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# Innovation Matters

## Competition Policy for the High-Technology Economy

By: Richard J. Gilbert

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# Notes

## Chapter 1

1. See, e.g., Khan (2017), Stiglitz (2017), and Wu (2018a, b).
2. I will refer to several actual antitrust cases to illustrate the principles in this book. I was personally involved in some of these cases, either in my capacity as Deputy Assistant Attorney General for Economics in the Antitrust Division of the DOJ or as a private consultant. In the interest of transparency, I indicate my involvement when I discuss the cases. My statements about these cases are not intended to reflect or endorse the official positions of any enforcement authority or any other party and do not reference confidential information. I have not received financial support from any private entity for the writing of this book.
3. I use the term “merger” here and throughout this book to also refer to acquisitions in which a firm acquires the assets of another firm or subsidiary and retains its preacquisition identity.
4. See, e.g., OECD (2018) at 20.
5. *Ibid.* at 44.
6. *US v. General Motors and ZF Friedrichshafen, AG, et al.*, Civil Action 93–530, Complaint, November 16, 1993.
7. The author was Deputy Assistant Attorney General for Economics when the Antitrust Division of the DOJ began its investigation of Microsoft and subsequently consulted with the Division in a private capacity.
8. 15 US Code § 1.
9. 15 US Code § 2.
10. 15 U.S.C. §§ 12-27, as amended.
11. 15 U.S.C. sec. 45(a)(1).
12. See, e.g., Hovenkamp (2010).
13. Canada introduced “An Act for the Prevention and Suppression of Combinations Formed in Restraint of Trade” in 1889, one year before the US passed the Sherman Act.
14. Arrow (1962).
15. Schumpeter (1942).

## Chapter 2

1. Isaacson (2014) provides a personalized account of the human factors that drove innovation for the digital economy.
2. This distinguishes applied innovation from basic research, for which there is a continued role for support from government, universities, and institutions that does not directly depend on commercial profitability.
3. See, e.g., Sidak and Teece (2009).
4. R&D intensity is likely to increase for motor vehicles that incorporate self-driving features, but perhaps not for automobile manufacturers if they purchase the technology from external suppliers.
5. Schumpeter (1942) at 83.
6. This is based on the rate at which firms enter and exit the S&P 500 Index. See Fox (2017).
7. In general, this presumption is correct (for existing resources) only if prices for all other goods and services equal their marginal costs. The theory of the second best says that marginal cost pricing is not necessarily efficient if prices for some products or services in the economy diverge from their marginal production costs. See Lipsey and Lancaster (1956).
8. Network effects are sometimes called network “externalities” to emphasize that consumers and firms may not account for the effects of their purchase and product decisions on the welfare of other consumers and firms.
9. See Katz and Shapiro (1985, 1994).
10. See Katz and Shapiro (1994) and Farrell and Saloner (1985, 1986).
11. Ibid.
12. Church and Gandal (1993) show that in markets for competing but incompatible computer systems, indirect network effects from complementary computer software can lead to inefficient adoption of computer hardware. Katz and Shapiro (1986a, b) and Farrell and Katz (1998, 2005) explore how consumer expectations can affect market competition with network effects.
13. See, e.g., Shelanski and Sidak (2001) at 35–36.
14. See, e.g., Lee (2014) and Weyl and White (2014).
15. Farrell and Katz (2005) at 237 conclude that “it seems almost inevitable that predation policy in network markets will sometimes be fighting the wrong war.”
16. *US v. Microsoft*, Court of Appeals for the District of Columbia Circuit (June 28, 2001), 253 F.3d 34, 11–12.
17. The fifth firm is Berkshire Hathaway.
18. “The key feature of payment systems, and one that arises in several other industries characterized by network externalities (media, software, matchmakers, etc.), is its two-sidedness.” Rochet and Tirole (2002); see also Baxter (1984–1985).

19. Rochet and Tirole (2006).
20. Evans and Schmalensee (2018) maintain that it is appropriate to view a business as a platform if (1) there are indirect network effects between members of at least one of the two customer groups and members of the other group, (2) these indirect network effects are strong enough to affect business conduct, and (3) the platform facilitates interactions between members of the two groups.
21. Lee (2013).
22. *Ohio et al. v. American Express Co. et al.*, US Supreme Court, No. 16-1454 (2018). (Note: The author testified on behalf of American Express in this case.)
23. The Supreme Court's majority opinion elicited a strong dissent, written by Justice Stephen Breyer, who argued that the district court was correct to focus its analysis on a market for credit card network services provided to merchants and that there was no precedent for defining a two-sided market. *Ibid.* at 14, 19.
24. Generally, platform competition is more intense on a side where agents are likely to choose a single platform (agents "single-home") rather than participate on several platforms (agents "multihome"). See, e.g., Armstrong (2006). Merchants that accept credit cards have an incentive to multihome because they want to serve any customer that presents a card. Many cardholders are willing to concentrate their purchases on a single card that offers high rewards if merchants accept the card, which incentivizes card issuers to offer high rewards.
25. See, e.g., Filistrucchi, Geradin, van Damme, and Affeldt (2014).
26. See, e.g., Cukier (2010).
27. See, e.g., Rubinfeld and Gal (2017).
28. See, e.g., Sivinski, Okuliar, and Kjolbye (2017).
29. US Department of Justice Press Release, "Justice Department requires Thomson to sell financial data and related assets in order to acquire Reuters," February 19, 2008.
30. *US v. Thomson Corporation and Reuters Group plc*, Complaint, February 19, 2008.
31. US Federal Trade Commission, *In the Matter of Nielsen Holdings N.V. and Arbitron Inc.*, File No. 131 0058, "Analysis of Agreement Containing Consent Order to Aid Public Comment," September 20, 2013.
32. European Commission, *Microsoft/LinkedIn*, Case M.8124, December 6, 2016 at §5.
33. Such firms are sometimes called "complementors." Shaprio and Varian (1999b) at 10.
34. Cournot (1927).
35. Integration often increases innovation effort compared to efforts by separate firms when the efforts are complementary. However, unlike the Cournot complements effect for prices, this is not a general result because there is an interaction with prices, which also affect the demand for innovations. See the appendix to Farrell and Katz (2000).
36. See US Department of Justice Press Release, "Justice Department will not challenge Cisco's acquisition of Tandberg," March 29, 2010; available at <https://www.justice.gov/opa/pr/justice-department-will-not-challenge-cisco-s-acquisition-tandberg>. (Note: The author consulted for Cisco Systems on matters related to this transaction.)

37. Cisco news release, "Cisco receives antitrust approvals from European Commission and US Department of Justice for pending acquisition of TANDBERG"; available at <https://newsroom.cisco.com/press-release-content?type=webcontent&articleId=5430146>, accessed March 12, 2019.
38. US Federal Trade Commission, *In the Matter of Intel Corporation*, Docket No. 9341, Complaint, December 16, 2009.
39. US Federal Trade Commission, *In the Matter of Intel Corporation*, Docket No. 9341, Decision and Order, October 29, 2010.
40. Not all firms in the high-technology economy face low barriers to enter related markets. A drug company that specializes in cardiovascular diseases would incur large expenses for R&D, clinical testing, and distribution to enter markets for vaccines and would have limited economies of scope from its existing assets.
41. Dryden and Iyer (2017) and Srinivason (2019) offer some other examples in which privacy issues intersect with antitrust concerns.
42. See, e.g., Furman and Orszag (2015), Furman (2016), and Gutiérrez and Philippon (2018).
43. See, e.g., Autor, Dorn, Hanson, Pisano, and Shu (2017) and Stiglitz (2017).
44. See, e.g., Khan (2017), Stiglitz (2017), and Wu (2018a, b).
45. See, e.g., Herndon (2019).
46. See, e.g., Baker and Shapiro (2008) and Kwoka, Greenfield, and Gu (2015).
47. Jay R. Ritter, Initial public offerings: Updated statistics; available at [https://site.warrington.ufl.edu/ritter/files/2019/01/IPOs2018Statistics\\_Dec.pdf](https://site.warrington.ufl.edu/ritter/files/2019/01/IPOs2018Statistics_Dec.pdf), accessed November 5, 2019.
48. Mauboussin, Callahan, and Majd (2017).
49. "Into the danger zone: American tech giants are making life tough for startups," *The Economist*, June 2, 2018, available at <https://www.economist.com/business/2018/06/02/american-tech-giants-are-making-life-tough-for-startups>.
50. Del Rey (2017).
51. For example, Facebook acquired Onavo in 2013. Onavo harvests user data and provides analytics for mobile applications, which Facebook can use to identify promising upstarts and potential competitors. Facebook reportedly shut down Onavo in 2019 in response to concerns about its collection of user data. See, e.g., Wells (2019).
52. Crunchbase, "Number of Google acquisitions," available at [https://www.crunchbase.com/organization/google/acquisitions/acquisitions\\_list#section-acquisitions](https://www.crunchbase.com/organization/google/acquisitions/acquisitions_list#section-acquisitions), accessed September 16, 2019.
53. Google sold Motorola to Lenova a few years after the acquisition but kept most of the patents.
54. Geradin and Katsifis (2018).
55. The Verge, "Facebook is shutting down a teen app it bought eight months ago," July 2, 2018; available at <https://www.theverge.com/2018/7/2/17528896/facebook-tbh-moves-hello-shut-down-low-usage>, accessed November 15, 2019.

