropolitan/Holt, 2007); Anthony Lowenstein, *Disaster Capitalism: Making a Killing Out of Catastrophe* (New York: Verso, 2015).
28. Robert B. Horwitz, *The Irony of Regulatory Reform: The Deregulation of American Telecommunications* (New York: Oxford University Press, 1989).
29. Tony Judt, *Ill Fares the Land* (New York: Penguin, 2010).
30. Charles Perrow, *The Next Catastrophe: Reducing Our Vulnerabilities to Natural, Industrial, and Terrorist Disasters* (Princeton, NJ: Princeton University Press, 2007); Charles Perrow, *Normal Accidents: Living with High-Risk Technologies* (1984; repr., Princeton, NJ: Princeton University Press, 1999).
31. Claudia Aradau, "Security That Matters: Critical Infrastructure and Objects of Protection," *Security Dialogue* 41.5 (2010): 491-514.
32. See Laura K. Donohue, *The Cost of Counterterrorism: Power, Politics, and Liberty* (New York: Cambridge University Press, 2008); Charlie Savage, *Takeover: The Return of the Imperial Presidency* (New York: Back Bay Books, 2007); Charlie Savage, *Power Wars: Inside Obama's Post-9/11 Presidency* (New York: Little, Brown, 2015).
33. Mark Danner, "After September 11: Our State of Exception," *New York Review of Books*, October 13, 2011.
34. *Ibid.*
35. Graham, *Cities under Siege*.
36. See Graham, ed., *Cities, War, and Terrorism*; Zygmunt Bauman and David Lyon, *Liquid Surveillance: A Conversation* (Malden, MA: Polity, 2013); David Lyon, *Surveillance after September 11* (Malden, MA: Polity, 2003).
37. This insight follows Jack Goldsmith's similar argument concerning executive power, the war on terror, and accountability. Goldsmith, *Power and Constraint: The Accountable Presidency after 9/11* (New York: Norton, 2012).
38. Langdon Winner, "Techne and Politeia," in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: University of Chicago Press, 1989), 40-60.
39. Giorgio Agamben, *State of Exception*, trans. Kevin Attell (Chicago: University of Chicago Press, 2003).

40. Cuéllar, *Governing Security*.
41. *Ibid.*, 191.
42. *Ibid.*, 211.
43. Ulrich Beck, *Risk Society: Towards a New Modernity*, trans. Mark Ritter (Thousand Oaks, CA: Sage, 1992).
44. Geoffrey C. Bowker, Karen Baker, Florence Millerand, and David Ribes, “Toward Information Infrastructure Studies: Ways of Knowing in a Networked Environment,” in *International Handbook of Internet Research*, ed. J. Hunsinger, L. Klastrup, and M. Allen (Dordrecht, The Netherlands: Springer, 2009), 97–117.
45. Barack Obama, Presidential Policy Directive 21—Critical Infrastructure Security and Resilience, February 12, 2013, <https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil>.
46. Thomas P. Hughes’ discussion of the development of electric power systems argues forcefully for an expansive notion of technological systems. Using electric power as his point of departure, he investigates the relationship between technical artifacts, organizations, regulations, laws, and culture. Thomas P. Hughes, “The Evolution of Large Technological Systems,” *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, Anniversary Edition (Cambridge, MA: MIT Press, 2012), 45–76; Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (1983; repr., Baltimore: Johns Hopkins University Press, 1993).
47. Phillip F. Schewe, *The Grid: A Journey through the Heart of Our Electrified World* (Washington, DC: Joseph Henry Press, 2007).
48. Data drawn from the U.S. Energy Information Administration (EIA), “Summary Statistics for the United States, 2007–2017,” *Electric Power Annual 2017*, table 1.2 (Washington, DC: Department of Energy, 2018), <https://www.eia.gov/electricity/annual/pdf/epa.pdf>; EIA, “Existing Capacity by Energy Source, 2017 (Megawatts),” *Electric Power Annual 2017*, table 4.3; Office of Electricity Delivery and Energy Reliability (OE), *United States Electrical Industry Primer* (Washington, DC: Department of Energy, 2015), 6, 13, <https://www.energy.gov/sites/prod/files/2015/12/f28/united-states-electricity-industry-primer.pdf>.
49. EIA, “Total Electric Power Industry Summary Statistics, 2017 and 2016,” *Electric Power Annual 2017*, table 1.1.
50. Cost figures for large power transformers taken from the OE, *Large Power Transformers and the U.S. Electric Grid* (Washington, DC: Department of Energy, 2012), 7, https://www.energy.gov/sites/prod/files/Large%20Power%20Transformer%20Study%20-%20June%202012_0.pdf.
51. David Nye, *Electrifying America: Social Meanings of a New Technology, 1880–1940* (Cambridge, MA: MIT Press, 1997).
52. *Ibid.*, ix.
53. Susan Leigh Star foregrounds the relational aspects of infrastructure in her classic overview of infrastructure. Susan Leigh Star, “The Ethnography of Infrastructure,” *American Behavioral Scientist* 43, no. 3 (1999): 377–391.

54. See Collier, Mizes, and Von Schnitzler, “Preface”; Le Dantec and Carl DiSalvo, “Infrastructure and the Formation of Publics in Participatory Design.”
55. Rowan v. United States Post Office Department, 397 US 728 (1970).
56. Finn Brunton, *Spam: A Shadow History of the Internet* (Cambridge, MA: MIT Press, 2013), xvi–xvii.
57. Ibid.
58. This synthesis of organizations and culture follows Charles Perrow’s work on the history of corporate power in America. Charles Perrow, *Organizing America: Wealth, Power, and the Origins of Corporate Capitalism* (Princeton, NJ: Princeton University Press, 2002).
59. Richard R. John, *Spreading the News: The American Postal System from Franklin to Morse* (Cambridge, MA: Harvard University Press, 1998); Paul Starr, *The Creation of the Media: Political Origins of Modern Communications* (New York: Basic, 2004).
60. Richard F. Hirsh, *Technology and Transformation in the American Electric Utility Industry* (New York: Cambridge University Press, 1989); Hughes, *Networks of Power*.
61. Paul Pierson, *Politics in Time: History, Institutions, and Social Analysis* (Princeton, NJ: Princeton University Press, 2004).
62. Perrow, *Next Catastrophe*; Perrow, *Normal Accidents*; Beck, *Risk Society*; Ulrich Beck, *World at Risk*, trans. Ciaran Cronin (Malden, MA: Polity, 2009).
63. Frank Knight, *Risk, Uncertainty, and Profit* (Chicago: Hart, Schaffner & Marx, 1921; New York: Kelley & Millman, 1957). Citations refer to 1957 edition.
64. Ibid.
65. Ibid.
66. Ibid.
67. Andrew Lakoff, *Unprepared: Global Health in a Time of Emergency* (Oakland: University of California Press, 2017), 16–18.
68. Ibid.
69. Ibid.
70. Perrow, *Normal Accidents*.
71. Ibid.
72. This thread runs through all of Perrow’s work. For an explicit focus on power and organizations, see Perrow, *Organizing America*.
73. Beck, *Risk Society*; Beck, *World at Risk*.
74. Ibid.
75. Ibid.

Chapter 1

1. Federal Energy Regulatory Commission (FERC), *The Con Edison Power Failure of July 13 and 14, 1977*, final staff report (Washington, DC: FERC, 1978), 99.

2. Ibid., 1.
3. Ibid.
4. Ibid.
5. “Blackout: Night of Terror,” *Time*, July 25, 1977, 12, 21.
6. Ibid.; “The Blackout,” *Washington Post*, July 16, 1977; “The New York Blackout—II Poor Plundering Poor,” *Boston Globe*, July 16, 1977; “The Illuminating Blackout,” *Hartford Courant*, July 17, 1977.
7. “Blackout: Night of Terror”; Lee Lescaze and Jack Egan, “Power Is Restored in Most Areas; Con Ed is Assailed,” *Washington Post*, July 15, 1977.
8. Lescaze and Egan, “Power Is Restored.”
9. Ari Goldman, “Still Fun City in Rockaway Peninsula,” *New York Times*, July 15, 1977.
10. Ibid.
11. Ibid.
12. Ibid.
13. Ibid.; Tom Goldstein, “Westchester Dark; Long Island’s Power Interrupted Briefly,” *New York Times*, July 14, 1977.
14. FERC, *Con Edison Power Failure*, 11.
15. On the embeddedness of infrastructures, see Star, “The Ethnography of Infrastructure”; Hughes, *Networks of Power*, 1–17.
16. Perrow, *Normal Accidents*.
17. In this fashion, Perrow’s understanding is in line with treatments that consider technologies as containing a set of affordances that make different types of activities more or less likely. See Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven, CT: Yale University Press, 2006).
18. In this way, normal accident theory is suitable to an “all hazards” approach. See Perrow, *Normal Accidents*; Perrow, *The Next Catastrophe*; Charles Perrow, “Shrink the Targets,” *IEEE Spectrum* 43, no. 9 (2006): 46–49.
19. Perrow’s theoretical framework is most succinctly presented in Perrow, “Complexity, Coupling, and Catastrophe,” chap. 3 in *Normal Accidents*, 62–100. For a discussion of the utility and flexibility of Perrow’s conceptual categories, see Karl E. Weick, “Normal Accident Theory as Frame, Link, and Provocation,” *Organization and Environment* 17, no. 1 (2004): 27–31.
20. Perrow also discusses the role that indirect information can play. Perrow, *Normal Accidents*, 73.
21. Ibid., 72–84.
22. Ibid.
23. Chris Williams, “Anatomy of OpenSSL’s Heartbleed: Just Four Bytes Trigger Horror Bug,” *Register*, April 9, 2014, https://www.theregister.co.uk/2014/04/09/heartbleed_explained/.

24. Perrow, *Normal Accidents*.
25. *Ibid.*, 81–100.
26. *Ibid.*, 93–94.
27. *Ibid.*, 81–100.
28. See also Perrow, *Organizing America*.
29. Perrow, *Normal Accidents*, 88.
30. Work approaching the analysis of infrastructure vulnerability through a focus on network structures fits well within Perrow's lens. See Ted G. Lewis, *Critical Infrastructure Protection in Homeland Security: Defending a Networked Nation* (Hoboken, NJ: Wiley & Sons, 2006); Sean Gorman, *Networks, Security and Complexity: The Role of Public Policy in Critical Infrastructure Protection* (Northampton, MA: Edward Elgar, 2005); Albert-László Barabási, *Linked: The New Science of Networks* (New York: Perseus, 2002); Reka Albert, Hawoong Jeong, and Albert-László Barabási, "Error and Attack Tolerance of Complex Networks," *Nature* 406 (2000): 378–382. For a precursor to Perrow's work, see Amory B. Lovins and L. Hunter Lovins, *Brittle Power: Energy Strategy for National Security* (Andover, MA: Brick House, 1982).
31. Perrow, *Normal Accidents*, 78.
32. John, *Spreading the News*.
33. *Ibid.*
34. David M. Henkin, *The Postal Age: The Emergence of Modern Communications in Nineteenth-Century America* (Chicago: University of Chicago Press, 2007).
35. From the 1790s to the 1820s, the postal system was operated by the General Post Office. In the 1820s, the General Post Office was renamed the Post Office Department (POD). For simplicity, the Post Office Department will be used throughout. James W. Cortada, *The Digital Hand*, vol. 3, *How Computers Changed the Work of American Public Sector Industries* (New York: Oxford University Press, 2008), 164.
36. Richard B. Kielbowicz, "A History of Mail Classification and Its Underlying Policies and Purposes," prepared for the Postal Rate Commission's Mail Reclassification Proceeding, MC95-1 (Washington, DC, 1995), 8, <http://www.prc.gov/Docs/40/40518/PRC-LR-2.pdf>.
37. John, *Spreading the News*.
38. *Ibid.*
39. *Ibid.*
40. John, *Spreading the News*. See also Richard B. Kielbowicz, *News in the Mail: The Press, Post Office, and Public Information, 1700–1860s* (New York: Greenwood, 1989); Alvin F. Harlow, *Old Post Bags: The Story of the Sending of a Letter in Ancient and Modern Times* (New York: Appleton, 1928), 112–113; George L. Priest, "The History of the Postal Monopoly in the United States," *Journal of Law and Economics* 18, no. 1 (1975): 34–38; Herbert Joyce, *The*

History of the Post Office: From Its Establishment down to 1836 (London: Bentley & Son, 1893), 7–10; Starr, *The Creation of the Media*, 31–71.

41. John, *Spreading the News*, 59–63; Kielbowicz, *News in the Mail*, 31; Kielbowicz, “History of Mail Classification,” 11–12.

42. For example, the Post Office exercised limited discretion concerning classification decisions and determinations concerning whether or not particular articles could be entered into the mail system. See Dorothy G. Fowler, *Unmailable: Congress and the Post Office* (Athens: University of Georgia Press, 1977); Kielbowicz, “History of Mail Classification.”

43. John, *Spreading the News*, 206–256; Wayne E. Fuller, *The American Mail: Enlarger of the Common Life* (Chicago: Chicago University Press, 1972), 285–330.

44. The Postal Act of 1792 established penalties for the private carriage of letters that resulted in the injury of Post Office revenue. The Private Express Statutes were amended and recodified by Congress in 1825, 1845, and 1909. See United States Postal Service (USPS), *Report on Universal Service and the Postal Monopoly* (Washington, DC, 2008), http://www.usps.com/postallaw/_pdf/USPSUSORReport.pdf.

45. The postal monopoly changed over time, admitting a number of exceptions at various points. Exemptions included noncommercial carriage, the carriage of prepaid stamped mail by third parties, special messenger services, and letters accompanying cargo. The postal monopoly also did not cover nonletter mail, such as newspapers, or postal service in areas where the Post Office did not operate. USPS, *Report on Universal Service*.

46. President’s Commission on Postal Organization, *Towards Postal Excellence: The Report of the President’s Commission on Postal Organization* (Washington, DC: Government Printing Office [GPO], 1968), 33–51.

47. Mechanization and automation targeted each of the different stages of mail processing, including culling, separating letters into various sizes and classes; facing, placing the letters in the same direction so they can be read; canceling the postage; and sorting, separating the mail into clusters for the next step of distribution and transportation. USPS, *United States Postal Service: An American History, 1775–2006* (Washington, DC, 2007), 41, <https://web.archive.org/web/20090508205717/http://www.usps.com/cpim/ftp/pubs/pub100.pdf>; Vern K. Baxter, *Labor and Politics in the U.S. Postal Service* (New York: Plenum Press, 1994), 69–72, 145–150.

48. President’s Commission, *Towards Postal Excellence: Commission*, 24, 27.

49. Nicole W. Biggart, “The Post Office as a Business: Ten Years of Postal Reorganization,” *Policy Studies Journal* 11, no. 3 (1983): 487; POD, *Postal Progress: An Accounting of Stewardship*, pub. 28 (Washington, DC: GPO, 1968), 7.

50. POD, *Postal Progress*, 5.

51. The Post Office introduced the Sectional Center System in 1963 in conjunction with zip codes as a means of reducing handling costs. Yet the postal system still relied on distributed processing throughout the system, as the continued

reliance on manual processing and the absence of mechanization and automation prevented the consolidation of sorting activities into a few central facilities.

52. Clerks during the 1960s could reliably sort letters for roughly 55 different postal facilities at a rate of fewer than 1,000 letters per hour. During the same period, a team of clerks using advanced mechanized multiple-position letter-sorting equipment could sort 28,000 letters per hour into 277 different separations. Baxter, *Labor and Politics*, 70–71.

53. POD, *Annual Report of the Postmaster General, 1969* (Washington, DC: GPO, 1970), 236–241, table 801; President’s Commission, *Towards Postal Excellence: Commission*, 16, 170.

54. President’s Commission, *Towards Postal Excellence: Commission*, 16, 170; POD, *Annual Report, 1969*, 246, table 804.

55. See Baxter, *Labor and Politics*.

56. President’s Commission, *Towards Postal Excellence: Commission*, 161.

57. GAO, *Postal Service: Automation Is Restraining but Not Reducing Costs: GGD-92-58* (Washington, DC, 1992).

58. Baxter, *Labor and Politics*, 70–71.

59. *Ibid.*

60. The contention that the political structure of postal service slowed the pace and terms of adopting new technologies, detailed below, is central to the observations of the President’s Commission on Postal Organization and is echoed in Baxter, *Labor and Politics*. See also the President’s Commission, *Towards Postal Excellence: Commission*.

61. Between 1838 and 1968, postal revenues were in the red for all but 17 years. The amount of the deficit fluctuated from year to year, but the President’s Commission calculated that as of 1968, the cumulative postal deficit accounted for 15% of total postal costs. During the 1960s, shortfalls were, however, growing; in 1967 the deficit was \$1.17 billion, or 19.1% of the total postal budget. President’s Commission, *Towards Postal Excellence: Commission*, 22.

62. *Ibid.*, 37.

63. On the connection between the deficit model and disincentives to innovate to reduce costs, see Daniel P. Carpenter, *The Forging of Bureaucratic Autonomy: Reputations, Networks, and Policy Innovation in Executive Agencies, 1862–1928* (Princeton, NJ: Princeton University Press, 2001), 73–94; President’s Commission, *Towards Postal Excellence: Commission*, 37.

64. Cortada, *Digital Hand*, 167; see, for example, POD, Office of Research and Engineering, *The Post Office: Challenge to Industry*, publication 48 (Washington, DC: GPO, 1967); POD, *Postal Progress*.

65. On the role of interest group politics and postage, see Jane Kennedy, “United States Postal Rates, 1845–1951” (PhD diss., Columbia University, 1955).

66. Typically, the Post Office would request a new rate increase only once every three to six years. See Arthur D. Little, “A Description of the Postal Service

Today: Appendix A to the General Contract,” Annex contractor’s reports, vol. 4, in *Towards Postal Excellence: Report of the General Contractor*, President’s Commission on Postal Organization (Washington, DC: Government Printing Office, 1968), 6–69.

67. Postal rates for first-class letters were established at 3 cents in 1851. Subsequently, they were adjusted as follows: 1883, two cents; 1917, three cents; 1919, two cents; 1932, three cents; 1958, four cents; 1963, five cents; 1968, six cents. In addition to the generally cheap postage afforded second-class mail, second-class postage on in-county publications remained unchanged from 1879 until reorganization. USPS, “Rates for Domestic Letters, 1863–2009” (Washington, DC, 2009), http://www.usps.com/postalhistory/_pdf/DomesticLetterRates1863-2009.pdf; President’s Commission, *Towards Postal Excellence: Commission*, 39; Foster Associates, “Rates and Rate-Making,” Annex contractor’s reports, vol. 2, in *Towards Postal Excellence: Report of the General Contractor*, President’s Commission on Postal Organization (Washington, DC: Government Printing Office, 1968), 2–24.

68. Before the inauguration of the Cost Ascertainment System in 1926, the Post Office did not collect comprehensive cost data on its services. Even after the introduction of the CAS, however, data on cost were disputed and ignored, as Congress fixed rates. See Foster Associates, “Rates and Rate-Making,” 2-8-2-13.

69. On this point, see Arthur D. Little, “The U.S. Post Office and Organizational Options for Its Improvement,” Annex Contractor’s Reports, vol. 1, in *Towards Postal Excellence: Report of the General Contractor*, President’s Commission on Postal Organization (Washington, DC: Government Printing Office, 1968), 109.

70. President’s Commission, *Towards Postal Excellence: Commission*, 35–36; Fuller, *American Mail*, 331–341; John T. Tierney, *The U.S. Postal Service: Status and Prospects of a Public Enterprise* (Boston: Auburn, 1988), 9–43; Richard B. Kielbowicz, *Postal Enterprise: Post Office Innovations with Congressional Constraints, 1789–1970*, prepared for the Postal Rate Commission (Seattle, 2000), 63–68, www.prc.gov/tsp/55/enterprise.pdf.

71. Before 1951, funds were made in 58 separate appropriations. Legislation in 1951 simplified the appropriations structure into eight accounts. The Post Office, before 1968, did have limited authority to transfer funds between accounts in amounts that did not exceed more than 2.5% of either donor or acceptor appropriations. Little, “Description of the Postal Service,” 6-33-6-34.

72. *Ibid.*, 6-87-6-88.

73. *Ibid.*, 6–30.

74. The disjunction between the time horizons of elected officials and the requirements of long-term planning are explored clearly by Pierson, *Politics in Time*.

75. By the late 1960s, 87.5% of postal workers were represented by 1 of 12 craft unions. The largest two unions, the National Association of Letter Carriers and the United Federation of Postal Clerks, represented well over half of all postal employees. President’s Commission, *Towards Postal Excellence: Commission*, 18–19.

76. They did this not only by lobbying Congress to limit the amount of money appropriated for investment in new technology but also by refusing to fully cooperate with some equipment field tests. See Baxter, *Labor and Politics*, 73–74.
77. Figure calculated from data in Little, “Description of the Postal Service,” 4–23, table 4.1.11.
78. Calculated from data in *ibid.*, 4-20-4-23, table 4.1.11; POD, *Annual Report, 1969*, 246, table 804.
79. Little, “Description of the Postal Service,” 4–20.
80. President’s Commission, *Towards Postal Excellence: Commission*, 27.
81. See “Frequently Asked Questions,” Smithsonian National Postal Museum, accessed September 20, 2017, <http://postalmuseum.si.edu/about/frequently-asked-questions/index.html#history10>.
82. Perrow highlights in passing the postal system as an example of a loosely coupled system, though he does not provide an analysis of the network. Perrow, *Normal Accidents*, 97–99.
83. Theodore E. Keeler, *Railroads, Freight, and Public Policy* (Washington, DC: Brookings Institution, 1983), 19–20; Ari Hoogenboom and Olive Hoogenboom, *A History of the ICC: From Panacea to Palliative* (New York: Norton, 1976), 7.
84. Railroads provided many obvious benefits over other modes of transportation. Unlike other forms of overland transportation, such as canals, the railroads were quicker, cheaper, and far more reliable—particularly in difficult weather conditions. Alfred D. Chandler Jr., *The Visible Hand: The Managerial Revolution in American Business* (1977; repr., Cambridge, MA: Harvard University Press, 1993), 86.
85. Despite support for subsidy, these same groups rarely called for public ownership of the railroads during the early period of development. Only a small number of railroads in the United States were ever operated as public enterprises, and by 1850, with few exceptions, these were transferred to private hands. *Ibid.*, 82; Frederick C. Clark, *State Railroad Commissions, and How They May Be Made Effective* (Baltimore: Guggenheimer and Weil, 1891), 12–14.
86. During the period before 1861, 30% of all funding for railroad building came from the state. The states spent an estimated \$350 million on railroads and canals before 1873. Gabriel Kolko, *Railroads and Regulation, 1877–1916* (Princeton, NJ: Princeton University Press, 1965), 15; Horwitz, *Irony of Regulatory Reform*, 54.
87. Eminent domain law allowed states to annex private land and provide it at a discounted price for the purpose of supporting the growth of railroads. The granting of rights-of-way plainly reduced the costs of constructing railroads and made them more feasible. Horwitz, *Irony of Regulatory Reform*, 49–54; Keeler, *Railroads, Freight, and Public Policy*, 20; Chandler, *Visible Hand*, 82; Richard Stone, *The Interstate Commerce Commission and the Railroad Industry: A History of Regulatory Policy* (New York: Praeger, 1991), 2–3.

88. Chandler, *Visible Hand*, 83.

89. *Ibid.*; Horwitz, *Irony of Regulatory Reform*, 58.

90. Often, railroads set local rates above through rates in an effort to capture long-haul traffic. This long/short divide disadvantaged farm producers and merchants situated on interior lines, who were effectively bypassed in favor of those situated at the ends of the lines. Hoogenboom and Hoogenboom, *History of the ICC*, 4–5.

91. Undisclosed rebates and drawbacks (rebates on competitor's freight) were used by the railroads to capture certain large industrial shippers and drew immense disapproval from competitors that were denied such benefits. Famously, Standard Oil was a beneficiary of such practices. *Ibid.*, 5.

92. For example, 1,300 farmers spread across eight different Wisconsin counties mortgaged their farms to raise \$1.5 million to attract rail service. Stone, *Interstate Commerce Commission*, 2–3; Hoogenboom and Hoogenboom, *History of the ICC*, 6–7.

93. Stone, *Interstate Commerce Commission*, 4; Horwitz, *Irony of Regulatory Reform*, 58; Wesley R. Kriebel and C. Phillip Baumel, "Issues in Freight Transportation Regulation," *American Journal of Agricultural Economics* 61, no. 5 (1979): 1003–1009; Lee Benson, *Merchants, Farmers, and Railroads: Railroad Regulation and New York Politics* (Cambridge, MA: Harvard University Press, 1955); Ida M. Tarbell, *The History of the Standard Oil Company* (New York: McClure, Philips, 1904).

94. Hoogenboom and Hoogenboom, *History of the ICC*, 5.

95. Under conditions of high fixed costs, increased volume does not dramatically alter cost. Hence, where competition exists, the inclination to slash rates to attract greater volume is acute. One estimate stated that during the 1880s as much as two-thirds of rail costs did not vary with volume carried. Chandler, *Visible Hand*, 134; Hoogenboom and Hoogenboom, *History of the ICC*, 2–3.

96. These practices were self-defeating and led to cycles of boom and bust. Freight revenue per ton-mile declined between 1870 and 1900 (just before ICC regulation became effective in maintaining stability) from \$1.88 in 1870 to \$1.22 in 1880, \$0.94 in 1890, and, finally, \$0.73 in 1900. Large customers on competitive lines extracted rebates of up to 50% of the published rate as railroads scrambled to maintain traffic levels. During the rate war of 1876 and 1877, eastbound freight rates fell from \$1.00 to \$0.15 per 100 lbs., while freight rates heading west fell from \$0.75 to \$0.25. Keeler, *Railroads, Freight, and Public Policy*, 21–22; Hoogenboom and Hoogenboom, *History of the ICC*, 2–3; Kolko, *Railroads and Regulation*, 7–12; Chandler, *Visible Hand*, 134–143; Horwitz, *Irony of Regulatory Reform*, 60–61; George W. Hilton, "The Consistency of the Interstate Commerce Act," *Journal of Law and Economics* 9 (1966): 90.

97. The first pools were formed as early as the 1850s. The major pools were created during the 1870s, first as informal agreements between regional competitors and then as formal administrative federations containing executive, legislative,

and judicial branches. Hoogenboom and Hoogenboom, *History of the ICC*, 4–5; Kolko, *Railroads and Regulation*, 8–9; Chandler, *Visible Hand*, 135.

98. Of the eight pools in operation in 1879, all but one rapidly failed. Chandler argues that consolidation and expansion helped buffer the ruinous effects of competition and, as a result, helped stabilize the industry to a greater degree than federal regulation. Yet, as Chandler later notes, these efforts did not eliminate rebates or drawbacks, two key elements of ruinous competition. Indeed, ruinous competition continued after the railroads pursued the creation of integrated systems. *Visible Hand*, 142–187. See also Kolko, *Railroads and Regulation*, 7–19, 64–101.

99. The first state commission was established in 1832 in Connecticut, though commissions remained irregular until the 1860s. Between 1860 and 1887, 20 state commissions were in operation; in New England, all states, with the exception of New Hampshire, had state commissions, while the Grange successfully pushed for strong state commissions in the Midwest. Generally, state commissions attempted to ensure that railroads operated as common carriers and did not refuse service, charged reasonable and nondiscriminatory rates, and did not discontinue or abandon service without the consent of those served. These provisions were, however, often self-enforcing and, as result, translated into little practical control. The majority of state commissions were weak; of 20 state commissions, only 8 had the power to set mandatory rates. The remaining commissions acted as advisory boards, with little power of enforcement. Benson, *Merchants, Farmers, and Railroads*, 1–2; Hoogenboom and Hoogenboom, *History of the ICC*, 7; Kolko, *Railroads and Regulation*, 16.

100. The case considered the status of state controls over the economy and, specifically, the granger laws. The case focused on grain elevators but was directly linked to the railroad issue. As the court opinion clarifies: “Property does become clothed with a public interest when used in a manner to make it of public consequence, and affect the community at large. When, therefore, one devotes his property to a use in which the public has an interest, he, in effect, grants to the public an interest in that use, and must submit to be controlled by the public for the common good, to the extent of the interest he has thus created.” The common-law principle of common callings, or, as it became known within the realm of transportation, common carriers, was applied to a wide swath of activities, including canals, turnpikes, millers, inns, and railroads. *Munn v. Illinois*, 94 U.S. 113, 116 (1876); Horwitz, *Irony of Regulatory Reform*, 49.

101. *Munn v. Illinois*, 94 U.S. at 132.

102. Horwitz, *Irony of Regulatory Reform*, 58; Hoogenboom and Hoogenboom, *History of the ICC*, 8; C. Gregory Bereskin, “Regulation, Deregulation, and Reregulation in the Surface Transportation Industry,” in *Transportation in the New Millennium: State of the Art and Future Directions, Perspectives from Transportation Research Board Standing Committees* (Washington, DC: Transportation Research Board, 2000), <http://onlinepubs.trb.org/onlinepubs/millennium/00097.pdf>.

103. *Wabash, St. Louis & Pacific Railway Company v. Illinois*, 118 U.S. 557 (1886); Hoogenboom and Hoogenboom, *History of the ICC*, 8; Keeler, *Railroads, Freight, and Public Policy*, 22; Horwitz, *Irony of Regulatory Reform*, 58–61.

104. Keeler, *Railroads, Freight, and Public Policy*, 22; Hoogenboom and Hoogenboom, *History of the ICC*, 18; Kolko, *Railroads and Regulation*, 44.
105. Stone, *Interstate Commerce Commission*, 5; Horwitz, *Irony of Regulatory Reform*, 63.
106. Keeler, *Railroads, Freight, and Public Policy*, 23.
107. *Ibid.*, 22.
108. Hoogenboom and Hoogenboom, *History of the ICC*, 17–18.
109. *Ibid.*, 118; Kolko, *Railroads and Regulation*, 45–63.
110. Kolko, *Railroads and Regulation*, 45–63.
111. After some initial success in enacting rail regulations, a series of court decisions in the 1890s circumscribed the power of the commission. In 1889, during the first appeal of an ICC decision, the presiding Federal Circuit Court ruling insisted on rehearing and examining evidence previously submitted. As a result, the courts routinely considered new evidence and reevaluated evidence already presented to the ICC during the appeals process. This practice undercut the authority of the commission and gave the courts tight control over the regulatory process. During the 1890s, the Supreme Court further reduced the power and effectiveness of the ICC. In *Smyth v. Ames* (1898) (also known as *Maximum Freight Rate*), the court stripped the ICC of the power to set rates, while in *U.S. v. Trans-Missouri* (1897) the court argued that cartel agreements and joint rates, which the ICC had moved to adopt and support, violated the Sherman Antitrust Act. Horwitz, *Irony of Regulatory Reform*, 11; Stone, *Interstate Commerce Commission*, 7–8; Hoogenboom and Hoogenboom, *History of the ICC*, 30–31; Kolko, *Railroads and Regulation*, 71–83; *Smyth v. Ames*, 169 US 466 (1898); *U.S. v. Trans-Missouri* 166 US 290 (1897).
112. These were the Elkins Act (1903), the Hepburn Act (1906), and the Mann-Elkins Act of 1910. The Elkins Act made the published rate the legal rate and made deviations, such as rebates, punishable by law. The act also allowed for joint or collective rate making by the railroads. The Hepburn Act gave the ICC the power to replace existing rates and made ICC decisions binding, shifting power away from the courts and back to the ICC. It also provided the ICC with the power to appoint examiners and agents to inspect railroad accounts. Finally, the Mann-Elkins Act gave the ICC the power to suspend rates and determine if circumstances between routes were substantially different enough to warrant pricing differences. Together, the acts provided the ICC with powers that the courts had previously neutered. Keeler, *Railroads, Freight, and Public Policy*, 23; Stone, *Interstate Commerce Commission*, 10–12; Kolko, *Railroads and Regulation*, 58–61; Hoogenboom and Hoogenboom, *History of the ICC*, 60–61.
113. Performance under regulation increased: between 1888 and 1910, the percentage of railroad stocks paying dividends rose from 39% to 67%; during the same period, the average rate of dividends paid increased from 2.1% to 5%. Kolko, *Railroads and Regulation*, 232.
114. Although pooling was formally prohibited by the ICC, from its very beginning it achieved the desired end: the elimination of rate competition.

In drawing regulations the ICC allowed, informally at first and then legally, collective rate making through rate associations and eventually set maximum and minimum rate thresholds. Eventually, the Transportation Act of 1920 legalized pools, subject to ICC approval. Hoogenboom and Hoogenboom, *History of the ICC*, 18–29, 60–61, 109; Kolko, *Railroads and Regulation*, 58–63, 100.

115. Kolko, *Railroads and Regulation*, 58–63, 100; Keeler, *Railroads, Freight, and Public Policy*, 25–46.

116. Federal regulations also provided the railroads with a single set of predictable standards. One of the key concerns of rail interests before the enactment of federal regulations centered on the unpredictability of regulations at the state level. Federal regulations eliminated this problem and allowed the railroads to engage in long-term planning with some confidence. Kolko, *Railroads and Regulation*, 116–117, 232; Horwitz, *Irony of Regulatory Reform*, 34; Keeler, *Railroads, Freight, and Public Policy*, 23.

117. This principle was consistently put into practice by the ICC and appeared as early as 1890. The 1914 ICC ruling on a proposed general rate increase, in what is known as the 5 Percent Case, formalized this policy. The 1920 Transportation Act fixed the rate of return at 6%. Stone, *Interstate Commerce Commission*, 21; Kolko, *Railroads and Regulation*, 54, 210–217.

118. The predictability of published rates also allowed shippers to better forecast their costs and plan accordingly. Stone, *Interstate Commerce Commission*, 11; Hoogenboom and Hoogenboom, *History of the ICC*, 3, 42–45; Kolko, *Railroads and Regulation*, 93–96.

119. Keeler, *Railroads, Freight, and Public Policy*, 22–23; Horwitz, *Irony of Regulatory Reform*, 60–63.

120. One of the key aims of the Transportation Act of 1920 was to introduce a plan to consolidate the railroad system into a more efficient network. Such a plan was commissioned but ultimately ignored. Keeler, *Railroads, Freight, and Public Policy*, 26.

121. Jean-Paul Rodrigue, Claude Comtois, and Brian Slack, *The Geography of Transport Systems* (New York: Routledge, 2009), <http://people.hofstra.edu/geotrans/index.html>.

122. Redundant track included both small branch lines unsupported by traffic and duplicate or parallel lines connecting two points. Hilton, “Interstate Commerce Act,” 92–93.

123. Rodrigue, Comtois, and Slack, *Geography of Transport Systems*.

124. The redundancy and excess capacity of the railroad system was not, then, simply a by-product of the growth of other modes of transportation (such as air and truck). Rather, it was established during the 19th-century growth of the network. The development of competing modes merely reinforced these qualities. Richard C. Levin, “Regulation, Barriers to Exit, and the Investment Behavior of Railroads,” in *Studies of Economic Regulation*, ed. Gary Fromm (Cambridge, MA: MIT Press, 1981), 184.

125. Keeler, *Railroads, Freight, and Public Policy*, 26, 42; William R. Dougan, “Railway Abandonments, Cross-Subsidies, and the Theory of Regulation,” *Public Choice* 44, no. 2 (1984): 300–301.

126. Keeler, *Railroads, Freight, and Public Policy*, 21–39.

127. In the decade before deregulation, only 1% of total track was put up for abandonment. Of proposed abandonments, nearly all, 97.5%, were approved by the ICC. Levin, “Regulation,” 216–217; Dougan, “Railway Abandonments,” 302.

128. Keeler, *Railroads, Freight, and Public Policy*; Dougan, “Railway Abandonments,” 302; Levin, “Regulation,” 182; Rodrigue, Comtois, and Slack, *Geography of Transport Systems*.

129. Keeler, *Railroads, Freight, and Public Policy*, 42.

130. For a discussion of the history of DT&I conditions, see Darius W. Gaskins, “Regulation of Freight Railroads in the Modern Era: 1970–2010,” *Review of Network Economics* 7, no. 4 (2008), doi:10.2202/1446–9022.1162; Detroit, Toledo, and Ironton v. ICC, 725 F.2d 47 (1984).

131. Value-of-service pricing encouraged, by design, the widest possible utilization of the rail network and specifically encouraged rural farmers to ship via rail. In this way it also supported the continuation of an expansive network; whereas cost-of-service pricing would have discouraged the use of costly rural services, the adoption of value-of-service pricing encouraged wide use of the network. Stone, *Interstate Commerce Commission*, 13; Keeler, *Railroads, Freight, and Public Policy*, 14; Ann F. Friedlaender and Richard H. Spady, *Freight Transport Regulation: Equity, Efficiency, and Competition in the Rail and Trucking Industries* (Cambridge, MA: MIT Press, 1981), 1–3.

132. Ann F. Friedlaender, *The Dilemma of Freight Rail Transportation* (Washington, DC: Brookings Institution, 1969), 101.