56. Stone (2013) details a fierce price war between Amazon and Quidsi that ended when Amazon purchased Quidsi for \$545 million in 2010. Amazon shut down the Quidsi websites several years after the acquisition, although Amazon continues to sell consumables on its merchant platform.
57. “Hyenas and cheetahs: Artificial intelligence has revived the semiconductor industry’s animal spirits,” *The Economist*, June 9–15, 2018, pp. 54–56.
58. European Commission, *Facebook/WhatsApp*, Case No. COMP/M.7217, October 3, 2014.
59. UK Office of Fair Trading, “Anticipated acquisition by Facebook Inc of Instagram Inc,” ME/5525/12, 14 August 2012.
60. Market Realistic, available at <https://articles2.marketrealist.com/2019/01/instagrams-ad-revenue-more-than-doubled-in-2018/>, accessed November 5, 2019.
61. US Federal Trade Commission, “Statement of the Commission concerning Google/AdMob,” FTC file no. 101–0031, May 21, 2010. See also Farrell, Pappalardo, and Shelanski (2010) at 266.
62. eMarketer, “Net US mobile ad revenue share, by company, 2014–2017”; available at <https://www.emarketer.com/Chart/Net-US-Mobile-Ad-Revenue-Share-by-Company-2014-2017-of-total-billions/176289>, accessed January 13, 2019.
63. Mobbo, home page; available at <https://mobbo.com/whitepaper-monetization/>, accessed February 19, 2019.
64. Cunningham, Ederer, and Ma (2018).
65. Hovenkamp (2013) at 2471: “The dominant view of antitrust policy in the United States is that it should promote some version of economic welfare. More specifically, antitrust promotes allocative efficiency by ensuring that markets are as competitive as they can practicably be and that firms do not face unreasonable roadblocks to attaining productive efficiency, which refers to both cost minimization and innovation.”
66. The Antitrust Modernization Commission was created pursuant to the Antitrust Modernization Commission Act of 2002, Pub. L. No. 107–273, 116 Stat. 1856.
67. Garza et al. (2007) at 9. See also Posner (2001) at 925: “Antitrust doctrine is supple enough, and its commitment to economic rationality strong enough, to take in stride the competitive issues presented by the new economy.”
68. 15 US Code § 18.
69. 353 US 586, 592.
70. 463 F. Supp. 983 (December 29, 1978). See Tom (2001) for a useful discussion of the case.
71. 463 F. Supp. 983, 1000.
72. 645 F.2d 1195, 1210 (March 12, 1981) (emphasis added).
73. *Golden Gate Pharmacy Services, Inc. v. Pfizer, Inc.*, No. C-09–3854 (N.D. Cal. Dec. 2, 2009).
74. *Golden Gate Pharmacy Services, Inc. v. Pfizer, Inc.*, Court of Appeals for the Ninth Circuit, 433 Fed. Appx. 598 (May 19, 2011).
75. See Royall and DiVincenzo (2010). The doctrine of “actual potential competition” differs from the doctrine of “perceived potential competition.” The latter refers to the

disciplining effect of a firm that could enter an industry on prices charged by incumbents. The law has been more receptive to arguments about perceived potential competition than actual potential competition.

76. See, e.g., Kolasky and Dick (2003) and Kwoka (2008).

77. Hovenkamp (2013) at 2476.

### Chapter 3

1. Joseph Schumpeter does not present a formal description of his theory about the relationship between competition and innovation. His views appear in several publications but are most prominent in *Capitalism, Socialism, and Democracy* (1942).

2. Arrow (1962).

3. Both Kenneth Arrow and John Hicks were awarded the Nobel Prize in Economics in 1972. The Nobel committee emphasized the two men's pioneering contributions to general equilibrium and welfare theory rather than competition and innovation, but Arrow's Nobel biography highlights his 1962 paper on the allocation of resources to invention, and it is one of his most-cited papers. The Nobel Prize, "Kenneth J. Arrow, Biographical," available at <https://www.nobelprize.org/prizes/economic-sciences/1972/arrow/biographical/>.

4. Schumpeter (1942) at 106. Since impossible implies inferior, a more logical interpretation of this well-known quote is that competition would be an inferior organizational form for economic progress if it were possible.

5. Schumpeter (1942) at chapter VII. McCraw (2012) disputes the notion that Schumpeter promoted the benefits of size and monopoly power for innovation.

6. Schumpeter (1942) at 100–101 (footnote omitted).

7. Dasgupta and Stiglitz (1980).

8. Vives (2008).

9. See Spence (1984) for an analysis of cost-reducing innovation incentives with technological spillovers. Spillovers partly explain why geographic clusters of firms tend to be associated with high levels of industry productivity. See Porter (2001).

10. Katz and Shapiro (1987).

11. Arrow (1962) at 620.

12. The social value includes spillover benefits for firms and consumers that innovators often do not capture as profits. Jones and Williams (1998) estimate social rates of return to innovation and find that they average in excess of 27 percent per annum, which is much more than the average private return on innovation.

13. The discussion of monopoly preemption incentives in this chapter is based on Gilbert and Newbery (1982).

14. Isaacson (2011) at 408.

15. Reinganum (1983, 1989) makes this point clearly in a dynamic model of a race to patent an invention.

16. See Salant (1984).

17. Lewis (1983) shows that the value of a preemption strategy is a decreasing function of the number of alternative entry paths, and preemption is not profitable if the number of paths is sufficiently large.
18. The *US Department of Justice and Federal Trade Commission Antitrust Guidelines for the Licensing of Intellectual Property* do not presume that a patent, copyright, or trade secret necessarily creates market power for its owner, let alone confers a monopoly. The guidelines cite *Ill. Tool Works Inc. v. Indep. Ink, Inc.*, 547 US 28, 45–46 (2006) (“Congress, the antitrust enforcement agencies, and most economists have all reached the conclusion that a patent does not necessarily confer market power upon the patentee. Today, we reach the same conclusion.”)
19. Shapiro and Varian (1999) offer examples of industries in which complements feature prominently and describe implications for profitable business strategies.
20. Greenstein and Ramey (1998).
21. Chen and Schwartz (2013).
22. See, e.g., *Economic Report of the President*, February 2016.
23. Coase (1972) observed that the supplier of a durable good has an incentive to lower its prices continually to increase its sales. The distinction between pricing incentives for a durable and a nondurable good would be lost if the supplier of the durable good rented rather than sold it.
24. Ellison and Fudenberg (2000) show that a durable good monopolist can have excessive incentive to supply upgrades.

## Chapter 4

1. Winner-take-all is a strong assumption in this context. It rules out sharing or the expectation of sharing from simultaneous discovery.
2. This result first appears in Sah and Stiglitz (1987).
3. Total R&D investment can exceed the level that maximizes total economic welfare (the welfare of consumers and the profits earned by firms) because the incentive to innovate to take business from a rival does not have a corresponding social benefit.
4. Levin, Klevorick, Nelson, and Winter (1987) and Cohen, Nelson, and Walsh (2004) describe the mechanisms that firms employ to protect their comparative advantage.
5. See Loury (1979), Lee and Wilde (1980), Reinganum (1981), and the survey in Reinganum (1989). Technically, these models assume a Poisson discovery probability with a hazard rate that is independent of past R&D expenditures.
6. See, e.g., Jones and Williams (1998).
7. Stewart (1983) develops a model of a patent race and finds that intermediate levels of concentration can promote innovation if rivals benefit from technological spillovers.
8. Vickers (1986).
9. Fudenberg, Gilbert, Stiglitz, and Tirole (1983) and Harris and Vickers (1985) show that monopoly outcomes in R&D can emerge under more general conditions when firms differ in their stock of R&D capital and they can monitor investments by their rivals.



10. Doraszelski (2003) generalizes the patent race model to allow discovery probabilities that depend on past R&D expenditures. His model allows profit-maximizing strategic behavior, in which a firm that lags a technological leader can catch up to the leader by aggressively increasing its expenditures on R&D, provided that it already has a sufficiently large stock of R&D capital. The model also allows for increasing dominance, in which a technological leader builds on its lead and the laggard falls further behind.
11. Variants of the stepwise model include Aghion, Harris, and Vickers (1997), Aghion, Harris, Howitt, and Vickers (2001), and Aghion, Bloom, Blundell, Griffith, and Howitt (2005).
12. One example of this was done by varying the elasticity of substitution for the duopolists' products.
13. Biotech Industry Report (2015).
14. Erin Griffith, "Will Facebook kill all future Facebooks?," *Wired*, available at <https://www.wired.com/story/facebook-aggressive-moves-on-startups-threaten-innovation/>, accessed October 18, 2019, and the discussion in chapter 2.
15. For example, suppose the innovation is a nondrastic reduction in marginal cost and the price elasticity of substitution is equal and constant for all products in the acquiring market. Then an increase in the number of potential buyers with the old technology lowers the value of acquiring the new technology.
16. Marshall and Parra (2019).
17. The quoted phrase is in a letter from Isaac Newton to Robert Hooke, reported in Koyré (1952) at 5.
18. See, e.g., Merges and Nelson (1990).
19. Merges and Nelson (1990). The pool created the Radio Corporation of America (RCA). Patent logjams occurred in the early development of other industries, including electric lighting and automotive technology.
20. Research papers that examine the implications of cumulative innovation for the design of intellectual property rights include Scotchmer (1991, 2004), Chang (1995), O'Donoghue (1998), O'Donoghue, Scotchmer, and Thisse (1998), and Hunt (2004).
21. Kitch (1977).
22. "To give the second innovator an incentive to invest whenever social benefits exceed R&D costs, the second innovator must earn the entire social surplus of his innovation. But to compensate the first innovator for the externality or spillover she provides, she too must earn part of this surplus. It is impossible to give the surplus to both parties" (Scotchmer, 1991 at 34). See also Scotchmer (2004), at chapter 5.
23. The acronym stands for "clustered regularly interspaced short palindromic repeats." A palindromic sequence is a strand of DNA that is a mirror image of a sequence of nucleic acids in the complementary strand.
24. See Gilbert and Kristiansen (2018).
25. A further complication is that new competitors can become established firms whose conduct affects rewards for subsequent innovators. See, e.g., Segal and Whinston (2007) and Baker (2016).

26. Bessen and Maskin (2009).
27. See, e.g., Hart (1983).
28. See, e.g., Holmstrom (1982) and Nalebuff and Stiglitz (1983).
29. Scharfstein (1988) showed that product competition can lead to optimal compensation schemes that increase or decrease managerial effort depending on managers' preferences. Hermalin (1992) and Schmidt (1997) showed that competition can harm the ability of owners to negotiate compensation schemes with executives that motivate profit-maximizing behavior.
30. Dasgupta and Maskin (1987).
31. Cabral (1994) and Kwon (2010).
32. Christensen (1997).
33. Joshua Gans defines a technology as disruptive if the choices that once drove a firm's success become those that destroy its future. He also argues that disruptive technologies are inherently unpredictable, or else incumbents would react and avoid destructive consequences. Gans (2016) at 9.
34. See, e.g., Lepore (2014) and King (2017). These authors suggest that Christensen does not adequately account for mergers and acquisitions that enabled firms to sustain industry dominance.
35. This discussion is based on Tripsas and Gavetti (2000).
36. See Gilbert and Newbery (1982) and the discussion in chapter 3.
37. Franco and Filson (2006).
38. See, e.g., Gans (2016) at 122, 126.
39. Henderson and Clark (1990).
40. See, e.g., Lynn (1998).
41. While innovations sometimes require costly and disruptive changes to incumbents' existing competencies, incumbents can have differential advantages for other innovations because they complement their existing competencies. See, e.g., Tushman and Anderson (1986).
42. Grove (1996) at 106. Grove explained that the market success of 486-based computers was a crucial factor in Intel's decision to focus its efforts on the existing CISC microprocessor architecture.
43. Henderson (1993).
44. See, e.g., "Apple doesn't rely on market research, says marketing chief Phil Schiller," *Appleinsider*, July 31, 2012; available at [https://appleinsider.com/articles/12/07/31/apple\\_doesnt\\_rely\\_on\\_market\\_research\\_says\\_marketing\\_chief\\_phil\\_schiller](https://appleinsider.com/articles/12/07/31/apple_doesnt_rely_on_market_research_says_marketing_chief_phil_schiller), accessed December 3, 2019.
45. Gans (2016) describes strategies that incumbent firms have employed to manage disruptive change.
46. Hawking (2005) at 121, 132.

## Chapter 5

1. I do not distinguish between mergers and asset acquisitions in this discussion.
2. Some treatises classify acquisitions of potential competitors as a vertical transaction, but I do not follow that convention in this book.
3. Vertical mergers can have efficiency benefits that are generally absent in horizontal mergers, such as reducing mark-ups in the supply chain. See, e.g., European Commission (2016) at 4.
4. William Baxter, the Assistant Attorney General for Antitrust in the administration of Ronald Reagan, noted that mergers can raise prices for “today’s products,” for “tomorrow’s products,” or for the R&D activity that creates new or improved products (Baxter, 1984–1985).
5. See the Hart-Scott-Rodino Annual Report Fiscal Year 2018. The Hart-Scott-Rodino Antitrust Improvements Act of 1976, Pub. L. No. 94–435 (“HSR Act”), obligates companies to report proposed mergers or acquisitions to the FTC if they exceed defined monetary thresholds. Proposed mergers or acquisitions that fall below the HSR thresholds are not exempt from antitrust review, although reporting greatly facilitates review by the antitrust agencies.
6. The DOJ and FTC *Antitrust Guidelines for the Licensing of Intellectual Property* (“IP Guidelines”) published in 1995 and revised in 2017 did not address merger policy, but they noted the possible impacts of licensing arrangements on innovation incentives, and their publication in 1995 coincided with an inflection point in merger enforcement for innovation.
7. See Hesse (2014). In a footnote, she acknowledges that price and innovation effects do not always go hand in hand.
8. See Gilbert and Tom (2001), who observe that innovation concerns were not pivotal to enforcement decisions that occurred prior to the turn of the twentieth century.
9. The 1968 Merger Guidelines said, “In certain exceptional circumstances, however, the structural factors used in these guidelines [to define markets] will not alone be conclusive.... This is sometimes the case, for example, where basic technological changes are creating new industries, or are significantly transforming older industries, in such fashion as to make current market boundaries and market structure of uncertain significance.”
10. Merger Guidelines (1982), reprinted in 4 Trade Reg. Rep. ¶ 13,102 § I (June 14, 1982), available at [www.justice.gov/atr/hmerger/11248.htm](http://www.justice.gov/atr/hmerger/11248.htm).
11. A 1992 revision of the Merger Guidelines went slightly further to note that non-price impacts may include “product quality, service, or innovation.”
12. See US Department of Justice and Federal Trade Commission (2010) at § 10 (“Cognizable efficiencies are merger-specific efficiencies that have been verified and do not arise from anticompetitive reductions in output or service”).
13. Oliver Williamson (1983) describes advantages of internal organization compared to market transactions. In addition to his distinguished academic career, Williamson was a chief economist in the Antitrust Division of the DOJ. He was awarded a Nobel Prize in 2009.