133. Historically, states and local governments also provided funding for the development of roads.

134. Friedlaender, *Dilemma*, 1–27, 65–127; John Meyer et al., *The Economics of Competition in the Transportation Industries*, Harvard Economic Studies (Cambridge, MA: Harvard University Press, 1959); Keeler, *Railroads, Freight, and Public Policy*, 8–29.

135. GAO, *Railroad Regulation: Economic and Financial Impact of Staggers Rail Act of 1980*, GAO/RCED-90–80 (Washington, DC, 1990), 53.

136. United States Census Bureau, *Commodity Transportation Survey, Economic Census* (Washington, DC: GPO, 1963, 1967, 1972, 1977).

137. Transportation Research Board, *Cooperative Research for Hazardous Materials Training: Defining the Need, Converging on Solutions—Special Report 283* (Washington, DC: National Academies Press, 2005), 19, doi:10.17226/11198. For detailed information, see also U.S. Department of Transportation, *Commodity Flow Survey, Economic Census: Transportation* (Washington, DC, 1993–2016), http://www.bts.gov/publications/commodity_flow_survey/.

138. For a detailed discussion, see D. F. Brown, W. E. Dunn, and A. J. Policastro, *A National Risk Assessment for Selected Hazardous Materials in Transportation* (Argonne, IL: Argonne National Laboratory, 2000).

139. A *natural monopoly* is an industry with economies of scale in which average cost decreases as the size of the producing firm increases. Under these conditions, it is most beneficial to have one firm operating. See Alfred Kahn, “The Role and Definition of Competition: Natural Monopoly,” in *The Economics of Regulation: Principles and Institutions*, vol. 2, *Institutional Issues* (New York: Wiley and Sons, 1971), 113–171.

140. Mark Granovetter and Patrick McGuire, “The Making of an Industry,” in *Laws of the Markets*, ed. Michel Callon (New York: Blackwell, 1998), 147–73. See also Hughes, *Networks of Power*, 216–229; Richard F. Hirsh, *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System* (Cambridge, MA: MIT Press, 1999), 23–26; Douglas D. Anderson, *Regulatory Politics and Electric Utilities: A Case Study in Political Economy* (Boston: Augurn, 1981), 33–56.

141. Sharon Beder, *Power Play: The Fight to Control the World’s Electricity* (New York: New Press, 2003), 30.

142. Granovetter and McGuire, “Making of an Industry”; Richard F. Hirsh, “Emergence of Electrical Utilities in America,” *Powering the Past: A Look Back*, Smithsonian Institute, last modified September 2002, <http://americanhistory.si.edu/powering/past/h1main.htm>.

143. John F. Wasik, *The Merchant of Power: Sam Insull, Thomas Edison, and the Creation of the Modern Metropolis* (New York: Palgrave Macmillan, 2006), 3, 170, 203.

144. *Ibid.*

145. Insull was an early booster of the steam turbine as a replacement for the reciprocating steam engine. Steam turbines utilized roughly one-tenth the space of reciprocating steam engines and, eventually, were able to generate far greater amounts of power. *Ibid.*

146. This model of electricity provision, which Edison in effect inaugurated with the Pearl Street Station, is often described as centralized, as it pairs generation and a network of users. However, it is important to note that the degree of centralization was qualified and limited. As will be discussed below, control was organized at the level of individual power systems and the electric power grid, in aggregate, comprised a web of functionally discrete and autonomous linked systems. Note: transmission lines are high-voltage lines running from generating plants to substations; distribution lines are lower-voltage lines that connect directly to end users.

147. Insull divided customers into 11 different classes of consumers in order to analyze the diversity of demand. He particularly prized ice manufacturers because their demand was at its lowest on cold days when demand from other customers was at its peak. Hughes, *Networks of Power*, 217–218.

148. These ideas were not Insull’s alone. British engineer John Hopkinson and electricity manager Arthur Wright pioneered and outlined the importance of the

concepts of *load factor*, the ratio between average and peak demand, and the diversity of demand for electricity that Insull adopted. Hirsh, *Technology and Transformation*, 17–18; Hirsh, “Emergence”; Hughes, *Networks of Power*, 216–219.

149. Indeed, until 1915 the majority of consumers in the U.S. relied on isolated systems for electric power. Granovetter and McGuire, “Making of an Industry.”

150. Chicago, for example, issued 20 nonexclusive, competitive franchises between 1882 and 1905. Hirsh, *Power Loss*, 14.

151. *Ibid.*, 15; Beder, *Power Play*, 24.

152. Hirsh, *Power Loss*, 13–14.

153. Hirsh, *Power Loss*, 13; Wasik, *Merchant of Power*, 79–81.

154. Beder, *Power Play*, 27; Hughes, *Networks of Power*, 207.

155. Forrest McDonald, “Samuel Insull and the Movement for State Utility Regulatory Commissions,” *Business History Review* 32, no. 3 (1958): 241–254; Granovetter and McGuire, “Making of an Industry”; Hirsh, *Power Loss*, 21–23.

156. Hirsh, “Emergence”; Hirsh, *Power Loss*, 19–23; Anderson, *Regulatory Politics*, 48.

157. Generally, Progressives sought across spheres of the economy, not only in electric power, to harness the seeming inherent advantages afforded by large corporate operations with the tempering influence of state oversight. See Hirsh, *Power Loss*, 23; Arthur Schlesinger Jr., *Crisis of the Old Order, 1919–1933* (Boston: Houghton Mifflin, 1957).

158. Beder, *Power Play*, 27–30; Hughes, *Networks of Power*, 207; McDonald, “Samuel Insull,” 251; Anderson, *Regulatory Politics*, 4–16.

159. State regulatory bodies controlled entry through the granting of franchises. James E. Meeks, “Concentration in the Electric Power Industry: The Impact of Antitrust Policy,” *Columbia Law Review* 72, no. 1 (1972): 95–96.

160. Hirsh, “Emergence”; Beder, *Power Play*, 28–30; Granovetter and McGuire, “Making of an Industry.”

161. Hirsh, “Emergence.”

162. Hirsh, “Emergence”; Beder, *Power Play*, 28–30; Granovetter and McGuire, “Making of an Industry.”

163. Hirsh, *Power Loss*, 15–31.

164. *Ibid.*, 26–27; Beder, *Power Play*, 28–29; Anderson, *Regulatory Politics*, 61–88.

165. Hughes, *Networks of Power*, 325.

166. Hughes, *Networks of Power*, 292.

167. The war drove demand for electricity and stressed the capacity of providers, particularly in areas undertaking the production of munitions and shipbuilding. In 1917, army engineers working under the newly formed War Industries Board conducted a survey of U.S. generating capacity in order to determine if the electric power facilities were sufficient to support mobilization.

Even though new, fast-tracked construction projects would have increased generating capacity by 10% in two years, the study forecast dire shortfalls that could have crippled the war effort. Leonard DeGraaf, "Corporate Liberalism and Electric Power System Planning in the 1920s," *Business History Review* 64, no. 1 (1990): 15; Thomas P. Hughes, "Technology and Public Policy: The Failure of Giant Power," *Proceedings of the IEEE* 64, no. 9 (1976): 1363; Hughes, *Networks of Power*, 289–292.

168. Hughes, *Networks of Power*, 292; Hughes, "Technology and Public Policy," 1361–1372; DeGraaf, "Corporate Liberalism," 1–31.

169. Hughes, *Networks of Power*, 289–292.

170. The voltage of transmission lines doubled every 10 years during the early 1900s. In 1900, 50,000 V lines were commercially available; in 1910, 110,000 V lines were available; and in 1920, 220,000 V were in use. Hughes, "Technology and Public Policy," 1362.

171. Hughes, *Networks of Power*, 292; Hughes, "Technology and Public Policy," 1361–1372; DeGraaf, "Corporate Liberalism," 1–31.

172. Julie A. Cohen, *The Grid: Biography of an American Technology* (Cambridge, MA: MIT Press, 2017), 126.

173. On the differences among the plans, see DeGraaf, "Corporate Liberalism."

174. Super Power sought to integrate electric power systems stretching from Boston to Washington, DC, into a single system boosted by additional large plants and transmission lines under the control of a new advisory board, the North America Super Power Board, which would assume the role of coordinating the distribution of power across the newly interconnected system of utilities. Giant Power, as envisioned, was a more radical public intervention. It called for a new Giant Power Board and the creation of new plants situated at mine mouths in Pennsylvania that could export power to load centers throughout the state and, eventually, to New York and New Jersey as well, across high-voltage transmission lines. Under this system, the state would reserve the right to take over private facilities in 50 years, and a stricter policy for setting rates that was not as hospitable to utilities would be implemented. *Ibid.*, 1–12; Hughes, *Networks of Power*, 296–313.

175. Initially, private utilities voiced some support for Super Power when it was first discussed in 1919. Quickly, however, as capital markets loosened and holding companies began having success at integrating operations outside of government control, industry turned against plans for Super Power. DeGraaf, "Corporate Liberalism," 11.

176. Hughes, *Networks of Power*, 308.

177. Hirsh, "Emergence"; U.S. Energy Information Administration (EIA), *Public Utility Holding Company Act of 1935: 1935–1992* (Washington, DC: Department of Energy, 1993), 5–6, <https://www.eia.gov/electricity/archive/0563.pdf>; Benjamin Graham and David Dodd, *Security Analysis: The Classic 1940 Edition*, 2nd ed. (New York: McGraw-Hill, 2002).

178. Between 1922 and 1927, the number of holding companies increased from 102 to 180, while the number of operating companies actually declined, from

roughly 6,000 to 4,000. In the following years, the trend toward consolidation continued as the ownership of more than half of all private utility companies changed hands. From 1927 to 1930, there were an astounding 2,500 changes of ownership, the majority involving holding companies gaining control over independent operators. Hirsh, "Emergence"; EIA, *Public Utility*, 5–6.

179. Holding companies not only served as tools for speculation and the overvaluation of operating companies. They also provided some legitimate benefits. They attracted investment to the capital-intensive industry and allowed the pooling of technical and managerial resources between previously failing smaller utilities and larger units. Hirsh, *Technology and Transformation*, 23–24; William Emmons III, "Franklin D. Roosevelt, Electric Utilities, and the Power of Competition," *Journal of Economic History* 53, no. 4 (1993): 883.

180. Three holding companies controlled nearly half the electricity in the country. "Section 11(b) of the Holding Company Act: Fifteen Years in Retrospect," *Yale Law Journal* 59, no. 6 (1950): 1088; Emmons, "Franklin D. Roosevelt," 883.

181. "Section 11(b)," 1111; DeGraaf, "Corporate Liberalism." For a larger discussion of the rise and breadth of holding companies, see Hughes, *Networks of Power*, 363–403.

182. Beder, *Power Play*, 62; Hughes, *Networks of Power*, 400–401.

183. Hughes, *Networks of Power*, 400–401; Hughes, "Technology and Public Policy," 1368.

184. Hughes, "Technology and Public Policy," 1363, 1368.

185. Emmons, "Franklin D. Roosevelt," 883; Hirsh, "Emergence"; "Section 11(b)," 1099.

186. Though none quite as spectacularly as Insull's Middle West Utilities Company. In 1929 shares of Insull's company traded at \$57 but were worth only \$0.25 in 1932 before it declared what was at the time the largest bankruptcy in history. The damage was stark: 100,000 stockholders lost what would today be roughly \$4 billion, including company employees who had been exhorted to invest in the company. The Middle West Utilities Company was unique only in the size of the failure, as the Great Depression drove holding companies, and the larger economy, to ruin. Beder, *Power Play*, 64; Emmons, "Franklin D. Roosevelt," 883–885; EIA, "Public Utility," 1–8; Hirsh, *Power Loss*, 40; "Section 11(b)," 1089.

187. Wasik, *Merchant of Power*, 200.

188. *Ibid.*, 201.

189. Quoted in Beder, *Power Play*, 65; Hirsh, "Emergence." See also EIA, "Public Utility," 1–8; Emmons, "Franklin D. Roosevelt," 883–885.

190. Roosevelt attacked the utility problem through three directions: (1) The PUHCA sought to break up holding companies and return them to effective state control; (2) the Tennessee Valley Authority attempted to spur regional economic development and lower electricity prices through the introduction of regional competition via the new public project; (3) the Rural Electric Administration made available loans to assist rural cooperatives in setting up their

own power systems. Though each of these initiatives was important, I focus on PUHCA, as it most directly affected the architecture of electric power networks. Emmons, "Franklin D. Roosevelt," 885–886. On the run up to the PUHCA, see also Hughes, *Networks of Power*, 392–393.

191. EIA, "Public Utility," 1; Emmons, "Franklin D. Roosevelt," 883–885.

192. "Section 11(b)," 1094.

193. *Ibid.*, 1094–1104; Hirsh, "Emergence."

194. Multiple systems could be retained if a system (1) could not otherwise be operated without a substantial economic burden, (2) resided in the same or adjoining state, and (3) would not impair the advantage of local management. In practice, the SEC developed a strict interpretation of the new law and required that systems be fully integrated and serve a single area (known as the *single-area interpretation*). "Section 11(b)," 1100–1104.

195. The number of holding companies registered with the SEC dropped to less than 20, while over 750 systems with assets valued at over \$7 billion were divested from various holding companies. For a thorough discussion of section 11(b) and its scope, purpose, and eventual interpretation, see "Section 11(b)."

196. *Ibid.*, 1104.

197. Hughes, *Networks of Power*, 401.

198. Barney Capehart, ed., *Encyclopedia of Energy Engineering and Technology* (Boca Raton: CRC Press, 2007), 392; "Section 11(b)," 1111.

199. Meeks, "Concentration," 67–69.

200. Cohen, *Grid*.

201. Hughes, *Networks of Power*, 372–374; Theodore J. Nagel, "Operation of a Major Electric Utility Today," *Science* 201, no. 4360 (1978): 985; F. D. Boardman, "Future Developments in the Control of Power Systems," *Philosophical Transactions of the Royal Society of London, Series A, Mathematical and Physical Sciences* 275, no. 1248 (1973): 244; James M. Griffin and Steven L. Puller, "Introduction: A Primer on Electricity and the Economics of Deregulation," in *Electricity Deregulation: Choices and Challenges* (Chicago: University of Chicago Press, 2005), 5.

202. Cohen, *Grid*, 51.

203. As Hughes notes, the central dispatcher had to be something of a historian, understanding patterns of use for the area under control. As early as 1910, central dispatch regularly had access to compiled records displaying hourly system output going back several years that could be matched against demand. *Networks of Power*, 215. For an overview of the use of real-time technologies in electrical power, see Nathan Cohn, "Recollections of the Evolution of Realtime Control Applications to Power Systems," *Automation* 20, no. 2 (1984): 145–162; Nagel, "Operating." For a detailed technical discussion of the history of control technology as it relates to electrical power and beyond, see Stuart Bennett, *A History of Control Engineering, 1800–1930* (New York: Institution of Electrical Engineers, 1979); Stuart Bennett, *A History of Control Engineering, 1930–1955* (London: Institution of Electrical Engineers, 1993).

204. Hirsh, *Technology and Transformation*, 80–82; Anderson, *Regulatory Politics*; GAO, *Changes in Electricity-Related R&D*, GAO/RCED-96-203 (Washington, DC, 1996), 3.

205. The normative case suggesting that firms under rate-of-return regulation seek investment in capital-intensive projects as a means of expanding profit is dealt with in the classic work by Harvey Averch and Leland L. Johnson, “Behavior of the Firm under Regulatory Constraint,” *American Economic Review* 52, no. 5 (1962): 1052–1069. The general phenomena, as a result, are known as the *Averch-Johnson effect* in the economics literature. See also E. David Emery, “Regulated Utilities and Equipment Manufacturers’ Conspiracies in the Electric Power Industry,” *Bell Journal of Economics and Management Science* 4, no. 1 (1973): 322–337.

206. State regulatory commissions did not have the staff to provide such detailed oversight. Nor was there a real call to do so until the upheavals of the 1970s and the advent of regulatory activism, which will be discussed in the next chapter. This gap, between shifting costs and unadjusted, stable rates, is known as regulatory lag. Hirsh, *Technology and Transformation*, 112–113, 150–152; Anderson, *Regulatory Politics*, 71.

207. Nathan Cohn et al., “On-Line Computer Applications in the Electric Power Industry,” *Proceedings of the IEEE* 58, no. 1 (1970): 78.

208. The replacement of manual controls with automated, computerized controls reduced but did not eliminate the hand of the operator. In addition to the programming and maintenance, even closed-loop automated power systems required a degree of operator oversight and contained interfaces to this end. Nagel, “Operating,” 988.

209. Hirsh, *Technology and Transformation*, 84; Cohen, *Grid*.

210. This is not to say that such technologies did not improve utility performance or that utility managers did not see their adoption as a good faith effort to improve operation. Rather, the structure of incentives as designed under rate-of-return regulation simply made adoption more attractive regardless.

211. Vannevar Bush suggested that there were essentially three different ways to study the stability of power systems: direct experience, test of laboratory models, and mathematical analysis. Bush turned toward the latter two options; the actual systems were too new, expensive, and complex to allow direct experimentation and testing. David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics* (Baltimore: Johns Hopkins University Press, 2002), 146; Larry Owens, “Vannevar Bush and the Differential Analyzer: The Text and Context of an Early Computer,” *Technology and Culture* 27, no. 1 (1986): 66–67.

212. GE provided funding, equipment, and facilities and shared research. The linkages between MIT and GE extended to an innovative cooperative master’s program that combined study and periods of work at GE’s Lynn plant, which graduated its first class in 1922. Hughes, *Networks of Power*, 376–377; Mindell, *Between Human and Machine*, 152–158; Fredrick E. Terman, “A Brief History of Electrical Engineering Education,” *Proceedings of the IEEE* 86, no. 8

(1998): 1796–1797, classic paper, reprinted from *Proceedings of the IEEE* 64, no. 9 (1976): 1399–1406; Aristotle Tympas, “Perpetually Laborious: Computing Electric Power Transmission before the Electric Computer,” *International Review of Social History* 48 (2003): 73–95.

213. The study of transients was central to the work Bush and the Electrical Engineering Department of MIT conducted during the 1920s and early 1930s. The network analyzer used small transformers as generators and motors, artificial lines, and a plugboard from a telephone exchange to allow reconfiguration. The network analyzer reproduced a 200 mi. system within 50 ft.² and differed from other earlier models and AC and DC calculating boards in that it was programmable: it could be reconfigured to represent and model different systems. The differential analyzer was the latest in a line of mechanical calculating machines that included the earlier intergraph. For an overview of the creation of the network analyzer and the differential analyzer, see Mindell, *Between Human and Machine*, 143–158; Owens, “Vannevar Bush,” 63–95; Hughes, *Networks of Power*, 376–377; Aristotle Tympas, “From Digital to Analog and Back: The Ideology of Intelligent Machines in the History of the Electric Analyzer, 1870s–1960s,” *IEEE Annals of the History of Computing* 18, no. 4 (1996): 42–48.

214. Mindell, *Between Human and Machine*, 152–153, 157–158; Tympas, “From Digital to Analog,” 45.

215. For a detailed overview of Westinghouse’s R&D of computational and computing equipment, see William Aspray, “Edwin L. Harder and the Anacom: Analog Computing at Westinghouse,” *IEEE Annals of the History of Computing* 15, no. 2 (1993): 35–52.

216. Hughes, *Networks of Power*, 377; Thomas Haigh, Mark Priestley, and Crispin Rope, *ENIAC in Action: Making and Remaking the Modern Computer* (Cambridge, MA: MIT Press, 2018), 7.

217. Gene Smith, “Computer to Get New Power Role,” *New York Times*, July 6, 1958, F1.

218. For contemporary news accounts, see Smith, “Computer to Get New Power Role”; “Daystrom to Build System for Utility,” *New York Times*, March 12, 1959, New York edition, 40; Gene Smith, “Automation Due in Power Plants,” *New York Times*, February 5, 1961, F1; “Computer Industry Chalks Up a Big Day,” *New York Times*, April 4, 1963, New York edition, 67; Gene Smith, “Power Industry Adds Computers,” *New York Times*, October 8, 1964, New York edition, 63.

219. Robert H. Miller, *Power System Operation* (New York: McGraw-Hill, 1983), 47; Jerry Russell, “Brief History of SCADA/EMS,” accessed September 21, 2017, <http://scadahistory.com/index.html>; Gordon Friedlander, “Computer-Controlled Power Systems: Part II—Area Controls and Load Dispatch,” *IEEE Spectrum* 2, no. 5 (May 1965): 72–91; J. N. Boucher, “Real-Time Energy Control” (paper presented at the 1979 Power Industry Computer Applications Conference, Cleveland, OH), 177–184.

220. Cohn, “Recollections,” 157–159; Friedlander, “Computer-Controlled Power Systems,” 72–89. On the development of economic dispatch techniques

and computers, see E. D. Early, W. E. Philips, and W. T. Shreve, "An Incremental Cost of Power-Delivered Computer," *Transactions of the American Institute of Electrical Engineers* 74, no. 3 (1955): 529–535; C. D. Morrill and J. A. Blake, "A Computer for Economic Scheduling and Control of Power Systems," *Transactions of the American Institute of Electrical Engineers* 74, no. 3 (1955): 1136–1142.

221. Martin H. Weik, *A Fourth Survey of Domestic Electronic Digital Computing Systems*, Ballistic Research Laboratories, report no. 1227, January 1964, 89, accessed July 10, 2018, <http://ed-thelen.org/comp-hist/BRL64.html#TOC>.

222. *Ibid.*

223. *Ibid.*

224. On generativity, see Johnathan Zittrain, *The Future of the Internet—and How to Stop It* (New Haven, CT: Yale University Press, 2008).

225. *Ibid.*

226. *Munn v. Illinois*, 94 U.S.

Chapter 2

1. Richard Nixon, "Remarks on Reform of the Nation's Postal System," September 2, 1969, transcript, The American Presidency Project, <https://www.presidency.ucsb.edu/documents/remarks-reform-the-nations-postal-system>.

2. Robert B. Simple Jr., "Nixon Again Urges Postal Corporation," *New York Times*, September 3, 1969.

3. See *ibid.*; "The Halt and the Blind," *New York Times*, July 11, 1969.

4. Lawrence F. O'Brien, *No Final Victories: A Life in Politics from John F. Kennedy to Watergate* (New York: Doubleday, 1974), 210–211.

5. Albin Krebs, "Lawrence O'Brien, Democrat, Dies at 73," *New York Times*, September 29, 1990.

6. O'Brien, *No Final Victories*, 210–211; Baxter, *Labor and Politics*, 83–85.

7. Baxter, *Labor and Politics*, 83–85.

8. O'Brien, *No Final Victories*, 210–211.

9. As quoted in Ted Sell, "Nixon Plea for P.O. Reform," *Boston Globe*, September 3, 1969.

10. O'Brien, *No Final Victories*, 211.

11. *Ibid.*, 210–211.

12. Krebs, "Lawrence O'Brien."

13. On the unexpectedness of deregulation, see Martha Derthick and Paul Quirk, *The Politics of Deregulation* (Washington, DC: Brookings Institution, 1985); Horwitz, *Irony of Regulatory Reform*; Richard H. K. Vietor, *Contrived Competition: Regulation and Deregulation in America* (Cambridge, MA: Belknap Press of Harvard University Press, 1994).

14. See Judt, *Ill Fares the Land*.

15. Per capita volume growth was just as striking. In 1970 per capita mail volume was 421 for each person in the U.S., compared to 371 in 1965 and 228 in 1930. Gerald Cullinan, *The United States Postal Service* (New York: Praeger, 1973), 2; Fuller, *American Mail*, 334; POD, *Annual Report, 1969*, 236–241, table 801.
16. POD, *Annual Report, 1969*, 236–241, table 801.
17. Congress consistently refused to increase investment in postal infrastructure (in the form of creating new facilities or investing in new technologies to modernize sorting and transportation) through rate increases (which were never popular) or appropriations. For a complete discussion of the relationship between the structure of regulation and mail processing, see chapter 1. The decline in rail service was sharp and challenged the ability of the Post Office to move the mail quickly and efficiently. Post offices had been strategically located adjacent to rail lines in order to assist quick processing and distribution, and railway postal cars provided in-transit sorting. With the decline of rail and the subsequent shift to truck and air, the postal network became increasingly difficult to access, and the railway postal cars became mostly a curiosity. President's Commission, *Towards Postal Excellence: Commission*, 170.
18. Eventually, extra workers were hired, others worked overtime, and the situation was corrected. Kathleen Conkey, *The Postal Precipice: Can the U.S. Postal Service be Saved?* (Washington, DC: Center for the Study of Responsive Law, 1983), 37; President's Commission, *Towards Postal Excellence: Commission*, 11–14.
19. President's Commission, *Towards Postal Excellence: Commission*, 12.
20. Lawrence F. O'Brien, "Lawrence F. O'Brien Oral History Interview XXI," June 18, 1987, interview by Michael L. Gillette, LBJ Library, http://www.lbjlibrary.net/assets/documents/archives/oral_histories/obrien_l/OBRIEN21.PDF.
21. The case for reorganization is provided in the Kappel Commission's report and supplementary documentation. See President's Commission, *Towards Postal Excellence: Commission*; President's Commission on Postal Organization, *Towards Postal Excellence: Report of the General Contractor*, Annex Contractor's Reports, vol. 1–4 (Washington, DC: Government Printing Office [GPO], 1968).
22. Blount only accepted the position of postmaster general on the condition that President Nixon support him in seeking reform. The Citizens Committee for Postal Reform was created at the behest of the Nixon administration to help advance the difficult cause of postal reform. The cochairs of the committee were O'Brien and Thurston Morton, former chairs, respectively, of the Democratic and Republican National Committees. O'Brien, "Lawrence F. O'Brien Oral History"; Robert Saltzstein and Ronald Resh, "Postal Reform: Some Legal and Practical Considerations," *William and Mary Law Review* 12, no. 4 (1971): 766–786; Murray B. Comarow, "The Strange Story of Postal Reform" (Washington, DC: Federal Trade Commission, 2007), accessed June 5, 2013,

<https://web.archive.org/web/20130605181043/http://www.ftc.gov/os/comments/USPS%20Study/529332-00004.pdf>.

23. Most notably, during the 1840s private expresses mounted a sustained challenge to the legitimacy and viability of the Post Office. See Priest, "History of the Postal Monopoly," 33–80.

24. POD, *Annual Report, 1969*, 236–241.

25. Richard John and Richard Kielbowicz note the important role that postal rates played in the development of a national market for information and the publishing industry. See John, *Spreading the News*; Kielbowicz, *News in the Mail*. Theda Skocpol notes that the spread of voluntary associations on a national scale mimicked the structure of the federal government and was supported by cheap second-class postage. *Diminished Democracy: From Membership to Management in American Civic Life* (Norman: University of Oklahoma Press, 2003). After Andrew Jackson took office in 1829, the Post Office functioned as an adjunct to the growing national political parties and as a key means of allocating spoils. Postmaster positions, representing each district in the nation, were lucrative (particularly when combined with operating a store or other business) and were an easy way of keeping the political machinery well oiled. John, *Spreading the News*, 206–256; Fuller, *American Mail*, 285–330. Civil service reform and the passage of the Pendleton Act in 1883 did little to separate the connection between the postal bureaucracy and the spoils system. Postmaster positions were exempt from the reform and were still doled out according to political favoritism. For example, Postmaster General Wanamaker replaced over 48,000 of the total 56,315 postmasters during his tenure (1889–1893) in office. Wayne E. Fuller, *RFD: The Changing Face of Rural America* (Bloomington: Indiana University Press, 1964), 86. Clerks and city mail carriers, the bulk of the urban workforce, however, did come under civil service regulation during the early 1900s. Fuller, *American Mail*, 310–330.

26. Special interests played a key role in postal rates and classifications. Importantly, however, these interests were not only external to postal policy but were creations of postal policy. See Kennedy, "Postal Rates."

27. Though challenges were frequent, none was quite as serious as that presented by the private express companies during the middle decades of the 19th century. On how the linkages between the Post Office, political parties, and the publishing industry helped to maintain the unique iteration of postal service, see Priest, "History of the Postal Monopoly"; Richard R. John, "Private Mail Delivery in the United States during the Nineteenth Century: A Sketch," *Business and Economic History* 2, no. 15 (1986): 135–147.

28. Letter carrier unions and voluntary associations were founded in the wake of the creation of free city delivery in 1863. By the early 1960s, the Post Office was one of the most heavily unionized areas of government, with 87.5% of all workers belonging to one of the craft unions. Although these workers could not legally strike, Executive Order No. 10988 in 1962 recognized unions within federal agencies. President's Commission, *Towards Postal Excellence: Commission*, 18–22, 114. A detailed history of the unionization of the postal workforce

can be found in Sterling D. Spero, *The Labor Movement in a Government Industry: A Study of Employee Organization in the Postal Service* (New York: Arno, 1971).

29. In 1970 postal workers engaged in a wildcat strike over wages and working conditions that severely affected service. As part of negotiations to end the strike, the unions and administration worked out the deal to secure passage of the PRA. Tierney, *Postal Service*, 15–31; Conkey, *Postal Precipice*, 52–58; President’s Commission, *Towards Postal Excellence: Commission*, 102.

30. Postmaster General O’Brien played a key in shaping the ultimate recommendations of the commission. See O’Brien, “Lawrence F. O’Brien Oral History.”

31. The Kappel Commission argued that reorganization would reduce postal costs by 20% without having an impact on levels of service. President’s Commission, *Towards Postal Excellence: Commission*, 5–6.

32. The commission noted that “only a Post Office quick to identify and meet market needs can successfully serve a changing economy.” *Ibid.*, 3.

33. Appropriations were phased out gradually. Currently, appropriations covering “revenue foregone” are only provided for discounted mail for the blind and overseas absentee ballots. See Congressional Research Service, *The Postal Revenue Foregone Appropriation: Overview and Current Issues*, RS21025 (Washington, DC, December 28, 2005).

34. The Board of Governors is composed of nine appointed board members and two further members—the postmaster and deputy postmaster general—who are appointed by the other members of the board.

35. See Tierney, *Postal Service*; Conkey, *Postal Precipice*.

36. Postal Reorganization Act of 1970, Pub. L. No. 91–375 § 3622(b)2–3 (1970).

37. An administrative law judge was used by the U.S. Postal Rate Commission (PRC) to preside over the first two rate cases held after reorganization. Thereafter, the PRC held the hearings directly.

38. Dockets R71-1, R74-1, and R76-1 (PRC) provide exhaustive discussions of the different proposed costing methodologies and their implication for different categories of mailers. PRC, *Postal Rate and Fee Increases, 1971*, No. R71-1 (Washington, DC, 1972); PRC, *Postal Rate and Fee Increases, 1973*, No. R74-1 (Washington, DC, 1975); PRC, *Postal Rate and Fee Increases, 1975*, No. R76-1 (Washington, DC, 1976).

39. Second-class mailers (magazine publishers and newspaper associations) aligned with the Board of Governors against the positioning of cost as the central tenet of rate making. They pointed out the unique value of the content they mailed and the historic support postal rates afforded. Second-class mailers supported the accounting scheme introduced by the board that left a significant (greater than half) portion of total costs assignable and employed inverse elastic pricing as well as an interpretation of value-of-service structured around content.

40. A partial listing of those costs classified by USPS as “institutional” or common is instructive. In the words of the administrative law judge who oversaw the first two rate cases, broad classification by USPS of institutional costs included “substantially all costs for the purchase and lease of buildings, the purchase and lease of equipment and vehicles, expenses for vehicle drivers, vehicle maintenance, building and equipment maintenance and custodial costs, the cost of a mailman’s driving or walking his route to deliver mail, one-third of purchased transportation, most supplies including gasoline and oil, and a considerable portion of clerk’s time.” Chief administrative law judge Seymour Wenner, in PRC, *Chief Administrative Law Judge’s Initial Decision*, No. R71-1 (Washington, DC: PRC, 1971), 8–9.

41. For the various interveners’ complaints and claims of discriminatory pricing, see PRC, *Postal Rate and Fee Increases, 1971*, 63–112.

42. Administrative law judge Seymour Wenner presided over the first two rate cases in concert with the PRC. He was very sympathetic to the claims of first-class mailers and challenged the continuation of cross-subsidies, noting disapprovingly: “If someone gets something for nothing someone else pays for it.” Wenner, *Initial Decision*, 44.

43. For a summary of the disputes over attributable and assignable costs in the first several cases, see Wenner, *Initial Decision*, 3–17; PRC, *Postal Rate and Fee Increases, 1973*, 1–114; PRC, *Postal Rate and Fee Increases, 1975*, 76–116; U.S. Commission on Postal Service, *Report of the Commission on Postal Service*, vol. 1 (Washington, DC: GPO, 1977), 57–73; John T. Tierney, *Postal Reorganization: Managing the Public’s Business* (Boston: Auburn, 1981), 119–134; Tierney, *Postal Service*, 142–171; Conkey, *Postal Precipice*, 205–277.

44. USPS assigned the following percentage of total costs as attributable: R71-1, 49%; R74-1, 45.1%; R76-1, 55.1%. The chief examiner countered in R74-1 by attributing 70.6%, which the PRC modified to 53.5%. In R76-1, the PRC modified the board’s figure to 60.4% (see PRC, *Postal Rate and Fee Increases, 1975*, 59–67 and the dockets of each case). During the fourth rate case, which began in 1977, the PRC attributed 74.5% of costs, in agreement with the board. Tierney, *Postal Reorganization*, 130; Tierney, *Postal Service*, 162.

45. The National Association of Greeting Card Publishers filed a lawsuit in 1975 challenging the discretionary authority of the board to determine costing methodology and assign rates (apportion institutional costs). The case eventually was joined with a similar challenge from UPS and progressed to the Supreme Court. In *National Association of Greeting Card Publishers, et al. v. United States Postal Service* (1983), the court upheld the authority of the board to use discretion in setting rates. In other words, full-cost accounting was not necessary. But by this time, first- and third-class mailers (along with private delivery firms) had already succeeded in pushing for a greater amount of cost attribution, successfully challenged the system of cross-subsidies, and attacked content-based assessments of value. Despite the victory for the Board of Governors, the basic terms of service were already radically transformed. National

Association of Greeting Card Publishers, et al. v. United States Postal Service, 462 U.S. 810 (1983).

46. Implicitly and explicitly, the challenge to the authority of the Board of Governors to use discretion to assign costs was linked with a narrow view of value. Wenner, echoing the sentiments of those seeking to reduce the freedom of the Board of Governors, stated: "Value of service considerations should in the main deal with demand factors. The demand for a class reflects the evaluation placed by both the sender and recipient." Wenner, *Initial Decision*, 15. This opinion is a radical rebuke to the way in which postal policy had been viewed for well over a century. In viewing value so narrowly, Wenner was arguing that postal service and indeed communication have little public value and instead are only significant as a matter between two contracting parties. A general disdain for evaluations of content is repeated throughout his opinions in R71-1 and R74-1. The PRC similarly adopted this dim view of content-related considerations of value in R76-1 but did not go so far as to say that the use of discretion was, in and of itself, discriminatory. PRC, *Postal Rate and Fee Increases, 1975*, 75–156. Many decried this development, noting that it would help hasten the decline of small, marginal publications. Arthur Schlesinger Jr. saw that rising second-class rates had transformed USPS into the "judge, jury, and executioner of the nation's intellectual life" (as quoted in Tierney, *Postal Reorganization*, 129). A June 16, 1975, *Time* magazine editorial also argued that the shifting of costs from first- to second-class mail would irrevocably damage small, marginal publications. It noted that second-class rates had increased over 100% since 1971 and that greater increases were forthcoming. "Postal Nightmare," *Time*, June 16, 1975.

47. The new hostility toward the reallocation of costs was expressed most clearly by Wenner. In his opinion in R74-1, he wrote: "The Postal service has become a tax-collecting agency, collecting money from first-class mailers to distribute to other favored classes" and that this situation had to be undone as quickly as possible. PRC, *Chief Administrative Law Judge's Initial Decision*, No. R74-1 (Washington, DC: PRC, 1973), 13. Antitrust principles have been applied to the Post Office's parcel delivery service since the inception of parcel post.

48. The Postal Accountability and Enhancement Act provides a further elaboration of these principles by dividing postal operations between competitive and market-dominant lines and calling for greater cost attribution and limitation on cross subsidies. Postal Accountability and Enhancement Act, Pub. L. No. 109–435, 120 Stat. 3198 (2006).

49. Presorting discounts were first suggested by Readers Digest Corporation and the Association of Public Utility Mailers (APUM) during the 1971 rate case and were given a separate classification hearing in 1973. PRC, *Opinion and Recommended Decision*, No. MC73-1 (Washington, DC: PRC, 1976), 11. For the initial call, see PRC, *Postal Rate and Fee Increases, 1971*, 112–120. The postal unions, such as the American Postal Workers Union, repeatedly challenged that these rates offer discounts above cost avoidance and transfer productivity gains to particular users at the expense of the general system. For an overview of the history of these categories and critiques of their effectiveness,

see GAO, *US Postal Service: A Primer on Postal Worksharing*, GAO-03-927 (Washington, DC, 2003).