14. Denicolò and Polo (2018a, 2018b) show that, under some conditions, merging parties can profitably reposition their R&D assets such that their innovation incentives post-merger exceed the parties' innovation incentives prior to the merger.
15. US Department of Justice and Federal Trade Commission (2010) at § 10.
16. US Department of Justice, Statement of the Department of Justice Antitrust Division on Its Decision to Close Its Investigation of the Internet Search and Paid Search Advertising Agreement Between Microsoft Corporation and Yahoo! Inc. (February 18, 2010).
17. US Department of Justice, Department of Justice Antitrust Division Statement on the Closing of Its Investigation of the T-Mobile/MetroPCS Merger (March 12, 2013).
18. See European Commission (2004) at ¶ 8.
19. *Ibid.* at ¶ 38.
20. For example, Crane (2011) argues for a more symmetrical treatment of predicted harms and benefits in merger enforcement.
21. Baker and Shapiro (2008) allege that some courts and enforcers have allowed mergers to proceed based upon dubious economic arguments about concentration, entry, expansion, and efficiencies.
22. See the review of merger retrospectives in Kwoka, Greenfield, and Gu (2015). Based on these studies, the authors argue that the agencies have not been sufficiently aggressive in challenging mergers and that structural and conduct remedies have not prevented anticompetitive price increases.
23. Michael Katz and Howard Shelanski call the causal effect of market structure on innovation the "innovation incentives" effect and call the reverse effect of innovation on market structure the "innovation impact" effect. See Katz and Shelanski (2005, 2007b).
24. Pleatsikis and Teece (2001) argue that the conventional approach to merger analysis ignores the dynamic nature of competition, which constrains market power for high-tech firms.
25. See, e.g., Posner (2001) and the discussion in chapter 2 of this book.
26. The DOJ did not challenge the merger of the satellite radio companies XM and Sirius, in part because the Antitrust Division anticipated competition from new audio-streaming services (US Department of Justice, Statement of the Department of Justice Antitrust Division on its Decision to Close its Investigation of XM Satellite Radio Holdings Inc.'s Merger with Sirius Satellite Radio Inc., March 24, 2008). (Note: The author consulted with the Antitrust Division on the XM-Sirius merger.)
27. See, e.g., the discussion of *US v. Microsoft* in chapters 2 and 8 (dynamic markets do not preclude investigations of anticompetitive conduct).
28. I use the terms "tacit agreement" and "conscious parallelism" interchangeably. Some characterize tacit agreement as an actual agreement that is not codified as an oral or written expression. This contrasts with conscious parallelism, in which firms recognize the interdependence of their actions, such as restraining from cutting prices because rivals will cut their prices.
29. One survey of R&D lab managers and directors found that about 85 percent of respondents did not learn about rivals' R&D projects until either the development stage or subsequent to product introduction (Cohen, Nelson, and Walsh, 2004).

30. *US v. Automobile Manufacturers Ass'n*, 307 F. Supp. 617 (C.D. Cal. 1969), *aff'd* in part and appeal dismissed in part; *City of New York v. US*, 397 U.S. 248 (1970).
31. European Commission Press Release, "Antitrust: Commission fines truck producers € 2.93 billion for participating in a cartel," Brussels, July 19, 2016.
32. *Kaufman v. BMW*, 17-cv-05440, U.S. District Court of New Jersey (July 25, 2017), and *Burton v. BMW AG*, 17-cv-04314, U.S. District Court, Northern District of California (July 28, 2017).
33. See Farrell and Shapiro (2010).
34. *Ibid.* at 33.
35. See Bulow, Geanakoplos, and Klemperer (1985).
36. *Ibid.*
37. Examples of unilateral effects models of innovation incentives include papers by Letina (2016), Federico, Langus, and Valletti (2017, 2018), Motta and Tarantino (2017), López and Vives (2019), and Gilbert (2019).
38. See, e.g., Salinger (2016) and Gilbert (2019).
39. As noted in chapter 4, Sah and Stiglitz (1987) first demonstrated that innovation incentives are independent of market structure if the discovery is winner-take-all. See also Gilbert (2019) and Jullien and Lefouili (2018).
40. D'Aspremont and Jacquemin (1988) provide an example in which a merger to monopoly increases both R&D and total economic welfare (but not consumer welfare) if intrafirm spillovers are sufficiently large. See also Motta and Tarantino (2017).
41. See López and Vives (2019) for a thorough analysis of the effects of intrafirm spillovers and competition on firms' incentives to invest to lower their production costs.
42. See Aghion, Harris, Howitt, and Vickers (2001) and Aghion, Bloom, Blundell, Griffith, and Howitt (2005).
43. See, e.g., Federico, Scott-Morton, and Shapiro (2020).
44. See Gilbert (2019).
45. Royall and Divincenzo (2010) document the agencies' low success rates for these types of cases.
46. A district court denied the FTC's most recent attempt to prevent the acquisition of a potential competitor for this reason. *FTC v. Steris Corporation*, 133 F. Supp. 3d 962 (September 25, 2015).
47. DiMasi, Grabowski, and Hansen (2016) found that 1,442 self-originated compounds from the top fifty pharmaceutical firms had an average probability of clinical success of about 12 percent. Furthermore, a sample of 106 randomly selected new drugs developed by ten pharmaceutical firms required, on average, about eight years to complete clinical trials.
48. For example, sildenafil citrate began clinical trials for the treatment of hypertension and angina, but now it is better known as the erectile dysfunction drug Viagra.
49. The measure of expected harm  $H$  is net of any merger-specific efficiencies that would be realized postmerger, under the assumption that the project would have been successful if Alpha and Beta had not merged.  $H$  may include any decrease or increase in the discovery probability from the merger.

50. This approach to evaluate the effects of mergers that eliminate potential competitors is consistent with the decision-theoretic approach advocated by Katz and Shelanski (2007a). They observe that courts typically require evidence that the claimed harms and efficiencies exceed probability thresholds, which can lead to different enforcement outcomes than would be achieved from decision theory.

51. *United States v. Phila. Nat'l Bank*, 374 US 321, 361 (1963). ("Specifically, we think that a merger which produces a firm controlling an undue percentage share of the relevant market, and results in a significant increase in the concentration of firms in that market, is so inherently likely to lessen competition substantially that it must be enjoined in the absence of evidence clearly showing that the merger is not likely to have such anticompetitive effects.")

52. IP Guidelines (January 12, 2017) at 11–12 (footnote omitted).

53. See, e.g., Carlton and Gertner (2003) and the response in Hoerner (1995) to Gilbert and Sunshine (1995).

54. IP Guidelines at 25.

55. US Department of Justice and Federal Trade Commission (2000) at § 4.3.

56. Katz and Shelanski (2007b) promote a much broader safe harbor. They conclude that economic evidence is weak for the innovation effects of mergers, with the possible exception of merger to monopoly, although they note that mergers can have replacement and business-stealing effects that harm innovation incentives.

57. Shapiro (2012) calls this "contestability."

58. "If we see R&D assets only dimly, we see tomorrow's product market more dimly still.... All the usual difficulties of measuring market shares are compounded, as we attempt to extend our time horizon farther into the future" (Baxter, 1984).

59. See Cartwright and Ahmed (2016) at 4.

60. See the discussion of the proposed acquisition of HeartWare by Thoratec in chapter 7.

## Chapter 6

1. See, e.g., Cohen (2010), Damanpour (2010), Gilbert (2006), and Baldwin and Scott (1987).

2. See, e.g., Scherer (1965).

3. Hall and Ziedonis (2001).

4. Henderson (1993).

5. This circularity also arises in empirical studies that attempt to determine a relationship between concentration and profits. A firm can have a very large market share because it charges very low prices, but that does not mean that market concentration causes low prices. Rather, the firm's choice to offer low prices creates the high degree of market concentration.

6. See, e.g., Levin, Cohen, and Mowery (1985).

7. John Sutton (1998) developed the theory that costs and characteristics of market demand, particularly the ability of firms to use innovation to raise consumers' willingness to pay for their products, imply a lower bound on the level of industry concentration and the ratio of R&D investment to sales.