50. Estimates during the 1970s suggested that roughly 14% of total first-class mail volume, the bulk of which consisted of checks and bills, could be diverted due to EFT by 1985. EMS was seen as a more long-term threat. USPS briefly considered but discarded extending the letter monopoly into electronic communications on the grounds that it was untenable. Rather, USPS sought to enter the electronic communications market as one of multiple providers. On the challenge posed by new forms of electronic communication, see USPS, *The Private Express Statutes and Their Administration* (Washington, DC: GPO, 1973); Commission on Postal Service, *Report*, vol. 1-2; U.S. Department of Commerce, *The Postal Crisis: The Postal Function as a Communications Service* (Washington, DC: GPO, 1977); PRC, *Opinion and Recommended Decision*, No. MC78-3 (Washington, DC: PRC, 1979); U.S. Office of Technology Assessment (OTA), *Implications of Electronic Mail and Message Systems for the US Postal Service*, OTA-CIT-184 (Washington, DC: OTA, 1982); OTA, *Selected Electronic Funds Transfer Issues: Privacy, Security, and Equity*, OTA-BP-CIT-12 (Washington, DC: OTA, 1982).

51. The PRC held open hearings, similar to a rate case, that weighed the merits of E-COM and were collected in PRC, *Mail Classification Schedule, Proposal 1978*, No. MC78-3 (Washington, DC: PRC, 1979).

52. PRC, *Opinion and Recommended Decision*, MC78-3, 24-30.

53. E-COM was supported by President Carter and the postal Board of Governors as a way of extending and expanding postal service. See "Administration's Policy Statement July 19, 1979," app. B, in James Duffy, *Dissenting Opinion and Recommended Decision*, No. MC78-3 (Washington, DC: PRC, 1979). The statement reads in part: "As long as physical delivery through the mails exists as a primary means of communications to a large segment of the population, USPS should take advantage of electronic communications to improve its service." The Board of Governors, the PRC, and the congressionally created Commission on Postal Service (created to review postal service) all concluded that integrating "electronic mail" and traditional letter mail was advisable. Duffy, *Dissenting Opinion*, MC78-3; PRC, *Mail Classification Schedule, Proposal 1978*; Commission on Postal Service, *Report*, vol. 1.

54. For a larger consideration of E-COM's failure, see Ryan Ellis, "The Premature Death of Electronic Mail: The United States Postal Service's E-COM Program, 1978-1985," *International Journal of Communication* 7 (2013): 1949-1967.

55. The complaints of the interveners are included in preconference statements in the record of MC78-3 and in app. A of the Federal Communications Commission (FCC) declaratory ruling at the request of Graphnet. PRC, *Mail Classification Schedule, Proposal 1978*; Graphnet Sys., Inc., 73 F.C.C. 2d 283 (1979).

56. The move to prevent cross-subsidies (particularly from first-class mail rates to E-COM) colors the entirety of the PRC's initial decision (1979) and reconsidered opinion (1980). PRC, *Opinion and Recommended Decision*, MC78-3;

PRC, *Opinion and Recommended Decision upon Reconsideration*, No. MC78-3 (Washington, DC: PRC, 1980).

57. The stinging dissenting opinions of Chairmen Duffy and Kieran O'Doherty make this point plain. Duffy notes that despite adopting the Board of Governors' terminology, "a careful reading of the majority opinion will reveal its true intent—to preclude Postal Service entry into electronic mail and to permanently trap the service in a subordinate role from which it cannot escape. ... It has recommended a data-processing, envelope-stuffing service, not an electronic mail service; [it] has rejected rather than accepted the concept of electronic mail service; [it] has contrived to postpone rather than encourage electronic mail service; [it] has done so by concealing rather than revealing the true important distinction." O'Doherty's dissent was no less forceful, noting that "the opinion issued by the majority today is a brazen attempt to arrogate the basic powers and responsibilities expressly reserved by statute for the management of the postal Service. ... It is a bold rejection of the Postal Service's primary role in the development of new mail services for the American Public." Duffy, *Dissenting Opinion*, MC78-3, 21; Kieran O'Doherty, *Dissenting Opinion and Recommended Decision*, No. MC78-3 (Washington, DC: PRC, 1979), 1.

58. PRC, *Opinion and Recommended Decision*, MC78-3," 1–59, 269–283.

59. In the first six months of operation, 660,000 messages were sent. But by July, E-COM was handling 172,000 messages weekly. OTA, *Implications*, 12.

60. The basic dispute between the PRC and the Board of Governors concerned determining when to recover the costs of investment. The PRC decided, in mid-stream, to move the test-year period from 1987 to 1985, causing rates to skyrocket. The PRC called for E-COM rates that would have risen from 26 cents to 52 cents for the first page. See PRC, *Opinion and Recommended Decision*, No. R83-1 (Washington, DC: PRC, 1984); PRC, *Opinion and Recommended Decision, upon Reconsideration*, No. R83-1 (Washington, DC: PRC, 1984); James Duffy, *Dissenting Opinion and Recommended Decision*, No. R83-1 (Washington, DC: PRC, 1984), 1–23.

61. *Decision of the Board of Governors of the United States Postal Service Concerning the Opinions and Recommended Decisions for E-COM Rate and Classification Changes*, No. R83-1 (Washington, DC: PRC, 1984).

62. Cortada, *Digital Hand*, 169; Biggart, "Post Office as a Business," 487; POD, *Postal Progress*, 7.

63. GAO, *Postal Service: Information on the Change to Multiline Readers for the Zip + 4 Program*, GAO/GGD-8862BR (Washington, DC, 1986), 31.

64. President's Commission, *Towards Postal Excellence: Commission*, 27–28.

65. GAO, *Conversion to Automated Mail Processing Should Continue; Nine Digit Zip Code Should Be Adopted If Conditions Are Met*, GAO/GGD-83-24 (Washington, DC, 1983), 2.

66. GAO, *Postal Service: Automation Is Taking Longer and Producing Less than Expected*, GAO/GGD-93-89BR (Washington, DC, 1997), 10.

67. *Ibid.*

68. GAO, *Automation Is Restraining*, 11.
69. DPS was first used in 1991. GAO, *Automation Is Taking Longer*, 10.
70. Figure calculated from data in Little, "Description of the Postal Service"; GAO, *Automation Is Restraining*, 10.
71. Little, "Description of the Postal Service."
72. GAO, *Automation Is Restraining*, 10–12.
73. By 2006, these figures would continue to improve to 306,034 pieces per career employee. Data from Cortada, *Digital Hand*, 166; USPS, "Statistics: Pieces and Post Offices," in *Postal Service: An American History*.
74. Data from Cortada, *Digital Hand*, 166; USPS, "Statistics: Pieces"; U.S. Census Bureau, *Statistical Abstract of the United States, 2004–2005* (Washington, DC: GPO, 2005), table 1112.
75. The adoption of mechanized equipment before reorganization was limited. President's Commission, *Towards Postal Excellence: Commission*, 24.
76. As of 2003, 13% of postal employees were noncareer workers. From 1980 to 2003, temporary labor increased by 292% (from 25,000 to 98,000), while during the same period career employees increased by only 13% (from 643,000 to 729,000). USPS repeatedly affirms its commitment to reduce costs through a smaller labor force and the deployment of temporary staff. Census Bureau, *Statistical Abstract*, table 1112.
77. GAO, *Automation Is Restraining*, 10–12; USPS, *United States Postal Service Transformation Plan* (Washington, DC, 2002).
78. Data from Cortada, *Digital Hand*, 166; USPS, "Statistics: Pieces." Prices calculated with "Inflation Calculator," U.S. Bureau of Labor Statistics, http://www.bls.gov/data/inflation_calculator.htm.
79. GAO, *Postal Service: Planned Benefits of Iowa Automated Mail Facility Not Realized*, GAO/GGD-94–78 (Washington, DC, 1994), 1.
80. The number of post offices faced a sharp decline in the early part of the 20th century with the introduction of the automobile. Since reorganization, the number of post offices has hovered around 30,000, with little change. The PRA specified that no post office could be closed due to an operating deficit. USPS instituted a moratorium on closing small rural post offices between 1998 and 2002. Robert H. Cohen et al., "The Conflict about Preserving Small Rural Post Offices: Differences in the Distribution of Pharmacies and Post Offices" (paper presented at Winton M. Blount Symposium on Postal History, Washington, DC, November 2006).
81. President's Commission, *Towards Postal Excellence: Commission*, 170–171.
82. USPS, *US Postal Service Emergency Preparedness Plan for Protecting Postal Employees and Postal Customers from Exposure to Biohazardous Material and for Ensuring Mail Security against Bioterror Attacks* (Washington, DC, 2002), app. A, H-1.
83. The postal system as of 2001 contained 350,000 collection boxes and 134.5 million delivery points serviced by a network of nearly 40,000 post offices.

USPS, *2001 Comprehensive Statement on Postal Operations* (Washington, DC, 2001), 51; USPS, *Emergency Preparedness Plan*, 1–4.

84. Figures are approximate and current to the fall of 2001. USPS, *Emergency Preparedness Plan*, 1–3.

85. For example, the Brentwood facility provides all incoming and outgoing mail processing for Washington, DC (zip codes 20000–20099), connects with 56 local USPS facilities (including branch post offices and stations), and serves 177 different federal facilities. “Anthrax in the U.S. Postal System: Lessons That Stunned Us,” Centers for Disease Control and Prevention, last modified 2002, accessed September 25, 2017, ftp://ftp.cdc.gov/pub/infectious_diseases/iceid/2002/pdf/pearson.pdf.

86. Albert Hirschman provides an apt conceptual framework for thinking about how the weakening of the letter monopoly through the introduction of new communication options, the restriction of USPS entry to electronic communication, and the circumscription of the public bureaucracy in the design of rates and classification amounts to the relative elevation of large-volume mailers in the provision of postal service. In his terms, these changes increased the possibility that large mailers could now exit the system. This makes the voice of these groups credible, more significant, and difficult to ignore. As he notes: “The *effectiveness* of the voice option is strengthened by the possibility of exit” (83). His analysis and characterization of the Post Office as a “lazy monopolist,” however, is lacking. Its laziness is less a function of its own initiative than the interventions of particular parties. *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States* (Cambridge, MA: Harvard University Press, 1970), 59–60, 82–105. On the dire condition that peak volume signals, see President’s Commission on the United States Postal Service, *Embracing the Future: Making the Tough Choices to Preserve Universal Service* (Washington, DC, 2003); USPS, *Transformation Plan*.

87. The limits of hub-and-spoke architecture in the face of nonrandom disruptions are outlined in Albert, Jeong, and Barabási, “Error and Attack Tolerance.” See also chapter 1.

88. For a detailed discussion, see chapter 1.

89. For a clear discussion of the railroads’ proffering of key support for the ICC, see Samuel P. Huntington, “The Marasmus of the ICC: The Commission, the Railroads, and the Public Interest,” *Yale Law Journal* 61, no. 4 (1952): 467–509.

90. James C. Nelson, “The Effects of Entry Control in Surface Transport,” in *Transportation Economics*, (New York: Columbia University Press, 1965), 381–422; Hoogenboom and Hoogenboom, *History of the ICC*.

91. Hoogenboom and Hoogenboom, *History of the ICC*, 118.

92. On the difficulty of maintaining cross-subsidies in the face of opportunities for bypass, see Horwitz, *Irony of Regulatory Reform*, 7–8.

93. Hoogenboom and Hoogenboom, *History of the ICC*, 146; Stone, *Interstate Commerce Commission*, 39; Levin, “Regulation”; Dennis W. Carlton and

Randal C. Picker, "Antitrust and Regulation," in *Economic Regulation and Its Reform: What Have We Learned?*, ed. Nancy L. Rose (Chicago: University of Chicago Press, 2014), 25–61.

94. Hoogenboom and Hoogenboom, *History of the ICC*, 129–131; Carlton and Picker, "Antitrust and Regulation"; Nelson, "Effects of Entry Control"; Huntington, "Marasmus of the ICC."

95. Hoogenboom and Hoogenboom, *History of the ICC*, 129–131; Nelson, "Effects of Entry Control"; Kriebel and Baumel, "Freight Transportation Regulation."

96. Hoogenboom and Hoogenboom, *History of the ICC*, 146; Stone, *Interstate Commerce Commission*, 39.

97. GAO, *Railroad Regulation*, 12.

98. Ibid.

99. Association of American Railroads (AAR), *The Impact of the Staggers Rail Act of 1980* (Washington, DC, 2010), accessed November 3, 2010, <https://web.archive.org/web/20101103064437/http://aar.org/~media/aar/backgroundpapers/impactofthestaggersrailactof1980.ashx/>; Laurits R. Christensen Associates, *Description of the U.S. Freight Rail Industry*, vol. 1, *Analysis of Competition, Capacity, and Service Quality*, prepared for the Surface Transportation Board (Washington, DC, November 2009), 2-2.

100. GAO, *Railroad Regulation*, 12.

101. AAR, "A Short History of U.S. Freight Railroads," August 2017, <https://www.aar.org/BackgroundPapers/A%20Short%20History%20of%20US%20Freight%20Railroads.pdf>; GAO, *Railroad Regulation*; Levin, "Regulation."

102. The failure of specific railroads presented a more general problem. The railroad network is interdependent, and freight moves across and between different carriers through exchanges to reach its end point. Thus, the failure of a sizable carrier has effects that impair the larger network. Gaskins, "Regulation of Freight Railroads"; GAO, *Railroad Regulation*, 11.

103. These committees, formed under the guidance of the Council of Economic Advisors, released a "Bicentennial Bill of Rights for Railroads" on the nation's bicentennial. Stone, *Interstate Commerce Commission*, 54–55, 85.

104. See, e.g., Meyer et al., *Economics of Competition*; James C. Nelson, *Railroad Transportation and Public Policy* (Washington, DC: Brookings Institution, 1959); George W. Hilton, *The Transportation Act of 1958: A Decade of Experience* (Bloomington: Indiana University Press, 1969); Friedlaender, *Dilemma*. For an overview of studies during this period, see Stone, *Interstate Commerce Commission*, 48–50.

105. John D. Bitzan and Theodore E. Keeler, "Economies of Density and Regulatory Change in the U.S. Railroad Freight Industry," *Journal of Law and Economics* 50, no. 1 (2007): 173.

106. Nelson, "Effects of Entry Control," 414.

107. Robert C. Fellmeth, *The Interstate Commerce Omission: The Public Interest and the ICC* (New York: Grossman, 1970). See also Stone, *Interstate Commerce Commission*, 50.
108. Kolko, *Railroads and Regulation*.
109. The Landis report prepared for President-Elect Kennedy in 1960 offered a strong critique of the regulatory agencies, and Congress issued the similarly stinging Doyle Report of the Senate Transportation Study Group in 1961. In 1962, President Kennedy issued a special Transportation Message to Congress, arguing that current regulations were “a chaotic patchwork of inconsistent and often obsolete legislation” in need of reform. Stone, *Interstate Commerce Commission*, 48–54.
110. *Ibid.*, 78–80.
111. See Derthick and Quirk, *Politics of Deregulation*.
112. Hoogenboom and Hoogenboom, *History of the ICC*, 178–179; Stone, *Interstate Commerce Commission*, 76.
113. Stone, *Interstate Commerce Commission*, 77–78.
114. *Ibid.*, 88–90.
115. Stone, *Interstate Commerce Commission*, 113–141; GAO, *Railroad Regulation*, 15; Gaskins, “Regulation of Freight Railroads”; Bitzan and Keeler, “Economies of Density,” 157–179; Ming-Jeng Hwang and Patrick C. Mann, “Deregulation and Efficiency in the Rail Industry,” *Atlantic Economic Journal* 15, no. 2 (1987): 47–52; Elizabeth E. Bailey, “Price and Productivity Change Following Deregulation: The US Experience,” *Economic Journal* 96, no. 381 (1986): 1–17.
116. 4(R) also attempted to speed up the abandonment process. Stone, *Interstate Commerce Commission*, 97.
117. AAR, “Overview of America’s Freight Railroads,” August 2017, <https://www.aar.org/BackgroundPapers/Overview%20of%20America's%20Freight%20RRs.pdf>; Rodrigue, Comtois, and Slack, *Geography of Transport Systems*.
118. The dramatic consolidation of Class I railroads also followed Staggers. In 1980 there were 40 Class I railroads; two decades later there were 7. Carlton and Picker, “Antitrust and Regulation,” 46–48; AAR, “Overview of America’s Freight Railroads.”
119. In concert with the relaxation of abandonments, after 1980 the ICC moved to eliminate Detroit, Toledo, and Ironton conditions (DT&I), which compelled railroads to preserve patterns of freight movement in the wake of mergers. Gaskins, “Regulation of Freight Railroads.”
120. Significant savings came from reductions in labor as well as the elimination of unprofitable track. Carlton and Picker, “Antitrust and Regulation.”
121. The use of contract rates helped, in part, to drive the decline in rates. By 1988, 60% of all Class I freight moved under contract rates. AAR, “Overview of America’s Freight Railroads”; Stone, *Interstate Commerce Commission*, 161.

122. Data from AAR, “Impact of the Staggers Rail Act of 1980”; Christensen Associates, *Freight Rail Industry*, 2-2.
123. Data from “A Short History of U.S. Freight Railroads.”
124. For a detailed discussion of the impact of deregulation on density, see Bitzan and Keeler, “Economics of Density.”
125. *Ibid.*, 173–175.
126. After Staggers, during the 1990s, the Department of Transportation (DOT) reconfigured how to tabulate commodity flow after surveys during the 1980s were considered incomplete and abandoned due to quality concerns. As part of this reconfiguration, the economic census now provides fairly detailed and specific information about commodity flow.
127. GAO, *Railroad Regulation*, 53; H. Barry Spraggins, John Ozment, and Phillip Fanchon, “Risk Modeling of Hazardous Materials Rail Movement to Include a Terrorist Incident,” *Journal of the Academy of Business and Economics* 5, no. 3 (2005); AAR, “Overview of America’s Freight Railroads.”
128. Note, updated figures from the 2017 *Commodity Flow Survey* are not yet available. Bureau of Transportation Statistics, “Hazardous Materials,” in DOT, *Commodity Flow Survey*, February 2015, tables 1a, 6.
129. Commodity flow data from the economic census are not available for the 1980s. Additionally, the categories listed changed in the mid-1990s, making direct comparisons between eras difficult (for example, in the 1990s flow data about hazardous materials were collected, while in the 1960s and 1970s no such data were collected). However, the basic picture indicated—of increasing rail volume and increasing shares of transported commodities both generally and for dangerous materials—appears to be valid. In 1993, when data and categories comparable to those used in previous surveys were last employed, rail carried 59.9% of total ton-miles for industrial chemicals, compared with just 20.7% carried by truck. This shows a reversal of the trend observed during the 1960s and 1970s, when rail’s share declined from a high of 67.1% to 57.4%, and truck increased its share from a low of 15.6% to 24.9%. *Ibid.*; DOT, *1993 Economic Census* (Washington, DC, 1996); Census Bureau, *Commodity Transportation Survey*.
130. See Brown, Dunn, and Policastro, *National Risk Assessment*.
131. Similar figures hold for TIH materials. TIH shipments via rail travel in 90-ton tanker trucks and travel, on average, 480 miles. Transportation Research Board, *Cooperative Research*, 19; Bureau of Transportation Statistics, “Hazardous Materials,” tables 1a, 6; Brown, Dunn, and Policastro, *National Risk Assessment*.
132. Statistics show that 99.9% of all rail shipments arrive without incident. AAR, “Railroads the Safe Way to Move,” March 2005, accessed July 10, 2012, http://www.aar.org/pubcommon/documents/policy/safe_way_to_move.pdf.
133. Brown, Dunn, and Policastro, *National Risk Assessment*, 4, 179.
134. *Ibid.*, 148–150.