8. Cohen (2010).
9. Philippe Aghion and Jean Tirole call the relationship between R&D (or the output of innovations) and variables that alter the incentives for R&D “the second most tested hypothesis in industrial organization” after the relationship between market structure and prices (Aghion and Tirole, 1994 at 1195).
10. “Total factor productivity” is the portion of output that is not explained by labor and capital. It is measured by dividing output by the weighted average of labor and capital inputs.
11. See, e.g., Syverson (2011) and Van Reenen (2011).
12. Ghosh (2001) and Blonigen and Pierce (2016) find no evidence of merger efficiencies from operating data. Devos et al. (2016) report merger efficiencies based on forecasts by financial analysts.
13. See, e.g., Nickell (1966).
14. Blundell, Griffith, and Van Reenen (1999).
15. Damanpour (2010) surveys empirical studies and finds that most report a positive relationship between firm size and both product and process innovation.
16. See Aghion, Bloom, Blundell, Griffith, and Howitt (2005).
17. The Lerner Index is  $L = (p - c) / p$ , where  $p$  is the firm’s price and  $c$  is its marginal cost. Studies typically use average variable cost as a surrogate for marginal cost.
18. Aghion, Blundell, Griffith, Howitt, and Prantl (2009).
19. Instead of citation-weighted patents, the researchers use patents by UK firms registered with the US Patent and Trademark Office, which they argue are more likely to be highly valued due to the cost of obtaining and maintaining foreign patents.
20. Bloom, Draca, and Van Reenen (2016).
21. Unsurprisingly, they find that low-wage competition from China correlated with the exit of many low-tech manufacturing firms and the reallocation of employment to higher-technology production methods. This is the Darwinian selection effect from competition on productivity. They also report an increase in total factor productivity within surviving firms, most of which were relatively advanced, as measured by total factor productivity.
22. Gutiérrez and Philippon (2017) also document a trend toward increasing market concentration and profitability in the US, which they attribute to relatively low investment by market leaders relative to their profits.
23. Autor, Dorn, Hanson, Pisano, and Shu (2020) at 16.
24. See, e.g., Hombert and Matray (2018) and Xu and Gong (2017). Relatedly Kueng, Li, and Yang (2016) find a larger negative impact from competition on process innovation, for which benefits are proportional to firm scale. Macher, Miller, and Osborne (2017) find that larger firms are more likely to adopt cost-saving innovations in the cement industry. Adoption is less likely when firms face many nearby competitors, which the authors attribute to depriving firms of the scale necessary to recoup adoption costs.
25. Reinganum (1984).

26. See Gilbert and Newbery (1982) and the discussion in chapter 3.
27. Christiansen (1997). Chapter 4 describes Christiansen's theory in more detail.
28. The HDD industry demonstrates "winner-take-all" or "winner-take-most" competition. Consequently, this industry has the feature of a patent race, notwithstanding that patents have been relatively unimportant in this industry because the most relevant innovations are improvements in manufacturing processes to increase the density of data storage on the drive and read/write speeds. Firms are reluctant to patent process technologies because infringement is difficult to detect and enforce. One exception is a broad patent on 3.5-inch HDDs that was awarded in 1986, but ultimately held to be invalid (Igami, 2017).
29. Iain Cockburn and Rebecca Henderson (1994) find no evidence of racing behavior in their study of R&D investment in the ethical drug industry. Instead, they conclude that firms' investment decisions were driven by heterogeneous capabilities, adjustment costs, and the evolution of technological opportunity, with a strong influence from technological spillovers.
30. By renting rather than selling a durable good, the seller can use price to influence the demand for rentals by customers who have previously rented the good. Thus, a rental market gives a durable good the characteristic of a nondurable good with respect to consumer demand.
31. Lohr and Kantor (2019).
32. Commission Press Release IP/09/745 of May 13, 2009, available at [http://europa.eu/rapid/press-release\\_IP-09-745\\_en.htm?locale=en](http://europa.eu/rapid/press-release_IP-09-745_en.htm?locale=en). The European Court of Justice subsequently remanded the case for further consideration. See Court of Justice of the European Union Press Release No. 90/17, September 6, 2017, available at <https://curia.europa.eu/jcms/upload/docs/application/pdf/2017-09/cp170090en.pdf>.
33. *In the Matter of Intel Corporation*, available at <https://www.ftc.gov/enforcement/cases-proceedings/061-0247/intel-corporation-matter>.
34. See Cabral (1994), Kwon (2010), and the discussion in chapter 4.
35. Henderson (1993).
36. Cohen (2010).
37. Garcia-Macia, Hsieh, and Klenow (2017).
38. See Gilbert and Greene (2015) and chapter 5.
39. Wollmann (2019) finds that the agencies fail to review many mergers that fall below the HSR reporting thresholds and that firms are more likely to pursue mergers that greatly increase market concentration when the transactions fall below the reporting thresholds.
40. Gutiérrez and Philippon (2017).
41. Cassiman, Colombo, Garrone, and Veugelers (2005).
42. Igami and Uetake (2018).
43. Sometimes a single patent covers a pharmaceutical product, while in many other industries (such as computers and information technologies), hundreds of patents cover a product.



44. DiMasi, Grabowski, and Hansen (2016).
45. For data on market concentration and R&D expenditures in the field of agricultural crop protection, see Fuglie et al. (2011) and Phillips McDougall (2016).
46. Haucap, Rasch, and Stiebale (2019).
47. The authors also find that acquisitions that fell below the reporting thresholds under the HSR Act were more likely to be terminated. This finding underscores the importance of merger reporting for effective antitrust enforcement and is consistent with the results reported by Wollmann (2019).
48. Schmalensee (1999) at 1326.
49. Antitrust Subcommittee (1959) at 38. Among other conditions, the decree also prohibited Western Electric, the manufacturing arm of the Bell System, “from manufacturing and selling equipment not of a type sold to the telephone operating companies of the Bell System” (Antitrust Subcommittee, 1959 at 37).
50. *United States v. International Business Machines*, Final Judgment, US District Court for the Southern District of New York, Civil Action No. 72-344 (1956).
51. *Xerox Corp.*, 86 F.T.C. 364. Licensees could designate up to three Xerox patents royalty-free, with a maximum royalty for all patents not to exceed 1.5 percent of the licensee’s net revenues.
52. Willard Tom observed that “many of the practices alleged in the complaint or prohibited by the order seem innocuous to modern eyes and thus suggest an entirely foreign way of looking at the world” (2001 at 967).
53. Watzinger, Fackler, Nagler, and Schnitzer (2017).
54. Wessner (2001) at 86.
55. See Isaacson (2014) at 149.
56. Mowery (2011).
57. Grindley and Teece (1997) at 13.
58. See, e.g., Sabety (2005).
59. Tom (2001) at 989.
60. Bresnahan (1985).
61. Kearns and Nadler (1992).
62. Galasso and Schankerman (2015). Patent applicants are required to cite relevant patents even if they have been invalidated and the claimed technologies are in the public domain. In a subsequent study (Galasso and Schankerman, 2018), the authors find that invalidation of a patent on a core technology had a negative effect on future innovation by small and medium-size firms, but no significant impact for large firms.
63. Moser and Voena (2012).
64. Baten, Bianchi, and Moser (2017).
65. Scherer (1977).

66. Chien (2003). Compulsory licensing had no evident effect on innovation for five of six firms examined by Chien that were subjected to compulsory licensing decrees. One firm cut back on R&D investment, but she cites independent explanations for that behavior.

67. See, e.g., Delrahim (2004).

## Chapter 7

1. A nonexclusive license does not prevent the licensor from using the licensed technology or from licensing the technology to others.

2. See, e.g., the merger retrospective study by Kwoka, Greenfield, and Gu (2015) and the FTC merger divestiture study (US Federal Trade Commission, 2017).

3. See the related discussion of compulsory licensing in chapter 6.

4. *US v. General Motors and ZF Friedrichshafen*, Civil Action 93-530, Complaint, November 16, 1993 (“GM-ZF complaint”) at ¶ 43.

5. The author consulted with the FTC in its evaluation of the proposed merger of Thoratec and HeartWare.

6. US Federal Trade Commission, *In the Matter of Thoratec Corporation and HeartWare International, Inc.*, Docket No. 9339, Complaint, July 28, 2009.

7. Hill, Rose, and Winston (2015).

8. *Ibid.* at 434.

9. *Ibid.* at 432.

10. Applied Materials 2017 Annual Report at 32. The “E” stands for engineering.

11. Tokyo Electron 2017 Annual Report.

12. See the discussion of Cournot complements in chapter 2.

13. Statement of Acting Assistant Attorney General Renata Hesse, US Department of Justice Press Release, “Lam Research Corp. and KLA-Tencor Corp. Abandon Merger Plans,” October 5, 2016.

14. See comments by Dan Hutchenson of VSLI Research, quoted in Clark and Minaya (2016).

15. Firms that supply complementary products have a vertical relationship. The DOJ questioned whether behavioral commitments are adequate to address competition concerns in vertical mergers in its unsuccessful challenge in 2018 to the merger of AT&T and Time Warner (Delrahim, 2017).

16. US Federal Trade Commission Press Release, “FTC accepts proposed consent order in Broadcom Limited’s \$5.9 billion acquisition of Brocade Communications Systems, Inc.,” July 3, 2017.

17. *US v. Lockheed Martin Corp. and Northrop Grumman Corp.*, Complaint, March 23, 1998.

18. US Federal Trade Commission, Statement of Chairman Robert Pitofsky and Commissioners Janet D. Steiger, Roscoe B. Starek III, and Christine A. Varney in the Matter of the Boeing Company/McDonnell Douglas Corporation, July 1, 1997.

19. US Federal Trade Commission Press Release, "FTC seeks to block Cytyc Corp.'s acquisition of Digene Corp.," June 24, 2002.
20. Department of Justice Press Release, "Justice Department reaches settlement with Microsemi Corp.," August 20, 2009.
21. CLP Buyer's Guide, Cytyc Corp., available at <http://www.clpmag.com/buyers-guide/listing/cytyc-corp/>, accessed July 23, 2018.
22. CLP Buyer's Guide, Digene Corp., accessed July 23, 2018.
23. See <https://www.microsemi.com/products/> and <http://www.semicoa.com/products/>, accessed July 23, 2018.
24. US Federal Trade Commission, Statement of Chairman Timothy J. Muris in the matter of Genzyme Corporation/Novazyme Pharmaceuticals, Inc., January 13, 2004.
25. John Crowley's struggle to find a cure for Pompe disease is told in Anand (2006) and in the movie *Extraordinary Measures*.
26. Cunningham, Ederer, and Song (2018). This statistic does not demonstrate a loss of innovation, though, because the inventors may have made important contributions to innovation at other entities.
27. The reader might question why the FTC appears more often in these discussions despite the fact that the FTC and the Antitrust Division of the DOJ share responsibilities for merger enforcement. The reason is that cases with clearly identifiable innovation issues often appear in the pharmaceutical and related health industries, for which the FTC has historically been the lead agency for merger enforcement.
28. US Federal Trade Commission, "Announced Actions for October 4, 1996," available at <https://www.ftc.gov/news-events/press-releases/1996/10/announced-actions-october-4-1996>, accessed November 3, 2019.
29. GC Pharma, "R&D Pipeline," available at <http://www.globalgreencross.com/rd/pipeline>, accessed April 9, 2018.
30. US Federal Trade Commission, *In the Matter of Glaxo Wellcome and SmithKline Beecham*, Analysis of Proposed Consent Order to Aid Public Comment (2000).
31. *Ibid.*
32. Gilead Sciences, Inc., Form 10-K, for the fiscal year ending December 31, 2001.
33. OSI Pharmaceuticals, Inc., Form 10-K, for the fiscal year ending September 30, 2004.
34. See Aurelian (2004).
35. Scrip, Pharma Intelligence, "Xenova acquires Cantab in stock swap," March 2001, available at <https://scrip.pharmaintelligence.informa.com/deals/200110027>, accessed October 5, 2019.
36. US Securities and Exchange Commission, "Celtic Pharma Development UK plc, Form T-3," September 12, 2005.
37. GSK Press Release, "GSK provides update on Herpevac trial for women evaluating Simplirix™ (Herpes Simplex Vaccine)," available at <https://www.gsk.com/en-gb/media/press-releases/gsk-provides-update-on-herpevac-trial-for-women-evaluating-simplirix-herpes-simplex-vaccine/>, accessed October 17, 2019.

38. *US v. Heraeus Electro-Nite Co., LLC*, US District Court for the District of Columbia, Complaint, January 2, 2014.
39. *US v. Heraeus Electro-Nite Co., LLC*, US District Court for the District of Columbia, Final Judgment, April 7, 2014.
40. US Federal Trade Commission, *In the Matter of Nielsen Holdings N.V. and Arbitron Inc.*, File No. 131 0058, Analysis of Agreement Containing Consent Order to Aid Public Comment, September 20, 2013.
41. *Ibid.*
42. *Ibid.*
43. See Nielsen, "Audience," available at <http://www.nielsen.com/us/en/solutions/measurement/audience.html>, accessed October 2, 2019, and Comscore, "Understand and evaluate audiences and advertising everywhere," available at <https://www.comscore.com/Products/Audience-Analytics>, accessed October 2, 2019.
44. See, e.g., Deveau and Porter (2018).
45. See, e.g., Maddaus (2017). (A Comscore spokesperson said, "We can confirm that there is a dispute regarding interpretation of the 2013 [sic] FTC consent decree, which resulted from Nielsen's acquisition of Arbitron, that provides Comscore with access to certain Nielsen data.")
46. US Federal Trade Commission, *In the Matter of Novartis, AG and GlaxoSmithKline plc*, Docket No. C-4510, Complaint, February 20, 2015.
47. US Federal Trade Commission, *In the Matter of Novartis, AG and GlaxoSmithKline plc*, Analysis of Agreement Containing Consent Orders to Aid Public Comment, File No. 141-0141, February 23, 2015.
48. US Securities and Exchange Commission, Array BioPharma, Inc., Form 10-K, for the fiscal year ending June 30, 2017; and Array BioPharma, "Our pipeline," available at <https://www.arraybiopharma.com/product-pipeline>, accessed July 23, 2018.
49. See Delrahim (2017).
50. The six cases in Chien (2003) are *In re Roche Holding Ltd.*, 113 F.T.C. 1086 (1990); *In re Institut Merieux S.A.*, 113 F.T.C. 742 (1990); *In re Baxter Int'l Inc.*, 123 F.T.C. 904 (1997); *In re Dow Chem. Co.*, 118 F.T.C. 730 (1994); *In re Ciba-Geigy Ltd.*, 123 F.T.C. 842 (1997); and *In re Eli Lilly & Co.*, 95 F.T.C. 538 (1980). Chien concluded that compulsory licensing obligations caused only Institut Merieux S.A. to reduce its R&D efforts and attributed the reduction to uncertainty caused by a delay in finding a divestiture recipient.
51. Specifically, this refers to patents on the use of herpes simplex virus-thymidine kinase ("HSV-tk") vectors.
52. US Federal Trade Commission, *In the Matter of Ciba-Geigy, Chiron, Sandoz and Novartis*, Docket No. C-3725, Analysis of Proposed Consent Order to Aid Public Comment, December 17, 1996.
53. See Fisher (1994).
54. Sanofi-Aventis Annual Report on Form 20-F, 2009, available at <https://www.sanofi.com/en/investors/reports-and-publications/financial-and-csr-reports>.

55. Charles Bankhead, "Gene therapy flunks limb ischemia test," *Medpage Today*, June 2, 2011, available at <https://www.medpagetoday.com/cardiology/peripheralartery-disease/26814>.

56. FDA news release, "FDA approval brings first gene therapy to the United States," August 30, 2017, available at <https://www.fda.gov/news-events/press-announcements/fda-approval-brings-first-gene-therapy-united-states>.

57. The data reported in table 7.2 is from US Patent and Trademark Office (USPTO) patent searches with "gene therapy" in the patent description/specification. Other search terms produce similar results. For example, USPTO searches with the classification code A61K48/00 ("Medicinal preparations containing genetic material, gene therapy") capture a smaller number of patents, but they have a similar pattern.

58. Serono's annual report for 2003 describes plans to initiate a multicenter, multinational phase III program for Onercept, a recombinant, soluble type I TNF receptor. Serono terminated a phase III study for Onercept in June 2005 after concluding that the risk-benefit ratio was not sufficiently favorable to justify continued development (see <https://clinicaltrials.gov/ct2/show/NCT00090129>, accessed July 22, 2018). Merck acquired Serono in 2006. Both Serono and Merck describe research efforts for aurorakinase inhibitors, which are related to TNF inhibitors.

59. US Federal Trade Commission, *In the Matter of Flow International Corp.*, File No. 081-0079, Complaint, August 15, 2008. The complaint does not directly allege harm to innovation, although the effect of patent litigation on innovation is an issue in this industry.

60. US Federal Trade Commission, *Analysis of the Agreement Containing Consent Order to Aid Public Comment*, in the *Matter of Flow International Corp.*, File No. 081-0079.