135. For an extensive discussion of the cross modal comparisons of the risks of transporting hazardous materials and TIH materials, see *ibid.*
136. Eben Kaplan, *Rail Security and the Terrorist Threat* (New York: Council on Foreign Relations, 2007), <http://www.cfr.org/united-states/rail-security-terrorist-threat/p12800>.
137. For a discussion of the details of the Graniteville, South Carolina, accident and others, see Lewis M. Branscomb et al., “Rail Transportation of Toxic Inhalation Hazards: Policy Responses to the Safety and Security Externality” (working paper RPP-2010-01, Mossavar-Rahmani Center for Business & Government Regulatory Policy Program, Harvard University, 2010), <http://www.hks.harvard.edu/m-rcbg/rpp/Working%20papers/Rail%20Transportation%20of%20TIH.pdf>.
138. For a discussion of population density and the risk of hazardous materials transportation, see Brown, Dunn, and Policastro, *National Risk Assessment*.
139. Hirsh, *Power Loss*, 1.
140. The grow-and-build strategy was not particular to the postwar era. Samuel Insull’s machinations to increase load factors during the early 20th century set out to accomplish the same results. See chapter 1 for a discussion of Insull. See also Hirsh, *Power Loss*, 46; Hirsh, *Technology and Transformation*, 19–21.
141. Recall, as noted in chapter 1, that the structure of rate-of-return regulation rewarded investment in new technologies.
142. During the late 1940s, plants converted roughly 22% of a fuel’s content to energy, but by the 1960s advances in steam temperatures and turbines allowed plants to operate with a thermal efficiency of 33%. Hirsh, *Power Loss*, 56.
143. Capacity of the largest units jumped from 190 MW to 575 MW between 1950 and 1960, while the average cost of new plant construction dropped from \$173 per kilowatt-hour to \$149 per kilowatt-hour in adjusted dollars. *Ibid.*
144. *Ibid.*, 47.
145. Industrial prices, always lower than residential rates, fell to four cents in 1969. *Ibid.*, 47; U.S. Energy Information Administration (EIA), “Average Retail Prices of Electricity, 1960–2012,” in *Annual Energy Review* (Washington, DC: Department of Energy, 2017), table 8.10, <https://www.eia.gov/totalenergy/data/annual/>.
146. Daniel Czamanski, *Privatization and Restructuring of Electricity Provision* (Westport, CT: Praeger, 1999), 88.
147. The declining cost of electricity and the booming market for new electrical appliances helped household consumption spike 150% per household from 1945 to 1965. The growth in output increased over fivefold, from 296.1 billion kWh in 1949 to 1,535.1 billion kWh in 1970. Hirsh, *Power Loss*, 47; Czamanski, *Privatization and Restructuring*, 83; EIA, “Electricity Net Generation: Total (All Sectors) 1949–2012,” in *Annual Energy Review*, table 8.2a.
148. Hirsh, *Technology and Transformation*, 85–86.
149. Hirsh, *Power Loss*, 1; Hirsh, *Technology and Transformation*, 82–86.

150. Hirsh and others identify these three factors as the root causes of the revisiting of utility policy and the eventual introduction of limited competition through PURPA. See Hirsh, *Power Loss*; Czamanski, *Privatization and Restructuring of Electricity Provision*; James L. Sweeney, *The California Energy Crisis* (Stanford, CA: Hoover Institution, 2002); Beder, *Power Play*.

151. Metallurgical problems in boilers and turbines appeared as thermal efficiencies approached rates of 40% and presented real limitations to improved operation. New 1,300 MW units came online in the late 1960s and early 1970s and presented reliability problems. Hirsh, *Power Loss*, 55–58; Hirsh, *Technology and Transformation*, 89–99.

152. The Organization of Petroleum Exporting Countries (OPEC), in retaliation for support of Israel in the Yom Kippur War, cut oil production, increased prices, and subsequently embargoed oil shipments to the U.S.

153. Petroleum prices fell 30% between 1957 and 1970. Hirsh, *Power Loss*, 60.

154. *Ibid.*

155. *Ibid.*, 61.

156. *Ibid.*, 64–65.

157. Michael Schudson, *The Rise of the Right to Know: Politics and the Culture of Transparency, 1945–1975* (Cambridge, MA: Belknap Press of Harvard University Press, 2015).

158. *Ibid.*, 170–175.

159. Regulatory commissions, long deferential to utilities, began in some instances to deny cost recovery and proposed projects. The Environmental Defense Foundation (EDF) won a major victory during the 1976 California Public Utilities Commission’s review of a proposed Pacific Gas & Electric (PG&E) nuclear plant by introducing alternate demand forecasts based on conservation. Ultimately, PG&E incorporated some of the EDF’s suggestions and scrapped the planned project. The EDF’s victory was not an isolated event. Hirsh, *Technology and Transformation*, 151–152; Hirsh, *Power Loss*, 64–68.

160. Imported petroleum accounted for an increasing share of domestic consumption. In 1973 imported petroleum accounted for 36% of domestic consumption, but by 1976, imports accounted for 42% and showed signs of increasing growth. The plan included taxes and incentives in favor of conservation, nuclear power, and coal; the granting of new federal power to force utility interconnection; and the end of the promotional block rate structure. *Ibid.*, 73–75.

161. *Ibid.*, 73–80.

162. Section 210, which turned out to be the key provisions of PURPA, was overlooked during the debate. *Ibid.*, 81–88.

163. QFs were defined as renewable power producers under 80 MW and cogeneration facilities of any size. FERC, “What Is a Qualifying Facility?,” last modified November 18, 2016, <http://www.ferc.gov/industries/electric/gen-info/qual-fac/what-is.asp>; Sweeney, *California Energy Crisis*, 11–15; Hirsh, *Power*

- Loss, 81–88; Paul L. Joskow, “Deregulation and Regulatory Reform in the US Electric Power Sector,” in *Deregulation of Network Industries: What’s Next?*, ed. Sam Peltzman and Clifford Winston (Washington, DC: Brookings Institution, 2000), 126.
164. They controlled a monopsony market within which they were the only buyer.
165. Hirsh, *Power Loss*, 81–88.
166. *Ibid.*, 81–82.
167. *Ibid.*, 87.
168. QFs could buy power at residential rates from utilities, which were based on average costs that were significantly less than avoided costs, and then turn around and sell power back to utilities at higher rates based on avoided costs. *Ibid.*, 86–91.
169. *Ibid.*, 115–116, figs. 6.7 and 6.8.
170. EIA, “Net Generation by State by Type of Producer by Energy Source, 1990–2017,” last modified January 15, 2019, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html; Hirsh, *Power Loss*, 114; Paul L. Joskow, “The Difficult Transition to Competitive Energy Markets,” in Griffin and Puller, *Electricity Deregulation*, 47.
171. Hirsh, *Power Loss*, 123; Joskow, “Deregulation and Regulatory Reform,” 126.
172. Hirsh, *Power Loss*, 123; Joskow, “Deregulation and Regulatory Reform,” 126; Sweeney, *California Energy Crisis*, 15–16.
173. Hirsh, *Power Loss*, 119.
174. The Edison Electric Institute/Alliance of Energy Suppliers would push for deregulation, while entrenched utilities (IOUs) formed the Electric Reliability Coalition to fight the opening of transmission and distribution networks to competition. Beder, *Power Play*, 88; Hirsh, *Power Loss*, 245.
175. Joskow, “Deregulation and Regulatory Reform,” 126.
176. *Ibid.*
177. Hirsh, *Power Loss*, 241–245; Sweeney, *California Energy Crisis*, 17; Joskow, “Deregulation and Regulatory Reform,” 138; Griffin and Puller, “Introduction,” 3.
178. Paul L. Joskow, “Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector,” in *Designing Competitive Electricity Markets*, ed. Chao Hung-Po and Hillard G. Huntington (Boston: Kluwer, 1998), 11–31.
179. Hirsh, *Power Loss*, 244–245; Joskow, “Restructuring”; Beder, *Power Play*, 87–88.
180. “The Energy Policy Act of 1992,” EIA, accessed September 27, 2017, http://www.eia.doe.gov/oil_gas/natural_gas/analysis_publications/ngmajorleg/enrgypolicy.html.
181. Hirsh, *Power Loss*, 241–244.
182. *Ibid.*, 243.

183. By 2007, non-utility capacity accounted for 42% of capacity. Among utilities, IOUs accounted for 37.69% of capacity, while cooperatives and federal and public utilities accounted for an estimated 20%. See EIA, “Electric Power Industry Overview: 2007,” fig. 3, last accessed September 27, 2017, <http://www.eia.doe.gov/cneaf/electricity/page/prim2/toc2.html>; EIA, “Net Generation by State.”

184. EIA, *Electric Power Annual 2009* (Washington, DC: Department of Energy, 2011), 53, table 6.2, <https://www.eia.gov/electricity/annual/archive/03482009.pdf>; EIA, “Net Generation by State.”

185. FERC, “What Are the Benefits of QF Status,” last accessed August 22, 2018, <https://www.ferc.gov/industries/electric/gen-info/qual-fac/benefits.asp>.

186. FERC, Order No. 888, *Promoting Wholesale Competition through Open Access Non-discriminatory Transmission Services by Public Utilities and Recovery of Stranded Costs by Public Utilities and Transmitting Utilities*, 75 F.E.R.C. ¶ 61,080 (1996) (to be codified at 18 C.F.R. pts. 35, 385); FERC, Order No. 889, *Open Access Same-Time Information System (formerly Real-Time Information Networks) and Standards of Conduct*, 75 F.E.R.C. ¶ 61,078 (1996) (to be codified at 18 C.F.R. pt. 37); FERC, Order No. 2000, *Regional Transmission Organizations*, 89 F.E.R.C. ¶ 61,285 (1999) (to be codified at 18 C.F.R. pt. 35).

187. Under the Energy Policy Act, FERC now has the power to order utilities to open transmission facilities to independent producers (interconnection), even if such an extension requires the expansion of transmission facilities. Joskow, “Deregulation and Regulatory Reform,” 129–133; Hirsh, *Power Loss*, 244.

188. Joskow, “Deregulation and Regulatory Reform,” 131–132; Richard F. Hirsh, “Restructuring or Deregulation?,” *Understanding Deregulation*, Smithsonian Institute, last modified June 2012, <http://americanhistory.si.edu/powering/dereg/dereg1a.htm>.

189. ISO and RTO are used interchangeably by FERC, though RTOs historically have been multistate in nature. ISO/RTOs oversee what are known as *organized markets*, as opposed to markets lacking a central coordinator/operator, which are organized through bilateral contracts. U.S. Government Accountability Office (GAO), *Electricity Restructuring: FERC Could Take Additional Steps to Analyze Regional Transmission Organizations’ Benefits and Performance*, GAO-08–987 (Washington, DC, 2008), n3; ISO/RTO Council, *2009 State of the Markets Report* (Washington, DC, 2009), <http://www.isorto.org/Documents/Report/2009IRCStateOfTheMarketsReport.pdf>.

190. ISO/RTO Council, *2010 ISO/RTO Metrics Report* (Washington, DC, 2010), 9–26, http://www.isorto.org/Documents/Report/2010IRCMetricsReport_2005-2009.pdf; GAO, *Electricity Restructuring*, 2–3; “Electric Power Industry Overview: 2007.”

191. With one exception: ERCOT only operates within the state of Texas and is overseen by the state utility commission.

192. Current ISO/RTOs in operation: California ISO, Southwest Power Pool, Midwest ISO, New York ISO, ISO New England, PJM Interconnection, and the Electric Reliability Council of Texas (ERCOT). ERCOT, unlike the other ISO/RTOs, operates under Texas state laws, rather than FERC jurisdiction. “Electric Power Industry Overview: 2007”; ISO/RTO Council, *2010 ISO/RTO Metrics Report*.

193. In those areas not served by ISO/RTOs, competitive wholesale markets operate through bilateral contracts. ISO/RTO Council, *2010 ISO/RTO Metrics Report*, 11; ISO/RTO Council, “IRC Brings Value to Reliability and Electricity Markets,” accessed March 28, 2010, <http://www.isorto.org/site/c.jhKQIZPBImE/b.2603917/k.B00F/About.htm>; EIA, *Electric Power Annual 2009*, 4, fig. ES2; ERCOT, “ERCOT Quick Facts,” last modified July 2010, <http://www.ercot.com/content/news/presentations/2010/ERCOT%20Quick%20Facts%20-%20July%202010.pdf>.

194. GAO, *Electricity Restructuring*, 2–3; ISO/RTO Council, *2010 ISO/RTO Metrics Report*; ISO/RTO Council, *Markets Report*.

195. As noted in chapter 1, electric power, due to its unique characteristics, requires real-time control and coordination to balance demand and supply. Electricity does not move through interconnected networks in a point-to-point, switched fashion but rather moves according to Kirchhoff’s laws and requires that total generation and consumption must be balanced. ISO/RTOs now are entrusted to provide reliability through balancing, dispatch, and real-time system monitoring. Joskow, “Deregulation and Regulatory Reform,” 116; ISO/RTO Council, *2010 ISO/RTO Metrics Report*; ISO/RTO Council, *Markets Report*.

196. Cohen, Grid, 126.

197. Electric Reliability Council of Texas, “History,” <http://www.ercot.com/about/profile/history/>; ISO/RTO Council, *2010 ISO/RTO Metrics Report*, 145, accessed September 27, 2017, http://www.isorto.org/Documents/Report/2010IRCMetricsReport_2005-2009.pdf.

198. ISO/RTO Council, *2010 ISO/RTO Metrics Report*, 145.

199. See ISO/RTO Council, *Markets Report*; ISO/RTO Council, *2010 ISO/RTO Metrics Report*.

200. ISO/RTO Council, *Markets Report*, 3.

201. Functional unbundling replaced rate-of-return regulation with competitive markets for generation (while leaving rate-of-return regulation in place for transmission and distribution in those areas where retail competition was not introduced).

202. GAO, *Critical Infrastructure Protection: Challenges and Efforts to Secure Control Systems*, GAO-04-354 (Washington, DC, 2004), 1–13; Keith Stouffer et al., *Guide to Industrial Control Systems (ICS) Security: Supervisory Control and Data Acquisition (SCADA) Systems, Distributed Control Systems (DCS), and Other Control System Configurations Such as Programmable Logic Controllers (PLC)*, special publication 800-82 (Gaithersburg, MD: National Institute

of Standards and Technology, 2008), ES-1, 3–1; Ken Barnes, Briam Johnson, and Reva Nickelson, *Review of Supervisory Control and Data Acquisition Systems (SCADA)* (Idaho Falls: Idaho National Laboratory (INL), 2004), 1–3, <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.565.5922&rep=rep1&type=pdf>; INL, *National SCADA Test Bed Substation Automation Evaluation Report* (Idaho Falls: INL, 2009), vi–vii, <https://inldigitallibrary.inl.gov/sites/sti/sti/4374057.pdf>; OE, *National SCADA Test Bed Program: Multi-year Plan, 2008–2013* (Washington, DC: Department of Energy, 2008), https://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_OE_NSTB_Multi-Year_Plan.pdf; Energetics Inc., *Roadmap to Secure Control Systems in the Energy Sector*, 2006, 7–8, <https://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/roadmap.pdf>.

203. U.S. Department of Energy, “Enabling Modernization of the Electric Power System,” in *Quadrennial Technology Review: An Assessment of Energy Technologies and Research Opportunities* (Washington, DC, 2015), chap. 3, http://energy.gov/sites/prod/files/2015/09/f26/Quadrennial-Technology-Review-2015_0.pdf.

204. SCADA systems are used in a number of different industries to provide central control and monitoring of remote processes. In electric power, SCADA systems are commonly a part of energy management systems (EMS), which additionally contain automatic generation control (AGC), dispatch, and forecasting systems. Barnes, Johnson, and Nickelson, *Review of SCADA*, 13.

205. SCADA systems are used to monitor distributed processes, while distributed control systems (DCS) are used to monitor and control site-specific operations. DCS are also used in electric power, specifically at generation sites, but are often linked to SCADA systems to provide coordinated control. INL, *SCADA Test Bed Program*, 1; GAO, *Critical Infrastructure Protection: Challenges*, 8–9; Stouffer et al., *Guide to ICS Security*, 2–1.

206. Stouffer et al., *Guide to ICS Security*, 2–1; Barnes, Johnson, and Nickelson, *Review of SCADA*, 13.

207. GAO, *Critical Infrastructure Protection: Challenges*, ES-1, 3–1; Barnes, Johnson, and Nickelson, *Review of SCADA*, 1–3; INL, *National SCADA*, vi–vii; OE, *SCADA Test Bed Program*; Energetics, *Roadmap*, 7–8.

208. Zittrain, *Future of the Internet*.

209. Hirsh, *Technology and Transformation*, 80–82; Anderson, *Regulatory Politics*. See also chapter 1.

210. Indeed, as restructuring unfolded during the 1990s, electric power R&D investment, counted as part of the rate base under rate-of-return regulation, dropped sharply. GAO, *Changes in Electricity-Related R&D*, 3.

211. Barnes, Johnson, and Nickelson, *Review of SCADA*, 2–3; OE, *SCADA Test Bed Program*, 3; Energetics, *Roadmap*, 7–8.