61. "Waterjet cutting machine buyers' guide," *The Fabricator*, available at <https://www.thefabricator.com/guide/waterjet-cutting-machine>, accessed July 23, 2018. The comparison to January 2014 is based on this website listed in [archive.org](http://archive.org) for January 30, 2014, accessed July 29, 2018.

62. *US v. 3D Systems Corporation and DTM Corporation*, Complaint, US District Court for the District of Columbia, June 6, 2001.

63. Hundreds of patents cover RP-related technologies. However, 3D and DTM have major patent portfolios in some specializations. For example, a USPTO search of patents with "stereolithographic printing" in their descriptions returned a total of 533 issued patents, of which 75 were invented by or assigned to 3D Systems.

64. *US v. 3D Systems Corporation and DTM Corporation*, Competitive Impact Statement, US District Court for the District of Columbia, September 4, 2001. The final order also required the merged company to grant software licenses and provide a list of customers (*US v. 3D Systems Corporation and DTM Corporation*, Final Judgment, US District Court for the District of Columbia, April 17, 2002).

65. 3D Systems Corporation, Form 10-K, for the fiscal year ended December 31, 2002, at 19.

66. See, e.g., "Rapid prototyping (RP)—Rapid tooling (RT)—SONY," *Engineers Handbook*, available at <http://www.engineershandbook.com/RapidPrototyping/sony.htm>, accessed July 10, 2018.

67. A USPTO patent search with the terms "rapid prototyping printing" or "stereolithography" returned 956 successful patent applications in the five-year period from January

1, 1998, to December 31, 2002, of which 89 were filed by 3D Systems. A similar search for the five-year period from January 1, 2003, to December 31, 2007 returned a total of 1,152 successful applications, of which 55 were filed by 3D Systems.

68. 3D Systems Corporation, Annual Reports for 2004 and 2001.

69. “3D printer manufacturers: Who’s in the lead?,” Fabbaloo, April 16, 2018, available at <http://www.fabbaloo.com/blog/2018/4/16/3d-printer-manufacturers-whos-in-the-lead>.

70. This section follows the excellent review in Petit (2018).

71. European Commission, *Pasteur Mérieux-Merck*, IV/34.776, October 6, 1994.

72. European Commission, *Glaxo-Wellcome*, IV/M.555, February 28, 1995.

73. US Federal Trade Commission Press Release, “Glaxo plc,” June 20, 1995.

74. See CenterWatch, “Zomig (zolmitriptan),” available at <https://www.centerwatch.com/drug-information/fda-approved-drugs/drug/347/zomig-zolmitriptan>, accessed May 13, 2019.

75. European Commission, *Glaxo Wellcome/SmithKline Beecham*, Case No. COMP/M.1486, August 5, 2000, at ¶ 202.

76. *Ibid.*, at ¶ 214.

77. European Commission, *Astra Zeneca/Novartis*, Case No. COMP/M.1806, July 26, 2000, and US Federal Trade Commission, *In the Matter of Novartis and AstraZeneca*, Docket No. C-3979, Complaint, November 1, 2000.

78. European Commission, *Bayer/Aventis Crop Science*, Case No. COMP/M.2547, April 17, 2002, and US Federal Trade Commission, *In the Matter of Bayer AG and Aventis S.A.*, Docket No. C-4049, Analysis of Proposed Consent Order to Aid Public Comment, May 30, 2002.

79. Both agencies allowed the merger of Seagate and Samsung without conditions and blocked the proposed merger of Western Digital and Viviti Technologies (formerly known as Hitachi Global Storage Technologies). See Statement of the Federal Trade Commission Concerning Western Digital Corporation/Viviti Technologies Ltd. and Seagate Technology LLC/Hard Disk Drive Assets of Samsung Electronics Co. Ltd. and European Commission, *Western Digital Irland/Viviti Technologies*, Case No. COMP/M.6203, November 23, 2011.

80. European Commission, *Medtronic/Covidien*, Case No. COMP/M.7326, November 28, 2014, and US Federal Trade Commission, *In the Matter of Medtronic, Inc. and Covidien plc*, Docket No. C-4503, Decision and Order, January 21, 2015.

81. European Commission Press Release, “Mergers: Commission approves acquisition of Hospira by Pfizer, subject to conditions,” August 4, 2015.

82. US Federal Trade Commission, *In the Matter of Pfizer, Inc. and Hospira, Inc.*, Docket No. C-4537, Complaint, August 21, 2015.

83. A biosimilar is a close substitute for its reference biologic, although it is not a generic equivalent.

84. European Commission, *Pfizer/Hospira*, Case No. COMP/M.7559, April 8, 2015, at ¶ 57.

85. Pfizer registered Ixifi for sale in Japan. See Pfizer Form 10-K for the fiscal year ending December 31, 2018.

86. European Commission, *General Electric/Alstom*, Case No. COMP/M.7278, September 8, 2015.
87. The author was a consultant to Dow and DuPont in this transaction.
88. *US et al. v. Dow Chemical Corporation and E.I. DuPont de Nemours and Company*, Competitive Impact Statement, June 15, 2017.
89. European Commission, *Dow/DuPont*, Case No. COMP/M.7932, March 27, 2017.
90. European Commission Press Release, "Mergers: Commission clears merger between Dow and DuPont, subject to conditions." March 27, 2017.
91. European Commission, *Dow/DuPont* (2017), at § 8.6.
92. *Ibid.*, table 67. The HHI measures the sum of the squares of the shares. An HHI of 3,300 corresponds to three firms with equal patent shares.
93. See, e.g., European Commission, *Dow/DuPont* (2017), at ¶ 2016.
94. See, e.g., Delrahim (2004). ("There are important policy reasons to cause us to be cautious when considering a compulsory licensing remedy. The most important of these is the concern that an improperly designed compulsory license can stifle innovation.") However, Delrahim also recognizes that compulsory licensing can be a useful alternative to divestiture to resolve antitrust concerns in some cases.

## Chapter 8

1. The author was the Deputy Assistant Attorney General for Economics at the Antitrust Division of the Department of Justice when the Division initiated its investigation of Microsoft and later consulted with the Division on matters related to its Microsoft complaint.
2. Compare, e.g., Salop and Romaine (1999) with Cass and Hylton (1999).
3. *US v. Microsoft*, US District Court for the District of Columbia, Civil Action No. 98-1232 (TPJ), Complaint (May 18, 1998), at ¶ 6. "IBM-compatible" refers to PCs that are compatible with the IBM basic input/output system (BIOS). The complaint uses the term "Intel-compatible personal computer" because IBM-compatible PCs employed the Intel x86 microprocessor architecture. That term became a misnomer because other microprocessors such as Advanced Micro Devices (AMD) used the Intel architecture, and Intel subsequently supplied microprocessors for Apple and Linux operating systems.
4. Gilbert (1999).
5. IBM and Microsoft initially cooperated to develop OS/2 as a successor to the MS-DOS operating system. The first version of OS/2 launched in 1987 without a graphical user interface (GUI) and met with little success. A second version with a GUI failed because it offered poor support for MS-DOS applications and relatively few device drivers to support hardware other than IBM's. See Evans, Nichols, and Reddy (2002).
6. OS/2 Warp was not without its disadvantages, including larger memory requirements than Windows and IBM marketing missteps. See Swedin (2009). The fact that most Intel-compatible PCs shipped in the 1990s with Windows preinstalled was another factor that worked against the success of OS/2. See Evans et al. (2002).

7. “Memo from Bill Gates to executive staff and direct reports,” The Internet Tidal Wave, May 26, 1995, available at <https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/20.pdf>.

8. The term “Java” refers to a set of technologies that include (1) a programming language; (2) a set of programs written in that language, called the Java class libraries, which expose APIs; (3) a compiler, which translates code written by a developer into “bytecode” (low-level code); and (4) a Java virtual machine (JVM), which translates bytecode into instructions to the operating system. Programs calling upon the Java APIs will run on any machine with a “Java runtime environment”; that is, Java class libraries and a JVM. (See *US et al. v. Microsoft*, US District Court for the District of Columbia, Civil Action No. 98–1232 [TPJ], Findings of Fact [November 5, 1999], at ¶ 73.) Mentions of Java in this chapter do not refer to JavaScript, which is used for interactive web pages.

9. “Memo from Bill Gates to executive staff and direct reports,” The Internet Tidal Wave, May 26, 1995, available at <https://www.justice.gov/sites/default/files/atr/legacy/2006/03/03/20.pdf>. A client is a piece of hardware or software, such as a web browser, that interacts with a network server.