212. The new security challenges introduced by generativity and accessibility are identified and discussed widely. See GAO, *Critical Infrastructure Protection*:

Challenges, 2–13; GAO, *Critical Infrastructure Protection: Multiple Efforts to Secure Control Systems Are Under Way, but Challenges Remain*, GAO-08–119T (Washington, DC, 2007), 6; North American Electric Reliability Corporation, *Long-Term Reliability Assessment: 2009–2018* (Princeton, NJ: NERC, 2009), 67–69; OE, *SCADA Test Bed Program*, 4; Bri Rolston, *Improving Control System Security through the Evaluation of Current Trends in Computer Security Research* (Idaho Falls: Idaho National Engineering and Environmental Laboratory, 2005), 2, <https://inldigitalibrary.inl.gov/sites/sti/sti/3395023.pdf>; Stouffer et al., *Guide to ICS Security*, 3-15-3-16.

213. Tim Maurer, *Cyber Mercenaries: The State, Hackers, and Power* (New York: Cambridge University Press, 2018), 15. Mauer adapts the work of both Lockheed Martin and Assante and Lee. See Lockheed Martin, “Gaining the Advantage: Applying Cyber Kill Chain Methodology to Network Defense,” last accessed August 20, 2018, <https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html>; Michael J. Assante and Robert M. Lee, “The Industrial Control System Kill Chain,” SANS Institute, October 2015, <https://www.sans.org/reading-room/whitepapers/ICS/industrial-control-system-cyber-kill-chain-36297>.

214. Zittrain, *Future of the Internet*.

215. *Ibid.*

216. *Ibid.*

217. See Dragos Inc., “CRASHOVERRIDE: Analysis of the Threat to Electric Grid Operations,” version 2.20170613, last accessed August 20, 2018, <https://dragos.com/blog/crashoverride/CrashOverride-01.pdf>; Dragos Inc., “Industrial Control System Threats,” March 2018, last accessed August 20, 2018, <https://www.dragos.com/media/2017-Review-Industrial-Control-System-Threats.pdf>.

218. See Dragos, CRASHOVERRIDE; Dragos, “Industrial Control System Threats.”

219. The limited circulation of information about customized systems limits the community of skilled technicians working to identify flaws and improve reliability.

220. GAO, *Critical Infrastructure Protection: Challenges*, 17; Kevin Paulsen, “Slammer Worm Crashed Ohio Nuke Plant Network,” *Security Focus*, August 19, 2003, <http://www.securityfocus.com/news/6767>.

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Surprising Use of American Power (New York: Crown, 2012) and Symantec, *W32.Stuxnet Dossier*, version 1.4, February 2011.

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224. Sanger, *Confront and Conceal*; Symantec, *W32.Stuxnet Dossier*, Nachenberg, “Forensic Dissection of Stuxnet.”

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Chapter 3

1. President’s Commission on Critical Infrastructure Protection, *Critical Foundations: Protecting America’s Infrastructures* (Washington, DC, 1997), 13.

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6. Ibid.
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8. Mark Aldrich, *Death Rode the Rails: American Railroad Accidents and Safety, 1828–1965* (Baltimore: Johns Hopkins University Press, 2006).
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19. Ibid., at 51813.
20. Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001, Pub. L. No. 107–156, 115 Stat. 272 (2001).
21. Ibid.
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23. Ibid., § 1016(E).
24. Ibid., § 1016(C)(1).
25. On the coproduction of risk and vulnerability, see Wiebe Bijker, Anique Hommels, and Jessica Mesman, "Studying Vulnerability in Technological Cultures," in *Vulnerability in Technological Cultures: New Directions in Research and Governance*, ed. Anique Hommels, Jessica Mesman, and Wiebe E. Bijker (Cambridge, MA: MIT Press, 2014), 1–26; Sheila Jasanoff, "Vulnerability and Development—Bhopal's Lasting Legacy," in Hommels, Mesman, and Bijker, *Vulnerability in Technological Cultures*, 89–108.

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33. *Ibid.*

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58. *Ibid.*, 25–100.
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61. *Ibid.*, 138.
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73. Moteff, *Critical Infrastructures: Background, Policy, and Implementation*, 32.

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81. *Ibid.*, 137.

82. See *ibid.*, 125–150.

83. *Ibid.*, 139.

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85. Homeland Security Act of 2002, Pub. L. No. 107–296, 116 Stat. 2135 (2002).

86. George W. Bush, “Remarks by the President at the Signing of H.R. 5005 the Homeland Security Act of 2002,” November 25, 2002, transcript, The White House, President George W. Bush (*italics added*), <https://georgewbush-whitehouse.archives.gov/news/releases/2002/11/20021125-6.html>.

87. *Ibid.*; Cuéllar, *Governing Security*, 137–150.

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94. U.S. Department of Homeland Security, *Budget in Brief: Fiscal Year 2005* (Washington, DC, 2005), https://www.dhs.gov/sites/default/files/publications/FY_2005_BIB_4.pdf, 13.

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Security: Scope of the Secretary's Reorganization Authority, prepared by the Congressional Research Service (Washington, DC: Library of Congress, 2005), 5, <https://fas.org/sgp/crs/homsec/RS21450.pdf>; Harold C. Relyea and Henry B. Hogue, *Department of Homeland Security Reorganization: The 2SR Initiative*, prepared by the Congressional Research Service (Washington, DC: Library of Congress, 2006), <https://www.hsdl.org/?view&did=467158>; Elizabeth C. Borja, *Brief Documentary History of the Department of Homeland Security: 2001–2008* (Washington, DC: Department of Homeland Security, 2008), <https://www.hsdl.org/?view&did=37027>.

96. Figures tabulated OMB, “Appendix: Homeland Security.”

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98. This figure excludes funds marked for border and transportation security. If they are added into the mix, the total funding climbs to over \$51 billion and 70% of total homeland security funding. Ibid.

99. See Cuéllar, *Governing Security*, 127.

100. Ibid.

101. Quoted in Brown, *Critical Path*, 140.

102. Ryan Ellis, “Appropriating Risk: National Security and the Sunrise Powerlink Controversy” (paper presented at the National Communication Association Annual Convention, San Francisco, November 2011).

103. On crises and control, see James Beniger, *The Control Revolution: Technological and Economic Origins of Information Society* (Cambridge, MA: Harvard University Press, 1986).

104. Ulrich Beck, “The Reinvention of Politics,” in *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*, ed. Ulrich Beck, Anthony Giddens, and Scott Lash (Stanford, CA: Stanford University Press, 1994), 6.

105. Quoted in Deborah Lupton, *Risk* (New York: Routledge, 1999), 74. See Anthony Giddens, “Living in a Post-traditional Society,” in Beck, Giddens, and Lash, *Reflexive Modernization*, 56–109.

106. Beck, *Risk Society*, 19.

107. Beck's thesis concerning risk society is developed in numerous texts; see Beck, *Risk Society*, 1–50; Beck, *World at Risk*; Ulrich Beck, “Global Risk Politics,” *Political Quarterly* 68 (1997): 18–33; Beck, “Reinvention of Politics.” For useful commentary, see Scott Lash and Brian Wynne, “Introduction” in Beck, *Risk Society*, 1–8; Lupton, *Risk*; Beck, Giddens, and Lash, *Reflexive Modernization*.

108. Beck, *Risk Society*, 20–21.

109. Beck, *Risk Society*, 19–50; Beck, “Global Risk Politics”; Beck, *World at Risk*, 47–66.

110. Beck, “Global Risk Politics,” 25–26; Beck, *Risk Society*, 22–34; Beck, *World at Risk*, 47–66; Lupton, *Risk*, 64–65.

111. In this manner, *risks*, as Beck sketches the term, appear to be what are often described within the literature on risk as *uncertainties*. The classic distinction between risk, for which probabilistic estimates can be made, and uncertainty, for which such estimates cannot, is found in Knight, *Risk, Uncertainty, and Profit* (1921; repr., 1957). Beck's notion of risks is more closely aligned with what Knight terms uncertainty. Indeed, Beck adopts the phrase *manufactured uncertainties* in discussing the types of novel risks in which he is interested. Beck, *World at Risk*, 50. For a discussion of the disjunction between Beck's use of the term *risk* and its usage within economics and the literature on risk analysis, see Lupton, *Risk*, 7–8.

112. On this point, see also Francois Ewald, "Insurance and Risk," in *The Foucault Effect: Studies of Governmentality*, ed. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: University of Chicago Press, 1991), 197–210.

113. Beck, *Risk Society*; Beck, *World at Risk*; Beck, "Global Risk Politics"; Beck, "Reinvention of Politics." On the conceptual and policy challenges and difficulties of addressing what are often termed low-probability, high-consequence events, see Richard Posner, *Catastrophe: Risk and Response* (New York: Oxford University Press, 2005); Philip Auerwald et al., eds., *Seeds of Disaster, Roots of Response: How Private Action Can Reduce Public Vulnerabilities* (Cambridge: Cambridge University Press, 2006); Cass Sunstein, *Worst-Case Scenarios* (Cambridge, MA: Harvard University Press, 2007).

114. See Beck, "Reinvention of Politics," 18; Beck, "Global Risk Politics," 29–30; Beck, *Risk Society*, 28–47; Beck, *World at Risk*, 21.

115. Beck, *Risk Society*, 77.

116. *Ibid.*

117. In this sense, risks operate as what political scientists describe as *policy windows*. See Thomas A. Birkland, *After-Disaster: Agenda Setting, Public Policy, and Focusing Events* (Washington, DC: Georgetown University Press, 1997); Thomas A. Birkland, *Lessons of Disaster: Policy Change after Catastrophic Events* (Washington, DC: Georgetown University Press, 2006).

118. Beck, "Global Risk Politics," 32.

119. Beck, Giddens, and Lash, *Reflexive Modernization*, vii; Beck, *World at Risk*, 30, 68–69, 135.

120. For a discussion of how social movements can appropriate risk, see Kim Fortun, *Advocacy after Bhopal: Environmentalism, Disaster, New Global Orders* (Chicago: University of Chicago Press, 2001).

121. Beck, "Reinvention of Politics," 29; Ulrich Beck, "Self-Dissolution and Self-Endangerment of Industrial Society: What Does This Mean?," in *Reflexive Modernization*, 178.

122. Ulrich Beck, Wolfgang Bonns, and Christoph Lau, "The Theory of Reflexive Modernization," *Theory, Culture & Society* 20, no. 2 (2016): 20.

123. Beck, *Risk Society*, 29.

124. Ibid., 47–48.
125. Beck, *World at Risk*, 66.
126. Ibid., 30–34.
127. Ibid., 21.
128. Beck, *Risk Society*, 49–50; Beck, “Self-Dissolution,” 177; Beck, *World at Risk*, 57–59.
129. Beck, *Risk Society*, 78–81.
130. Beck, *World at Risk*, 32.
131. Beck’s discussion of the staging of risks in *World at Risk* highlights that collective knowledge and recognition of a risk is indispensable to its utility as a resource (10–16). See also Beck, *Risk Society*, 33–34.
132. Geertz’s notion of culture is informed most significantly by the work of Max Weber. See Clifford Geertz, “Thick Description: Toward an Interpretive Theory of Culture,” in *The Interpretation of Cultures: Selected Essays* (New York: Basic, 1973), 3–30.
133. Beck, *World at Risk*, 66.
134. Beck, “Global Risk Politics,” 30.
135. See Ann Swidler, “Culture in Action: Symbols and Strategies,” *American Sociology Review* 51 (1986): 273–286.
136. Barry Buzan, Ole Weaver, and Jaap De Wilde, *Security: A New Framework for Analysis* (Boulder: Lynne Rienner, 1998).
137. Ibid., 23.
138. Ibid., 29.
139. Corey Robin, *Fear: History of a Political Idea* (New York: Oxford University Press, 2004).
140. Robin’s discussion and use of *fear* is analogous to Beck’s more colloquial use of risks to mean perception of harm or danger.
141. John Mueller, *Overblown: How Politicians and the Terrorism Industry Inflate National Security Threats, and Why We Believe Them* (New York: Free Press, 2006). The argument that risks are used to justify the extension of power is also evident in the work of Robert Higgs and Naomi Klein. Higgs sees the appropriation of risks as driving the growth of the powerful administrative state, while Klein sees the same process as fostering the evisceration of public controls designed to protect public welfare in favor of powerful corporate interests. See Robert Higgs, *Crisis and Leviathan: Critical Episodes in the Growth of American Government* (New York: Oxford University Press, 1987); Klein, *Shock Doctrine*.
142. James Carey, “A Cultural Approach to Communication,” in *Communication as Culture: Essays on Media and Society* (New York: Routledge, 1992), 13–36.

Chapter 4

An earlier version of this chapter appeared as Ryan Ellis, “Creating a Secure Network: The 2001 Anthrax Attacks and the Transformation of Postal Security,” supplement, *Sociological Review* 62 (1 suppl) (2014): 161–182.

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2. Anthrax is the disease caused by spores of the bacterium *Bacillus anthracis*. Infection can take three different forms: inhalation, cutaneous, and gastrointestinal. As is colloquial, *anthrax* will be used to refer to both the spores of *Bacillus anthracis* and the disease that can result from exposure. It is presumed that not all of the letters initially treated with anthrax were recovered. See Thomas V. Inglesby et al., “Anthrax as a Biological Weapon, 2002: Updated Recommendations for Management,” *Journal of the American Medical Association* 287, no. 17 (2002): 2237; Affidavit of Thomas F. Dellafera in Support of Search Warrant, No. 07–524-M-01 (D.D.C. 2007); Thomas V. Inglesby et al., “Anthrax as a Biological Weapon: Medical and Public Health Management,” *Journal of the American Medical Association* 281, no. 18 (1999): 1735–1745.
3. See Inglesby et al., “Anthrax as a Biological Weapon, 2002”; Affidavit of Thomas F. Dellafera; Inglesby et al., “Anthrax as a Biological Weapon.”
4. See Committee on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: How Clean Is Safe?, *Reopening Public Facilities after a Biological Attack: A Decision Making Framework* (Washington, DC: National Academies Press, 2005), 1–22.
5. Nye Stevens, *Postal Service Financial Problems and Stakeholder Proposals*, prepared by the Congressional Research Service, RL31069 (Washington, DC: Library of Congress, 2002); Frank Gottron, *The U.S. Postal Service Response to the Threat of Bioterrorism through the Mail*, prepared by the Congressional Research Service, RL31280 (Washington, DC: Library of Congress, 2009); *Financial Security of the US Postal Service: Hearing before a Subcomm. of the Comm. on Appropriations*, 107th Cong. 284 (2001) (statement of John E. Potter, Postmaster General/CEO), <https://www.gpo.gov/fdsys/pkg/CHRG-107shrg77771/pdf/CHRG-107shrg77771.pdf>; Committee on Decontaminating Public Facilities, *Reopening Public Facilities*, 1.
6. U.S. Postal Inspection Service, *2002 Annual Report of Investigations of the United States Postal Inspection Service* (Washington, DC, 2002), 12, <https://postalinspectors.uspis.gov/pressroom/pubs.aspx>.
7. Lee Heath, “Weapons of Mass Disruption” (presentation to Mailers’ Technical Advisory Committee, Washington, DC, May 7, 2003), https://ribbs.usps.gov/mtac/documents/tech_guides/.
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9. Star, “Ethnography of Infrastructure.”

10. Theodore J. Cieslak and Edward M. Eitzen, "Clinical and Epidemiological Principles of Anthrax," *Emerging Infectious Diseases* 5, no. 4 (1999): 552. See also Donald Henderson, "The Looming Threat of Bioterrorism," *Science* 283, no. 5406 (1999): 1279–1282; Inglesby et al., "Anthrax as a Biological Weapon," 1735–1745; Tom Mangold and Jeff Goldberg, *Plague Wars: A True Story of Biological Warfare* (New York: St. Martin's, 2000).
11. Gisa Weszkalnys, "Anticipating Oil: The Temporal Politics of a Disaster Yet to Come," supplement, *Sociological Review* 62, no. S1 (2014): 211–235.
12. Thomas V. Inglesby, "Anthrax: A Possible Case History," *Emerging Infectious Diseases* 5, no. 4 (1999): 556.
13. See James C. Pile et al., "Anthrax as a Potential Biowarfare Agent," *Archive of Internal Medicine* 158, no. 5 (1998): 429–434; Inglesby et al., "Anthrax as a Biological Weapon, 2002," 2236–2252; World Health Organization, *Health Aspects of Chemical and Biological Weapons* (Geneva: World Health Organization, 1970), 84–100; Elizabeth Fee and Theodore M. Brown, "Preemptive Biopreparedness: Can We Learn Anything from History?," *American Journal of Public Health* 91, no. 5 (2001): 721–726.
14. OTA, *Proliferation of Weapons of Mass Destruction: Assessing the Risk*, OTA-ISC-559 (Washington, DC: Government Printing Office, 1993); Henderson, "Looming Threat of Bioterrorism," 1279–1282.
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19. USPS, "Emergency Response to Mail Allegedly Containing Anthrax," Management Instruction EL-860-1999-3, Washington, DC, October 4, 1999.
20. *Ibid.*
21. The letters sent to NBC, the *New York Post*, and both senators were recovered. Investigators established the presence of additional letters based on

environmental testing and additional evidence, though not all presumed letters were recovered. Affidavit of Thomas F. Dellafera; GAO, *US Postal Service: Better Guidance Needed to Ensure Appropriate Response to Anthrax Contamination*, GAO-04-239 (Washington, DC, 2004), 12.

22. GAO, *Bioterrorism: Public Health Response to Anthrax Incidents of 2001*, GAO-04-152 (Washington, DC, 2003), 9.

23. GAO, *Automation Is Taking Longer*.

24. GAO, *Bioterrorism*.

25. Center for Counterproliferation Research, “Anthrax in America: A Chronology and Analysis of the Fall 2001 Attacks” (working paper, Center for Counterproliferation Research, National Defense University, Washington, DC, 2002), 73, <http://www.fas.org/irp/threat/cbw/anthrax.pdf>.

26. Quoted in Center for Counterproliferation Research, “Anthrax in America.”

27. See T. W. Luke, “Everyday Techniques as Extraordinary Threats: Urban Technostructures and Non-places in Terrorist Actions,” in *Cities, War, and Terrorism*, ed. Stephen Graham, 120–136.

28. See Beck, *Risk Society*; Beck, *World at Risk*.

29. Canadian defense researchers conducted the only known laboratory tests of the distribution of anthrax through the mail prior to the fall of 2001 and echoed the conclusions reached by the CDC and USPS. See Kournikakis et al., “Risk Assessment,” 13.

30. Quoted in Center for Counterproliferation Research, “Anthrax in America,” 45.

31. See Centers for Disease Control and Prevention, “Bioterrorism Alleging Use of Anthrax”; USPS, “Emergency Response to Mail Allegedly Containing Anthrax.”

32. It is likely that testing did not identify the full scope of cross-contamination. For a discussion of the limitations of the testing process, see GAO, *Anthrax Detection: Agencies Need to Validate Sampling Activities in Order to Increase Confidence in Negative Results*, GAO-05-251 (Washington, DC, 2005).

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Chapter 5

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11. On the issue of rerouting, the rail and chemical industries aligned to reject government intervention. On other key issues, however, the rail and chemical industries sharply disagreed. Railroads supported legislation promoting the adoption of inherently safer technologies and the relaxation of common-carrier obligations that would have allowed them to refuse to carry hazmat cargo. On both these issues, the chemical industry actively challenged the position of the railroads. See *The Rail and Mass Transit Security: Industry and Labor Perspectives*, Hearing Before the Subcomm. on Transportation Security and Infrastructure Security, 110th Cong. (2007) (statement of Nancy Wilson, Vice President for Security, Association of American Railroads); AAR, *Hazmat Transportation by Rail: An Unfair Liability*, Washington, DC, September 2009, http://thehill.com/sites/default/files/aar_hazmatbyrailseptember2009_0.pdf.
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13. Railroads are not only prevented from refusing cargo due to common-carrier obligations but are also limited as to how much they can mark up rates

for hazmat cargo. The most obvious ways for the railroads to deal with the challenges of hazmat transportation—refusal to carry and excessive price—are not available. AAR, *Hazmat Transportation*.

14. TIH materials are gases or liquids that are toxic to humans. They are particularly dangerous due to their ability to disperse over large areas. TIH materials, or as they are occasionally dubbed, poisonous-by-inhalation materials, accounted for only .25% of annual railcar loads during the early 2000s. Hazardous materials, in total, during this period accounted for 5.5% of railcar loads. See Request for Comments, Hazardous Materials: Enhancing Rail Transportation Safety and Security for Toxic Inhalation Hazard Materials, 69 Fed. Reg. 50988 (August 16, 2004); AAR, *Hazmat Transportation*.

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18. Accidents involving hazardous materials were a frequent problem during the 19th and early 20th centuries (see chapter 3). In 1903, an accident involving explosive shipments in the Pennsylvania Railroad yard in Crestline, Ohio, set 500 railcars on fire, injured many, and left a 40 ft. crater in the ground. The Crestline accident provided the impetus for voluntary regulations and the formation of the Bureau of Explosives. Previously, shipments of hazardous materials were governed by private contracts and provisions taken from English common law. An 1866 federal law relating to hazardous cargo was ineffectual and largely ignored. Mark Aldrich, “Regulating Transportation of Hazardous Substances: Railroads and Reform, 1883–1930,” *Business History Review* 26, no. 2 (2002): 267–297; OTA, *Transportation of Hazardous Materials*, OTA-SET-304 (Washington, DC: Government Printing Office, 1986), 145–147.

19. Aldrich, “Regulating Transportation,” 267–285.

20. *Ibid.*, 267–297; OTA, *Transportation of Hazardous Materials*, 146.

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29. Jeremy F. Plant, “Terrorism and the Railroads: Redefining Security in the Wake of 9/11,” *Journal of Policy Research* 21, no. 3 (2004): 293–297.
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31. On this point, see the discussion of Ulrich Beck in chapter 3.
32. See Rick Hind, letter to Senators Collins and Lieberman, September 15, 2005; U.S. Federal Railroad Agency, “Regulatory Assessment, Regulatory Flexibility Analysis,” in *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (April 2008), 29; Friends of the Earth, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (May 15, 2007).
33. Plant, “Terrorism and the Railroads,” 299.
34. In addition to hazmat security, AAR’s security task force examined the protection of physical infrastructure, operational security, interaction with the military, and communication and information technology security. Ibid., 298.
35. Chemical Security Act of 2001, S. 1602, 107th Cong. (2001).
36. Eric Pianin, “Toxic Chemicals’ Security Worries Officials; Widespread Use of Industrial Materials Makes Them Potential Target of Terrorists,” *Washington Post*, November 12, 2001.
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42. Aviation and Transportation Security Act, Pub. L. No. 107–171, 115 Stat. 597 (2001).
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44. Advisory Notice, Enhancing the Security of Hazardous Materials in Transportation, 31 Fed. Reg. 6963–6966 (February 14, 2002).

45. Plant, "Terrorism and the Railroads," 299.
46. Federal Bureau of Investigation, "FBI Distributed through the NLETS Communications System," press release, October 23, 2002, <https://archives.fbi.gov/archives/news/pressrel/press-releases/fbi-distributed-through-the-nlets-communications-system>.
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48. "Hell on Wheels"; Greenpeace, "Re-routing Will Eliminate."
49. Homeland Security Act of 2002. Pub. Law. No. 107-296, § 1710-11, 116 Stat. 2135, 2319-20 (2002).
50. Final Rule: Hazardous Materials: Security Requirements for Offerors and Transporters of Hazardous Materials, 68 Fed. Reg. 14511 (March 25, 2003).
51. *Ibid.*, 14510-14521.
52. *Ibid.*
53. Greenpeace, "Submitted Comments," comment on *Hazardous Materials*, No. RSPA-2004-18730.
54. Greenpeace charged that the Bush administration's close ties with industry interfered with more substantive regulations. At the time, former CSX chairman John W. Snow served as treasury secretary. Spencer S. Hsu, "D.C. May Ban Hazardous Shipments; Anti-terror Proposal Pits Environmentalists against Rail Officials," *Washington Post*, January 24, 2004. On the relationship between the rail and chemical industries and regulation, see Public Citizen, *Homeland Unsecured: The Bush Administration's Hostility to Regulation and Ties to Industry Leave America Vulnerable* (Washington, DC: Public Citizen, 2004), <https://www.citizen.org/sites/default/files/acf1b7.pdf>.
55. Paolino, "All Aboard," 158-159.
56. Regarding the exceptional status of Washington, DC, as a terrorist target, Councilwoman Kathy Patterson noted that travelers in and out of Reagan National Airport alone face unique restrictions. Only when arriving or departing from Reagan are travelers prevented from leaving their seats for 30 minutes before takeoff and landing. Patterson, "Statement on Introduction."
57. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at *16 (D.D.C. Apr. 18, 2005).
58. Hsu, "D.C. May Ban Hazardous Shipments."
59. Terrorism Prevention and Safety in Hazardous Materials Transportation Act of 2003, B15-0525, D.C. City Council (2003); Terrorism Prevention and Safety in Hazardous Materials Transportation Emergency Act of 2004, B15-1100, D.C. City Council (2004); Spencer S. Hsu and Sari Horwitz, "Hazmat Rerouting Decision Delayed; White House Accused of 'Playing Politics' over DC Rail Line," *Washington Post*, October 25, 2004; Greenpeace, "Submitted Comments," comment on *Hazardous Materials*, No. RSPA-2004-18730.

60. In August 2004, DOT issued a request seeking comments on how to improve the security of hazmat transportation. Though comments were due by October, DOT did not take any further steps to introduce new regulations. Request for Comments, 69 Fed. Reg. at 50988–50994; Hsu and Horwitz, “Hazmat Rerouting Decision Delayed.”
61. Patterson, “Statement on Introduction.”
62. Terrorism Prevention in Hazardous Materials Transportation Emergency Act of 2005, DC Code §§8-1421-8-1426 (2005); Paolino, “All Aboard,” 154.
63. DC Code §8–1421.
64. *Ibid.*
65. Patterson, “Statement on Introduction.”
66. DC Code §§8–1423, 8–1424.
67. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569 at *16 (D.D.C. Apr. 18, 2005).
68. Specifically, the DC Council wanted CSX to enter into an interchange agreement, which would have allowed Norfolk Southern Railway to carry identified hazardous cargoes on its line 50 miles west of the district. Patterson, “Statement on Introduction.”
69. Elizabeth A. Moore, “Federalism vs. Terrorism: Damaging DC’s Defense against Chemical Attacks in *CSX Transportation, Inc. v. Williams*,” note, *George Washington Law Review* 74 (2005–2006): 772.
70. Others joining CSX include the American Petroleum Institute, Chlorine Chemistry Council, Chlorine Institute, Fertilizer Institute, National Association of Chemical Distributors, and the Sulphur Institute. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569.
71. *Wabash, St. Louis & Pacific Railway Company v. Illinois*, 118 U.S. 557 (1886).
72. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at *3.
73. *Ibid.*, *4–5.
74. For review of the questions raised in *CSX v. Williams*, see Moore, “Federalism vs. Terrorism”; Paolino, “All Aboard”; Chris McChesney, “Toxic Trains: Chemical Transportation Regulation, Terrorism, and the U.S. Capitol,” *Sustainable Development Law & Policy* 6, no. 3 (2006): 30–32, 81.
75. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at *16–17.
76. Moore, “Federalism vs. Terrorism,” 772.
77. 49 U.S.C. § 20106 (2012).
78. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at *28–29.
79. 49 U.S.C. § 20106 (2012); see also *ibid.*, *22.
80. 49 U.S.C. § 20106 (2012).
81. 49 U.S.C. § 5125(a) (2012); see also *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at 24.
82. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569.

83. *Ibid.*, *31–32.

84. *Ibid.*, *37.

85. The court notes that DOT estimates that compliance with HM-232 will occupy 50 hours of work—roughly one week of work by a single employee. In the court’s reading, such a minor effort can hardly be deemed to “cover” the complex issue of hazardous materials security. *Ibid.*

86. *Ibid.*

87. *Ibid.*

88. *Ibid.*

89. *Ibid.*, *39–41.

90. *CSX Transp., Inc. v. Williams*, 406 F.3d 667, 669 (D.C. Cir. 2005).

91. *Ibid.*, 672.

92. *Ibid.*

93. *Ibid.*, 673.

94. *Ibid.*, 672.

95. *Ibid.*

96. *Ibid.*, 673.

97. *Ibid.*

98. *Ibid.*

99. The concurring opinion of Judge Karen LeCraft Henderson notes that the act would also be preempted by the Hazardous Materials Transportation Act on similar ground. *Ibid.* at 674 (Henderson, K.L., concurring).

100. Implementing Recommendations of the 9/11 Commission Act of 2007, Pub. L. No. 110–152, 112 Stat. 266 (2007).

101. See *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569 (D.D.C. 2005) (No. 05–338).

102. See Notice of Proposed Rulemaking: Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments, 71 Fed. Reg. 76834–76850 (December 21, 2006); Interim Final Rule, 73 Fed. Reg. 20752–20773; Final Rule: Hazardous Materials: Enhancing Rail Transportation Safety and Security for Hazardous Materials Shipments, 73 Fed. Reg. 72182–72194 (November 26, 2008).

103. *CSX Transp.*, 2005 U.S. Dist. LEXIS 6569, at *37.

104. Notice of Proposed Rulemaking, 71 Fed. Reg. at 76842.

105. *Ibid.*, 76848.

106. *Ibid.*, 76842.

107. *Ibid.*, 76834.

108. *Ibid.*, 76839–76840.

109. *Ibid.*, 76842.

110. *Ibid.*, 76849.
111. *Ibid.*
112. *Ibid.*, 76844.
113. See Greenpeace, “Re-routing Will Eliminate”; Friends of the Earth, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (February 18, 2007); City of Baltimore, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (February 20, 2007); State of Connecticut, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (March 9, 2007); District of Columbia, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (February 16, 2007); City of Cleveland, “Submitted Comments,” comment on *Hazardous Materials*, No. PHMSA-RSPA-2004-18730 (February 16, 2007).
114. Notice of Proposed Rulemaking, 71 Fed. Reg. at 76834, 76848.
115. Interim Final Rule, 73 Fed. Reg. at 20752, 20761.
116. Final Rule, 73 Fed. Reg. at 72182, 72185.
117. Interim Final Rule, 73 Fed. Reg. at 20755–20756.
118. See note 113.
119. See Carol D. Leonnig, “Congress Approves Rail Cargo Measure; Hazardous Matter Would Be Banned on Lines in DC,” *Washington Post*, July 29, 2007; Friends of the Earth, “Congress Passes Toxic Rail Protections for Major Cities,” news release, July 30, 2007, <https://foe.org/2008-10-congress-passes-toxic-rail-protections-for-major-cit/>.
120. Implementing Recommendations of the 9/11 Commission Act of 2007.
121. *Ibid.*, § 1551(a).
122. *Ibid.*, § 1551(d).
123. *Ibid.*, § 1551(c)(h).
124. Previous attempts at passing rerouting legislation failed. See, for example, the Extremely Hazardous Materials Rail Transportation Act of 2005, S. 773, 109th Cong. (2005); Hazardous Materials Vulnerability Reduction Act of 2005, S. 1256, 109th Cong. (2005); 9/11 Commission Recommendations Implementation Act of 2006, S. 2412, 109th Congress.
125. Final Rule, 73 Fed. Reg. at 72182, 72186.
126. Interim Final Rule, 73 Fed. Reg. at 20752, 20771–20773.
127. Final Rule, 73 Fed. Reg. at 72183.
128. Interim Final Rule, 73 Fed. Reg. at 20761–20762, 20766–20768.
129. *Ibid.*, 20766.
130. On the frustrations with the regulations, see Friends of the Earth, “Friends of the Earth Blasts Bush Admin Railroad Routing Regs,” news release, April 16, 2008, <https://foe.org/2008-11-friends-of-the-earth-blasts-bush-admin-railroad-rout/>.

131. Final Rule: Hazardous Materials: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains, 80 Fed. Reg. 26664–26750 (May 8, 2015).
132. Final Rule, 80 Fed. Reg. at 26665.
133. Transportation Safety Board of Canada, “Runaway and Main-Track Derailment: Montreal, Maine and Atlantic Railway Freight Train MMA-002 Mile 0.23, Sherbrooke Subdivision Lac-Mégantic, Quebec 06 July 2013,” *Railway Investigation Report*, No. R13D0054, August 20, 2014, 1–3.
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Chapter 6

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88. Ibid., 48, 54–60.

89. Ibid., 105–140.

90. Ibid., 10.

91. For a discussion of industry claims in favor of a strong ERO unencumbered by substantive review and FERC’s rejection of this position, see *ibid.*, 50–54, 136–138.

92. Ibid., 136–138.

93. See, for example, the comment of PacifiCorp in *ibid.*, 136.

94. Ibid., 107–109.

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98. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 1.

99. Ibid., 4–5; NERC, “Standard Development Roadmap,” in *Mandatory Reliability Standards*, No. RM06-22-000 (n.d.); NERC, “Cyber Security,” in *Mandatory Reliability Standards*, No. RM06-22-000 (n.d.).

100. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 8–14.

101. FERC’s objections and analysis are outlined in *ibid.*; FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-16-000, 34–41; Notice of Proposed Rulemaking: Mandatory Reliability Standards for Critical Infrastructure Protection, 72 Fed. Reg. 43970 (August 6, 2007).

102. The approval process for reliability standard involves four general steps: (1) the ERO develops consensus standards through working groups and balloting; (2) FERC conducts a preliminary technical review of the proposed standard (or standards) and issues a report detailing findings; (3) FERC issues a formal

Notice of Proposed Rulemaking and opens the standard to public review and discussion; (4) FERC issues an order to either accept or remand the standard.

103. NERC, “Cyber Security: Standard CIP-002–1–CIP-009–1,” in *Mandatory Reliability Standards*, No. RM06-22-000 (August 28, 2006).

104. NERC, “Definitions of Terms Used in Standard,” in *Mandatory Reliability Standards*, No. RM06-22-000 (n.d.).

105. *Ibid.*

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107. The initial standards did not cover local distribution. Each CIP standard identified 11 responsible entities subject to the rules: reliability coordinator, balancing authority, interchange authority, transmission service provider, transmission owner, transmission operator, generator operator, load-serving entity, NERC, and regional reliability organizations. NERC, “Cyber Security: Standard CIP-002–1–CIP-009–1.”

108. NERC, “Definitions of Terms”; NERC, “Cyber Security: Standard CIP-002–1—CIP-009–1.”

109. Notice of Proposed Rulemaking, 72 Fed. Reg. 43970, 43971–43972.

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112. NERC, “Cyber Security: Standard CIP-002–1—CIP-009–1.”

113. NERC, “Frequently Asked Questions (FAQs): Cyber Security Standards CIP–002–1 through CIP–009–1,” in *Mandatory Reliability Standards*, No. RM06-22-000 (March 2006).

114. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 8–10; Notice of Proposed Rulemaking, 72 Fed. Reg. 43970, 43977.

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117. See comments at Notice of Purposed Rulemaking, 72 Fed. Reg at 43977; Final Rule: Mandatory Reliability Standards for Critical Infrastructure Protection, 73 Fed. Reg. 7368 (Feb, 7, 2008) (to be codified at 18 C.F.R. pt. 40); Pacific Gas and Electric, “Submitted Comments,” comment on *Mandatory Reliability Standards*, No. RM06-22-000 (February 12, 2007), 5–6.

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119. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 8–10; Notice of Proposed Rulemaking, 72 Fed. Reg. at 43976–43978; Final Rule, 73 Fed. Reg. at 7381–7383.

120. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 10.
121. Notice of Proposed Rulemaking, 72 Fed. Reg. at 43977. On the general challenges of interdependent security, see Geoffrey Heal et al., “Interdependent Security in Interconnected Networks,” in Auerswald et al., *Seeds of Disaster*, 258–276.
122. Final Rule, 73 Fed. Reg. at 7380.
123. Notice of Proposed Rulemaking, 72 Fed. Reg. at 43977.
124. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 3, 20–21, 32.
125. NERC, “Cyber Security: Standard CIP-002–1—CIP-009–1.”
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127. *Ibid.*
128. Notice of Proposed Rulemaking, 72 Fed. Reg. at 43979.
129. Final Rule, 73 Fed. Reg. 7368, 7383.
130. Notice of Proposed Rulemaking, 72 Fed. Reg. at 43980; FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 3, 20.
131. Notice of Proposed Rulemaking, 72 Fed. Reg. at 43980.
132. *Ibid.*
133. FERC, “Staff Preliminary Assessment,” in *Mandatory Reliability Standards*, No. RM06-22-000, 20–21.
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135. *Ibid.*, 11; Notice of Proposed Rulemaking, 72 Fed. Reg. at 43974; Final Rule, 73 Fed. Reg. 7368, 7375.
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139. *Ibid.*, 43974.
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149. Ibid., 7441–7442; Notice of Proposed Rulemaking, Final Rule, 72 Fed. Reg., 43970, 44010–44013.

150. Notice of Proposed Rulemaking, 72 Fed. Reg. at 44005–44006; Final Rule, 73 Fed. Reg. at 7440–7442.

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Conclusion

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Coda

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