10. Cusumano and Yoffie (1998) at 40.

11. Katz and Shapiro (1985).

12. *US v. Microsoft*, Complaint at ¶ 14, 70–73.

13. *Ibid.* at ¶ 16.

14. A second browser war broke out in the early 2000s, after Netscape spun off Navigator into the open-source Mozilla project, which developed the Firefox product, and Google followed with its Chrome browser. See, e.g., Steve Lovelace, “The second browser war,” July 31, 2015, available at <http://steve-lovelace.com/the-second-browser-war/>.

15. *US v. Microsoft*, Complaint at ¶ 64.

16. European Commission Press Release, “Commission examines the impact of Windows 2000 on competition,” February 10, 2000. (“The allegations which we have now decided to examine more closely centre on Microsoft leveraging its dominance from one market (PC operating systems) onto other markets, whereas in the US the main thrust of the proceedings seems to revolve around Microsoft protecting its dominance on the market for PC operating systems.”) Compared to client PCs, servers are more powerful machines that can support multiple users and have the capacity to store large amounts of data and files.

17. Rubinfeld (2008) provides a useful summary of the allegations in *US v. Microsoft* and Microsoft’s responses. Gavil and First (2014) provide a detailed description of the US antitrust case and several other related cases brought against Microsoft by US and European antitrust enforcers.

18. *US v. Microsoft*, Findings of Fact at ¶ 94–114 and ¶ 345–356.

19. *Ibid.*, Section VI; and *US et al. v. Microsoft*, US District Court for the District of Columbia, Civil Action No. 98–1232 (TPJ), Conclusions of Law (April 3, 2000), at 42–43.

20. *US v. Microsoft*, Complaint at ¶ 37.

21. *US v. Microsoft*, Conclusions of Law, 87 F. Supp. 2d 30, 38.

22. *Ibid.* at 39.



23. *US v. Microsoft*, Findings of Fact at ¶ 77.
24. The district court found that Microsoft's contracts with OEMs, ISVs, and ICPs did not satisfy the threshold requirements for unlawful exclusive dealing, in violation of Section 1 of the Sherman Act.
25. *US v. Microsoft*, Conclusions of Law, 87 F. Supp. 2d 30, 43.
26. *US v. Microsoft*, Final Judgment (November 12, 2002).
27. Courts have traditionally held tied sales to be per se unlawful when (1) two separate products or services are involved, (2) the sale or agreement to sell one is conditioned on the purchase of the other, (3) the seller has sufficient economic power in the market for the tying product to enable it to restrain trade in the market for the tied product, and (4) a not-insubstantial amount of interstate commerce in the tied product is affected. (See US Department of Justice and Federal Trade Commission, 2007, 105–106.)
28. *US v. Microsoft*, Court of Appeals, 253 F.3d 34, 85 (June 28, 2001).
29. *Ibid.* at 53.
30. *Ibid.* at 91.
31. One plaintiff state held out for additional sanctions, which the court rejected in June 2004. *Massachusetts v. Microsoft Corp.*, 373 F. 3d 1199 (D.C. Cir., 2004).
32. See Hesse (2009) for a detailed discussion of the settlement terms.
33. Commission Decision relating to a proceeding pursuant to Article 82 of the EC Treaty and Article 54 of the EEA Agreement against Microsoft Corporation (Case COMP/C-3/37.792—*Microsoft*), May 24, 2004. Affirmed by Judgment of the Court of First Instance, Case T-201/04, September 17, 2007.
34. Ayres and Nalebuff (2005) applaud the remedy, notwithstanding the few sales of Windows with WMP, because it addressed the alleged unlawful tie and did not impose costs on consumers.
35. Commission Decision relating to a proceeding pursuant to Article 82 of the EC Treaty (Case COMP/C-3/37.792—*Microsoft*), May 24, 2004 at ¶ 784.
36. See Kühn and Van Reenen (2009) for a useful discussion of the interoperability issues in the EC investigation of Microsoft.
37. Commission Decision relating to a proceeding pursuant to Article 82 of the EC Treaty (Case COMP/C-3/37.792—*Microsoft*), March 24, 2004 at ¶ 999.
38. *Ibid.* at ¶ 1007.
39. European Commission, "Antitrust: Commission initiates formal investigations against Microsoft in two cases of suspected abuse of dominant market position," Memo/08/19, January 14, 2008.
40. European Commission, "Antitrust: Commission market tests Microsoft's proposal to ensure consumer choice of web browsers; welcomes further improvements in field of interoperability," Memo/09/439, October 7, 2009.
41. Commission Decision, Case COMP/C-3/39.530—*Microsoft (tying)*, December 16, 2009.
42. *Ibid.*

43. Wikipedia, "Usage share of web browsers (citing several historical data sources)," available at [https://en.wikipedia.org/wiki/Usage\\_share\\_of\\_web\\_browsers](https://en.wikipedia.org/wiki/Usage_share_of_web_browsers), accessed April 16, 2019.
44. 540 US 398, 406 (2004).
45. Reynolds and Best (2012) review EC jurisprudence on refusals to deal by dominant firms. Chapter 9 addresses allegations of anticompetitive product design in the context of the Google Search case, where the US and European antitrust enforcers reached different conclusions.
46. Commission Decision relating to a proceeding pursuant to Article 82 of the EC Treaty and Article 54 of the EEA Agreement against Microsoft Corporation (Case COMP/C-3/37.792—*Microsoft*), May 24, 2004.
47. Council Directive on the legal protection of computer programs (91/250/EEC), May 14, 1991.
48. European Commission Decision, *Sea Containers Sealink/Stena*, OJ 1994 L15/8 (December 21, 1993), quoted in Vickers (2010).
49. Commission decision of December 21, 1988, *Magill TV Guide/ITP, BBC and RTE* ([1989] OJ L78/43) and Case C-418/01 *IMS Health GmbH & Co. OHG v. NDC Health GmbH & Co KG*, judgment of April 29, 2004.
50. *US v. Microsoft*, Court of Appeals, 253 F.3d 34, 11–12.
51. *Ibid.* at 57–59, 64–66.
52. On remand, the court would have allowed the plaintiffs to argue that the anticompetitive effects in the browser market from the Windows 98 override of a consumer's choice of default web browser outweighed Microsoft's claimed efficiency benefits for the operating system, but the Settlement preempted that investigation.
53. Segal and Whinston (2007) explore these trade-offs with a model of sequential innovation in which antitrust law determines the extent to which incumbents can profit by excluding entrants. See also Baker (2007, 2016).
54. Hylton and Lin (2013) argue that innovations create consumer benefits and should not be deterred by antitrust enforcement. However, they do not consider how monopoly conduct can harm rival innovation or slow the progress of future innovation.
55. Commission Decision relating to a proceeding pursuant to Article 82 of the EC Treaty and Article 54 of the EEA Agreement against Microsoft Corporation (Case COMP/C-3/37.792—*Microsoft*), May 24, 2004.
56. European Commission, "Antitrust: Commission imposes € 899 million penalty on Microsoft for non-compliance with March 2004 decision," IP/08/318, February 27, 2008.
57. *New York ex. rel. v. Microsoft*, California Group's Report on Remedial Effectiveness, Civil Action 98–1233 (CKK) (D.D.C. September 11, 2007).
58. *US v. Microsoft*, Joint Status Report on Microsoft's Compliance with the Final Judgments, (US D.D.C) Civil Action No. 98–1232 (CKK), April 27, 2011.
59. The Chrome, Firefox, and Safari browsers do not offer a Java plugin applet for their current versions, although the browsers can access websites that support Java applications.

See [https://java.com/en/download/help/enable\\_browser.xml](https://java.com/en/download/help/enable_browser.xml), accessed October 16, 2019.

60. Google used Java to code the major server-side functions of Google Docs. See Jonathan Strickland, "How Google Docs works," available at <https://computer.howstuffworks.com/internet/basics/google-docs5.htm>, accessed April 16, 2019.

61. See, e.g., Carlton and Waldman (2002) and Nalebuff (2004).

62. George Stigler was the first to articulate the benefits from mixed bundling (Stigler, 1963), followed by Adams and Yellen (1976). Janet Yellen went on to chair the Board of Governors of the US Federal Reserve from 2014–2018.

63. See, e.g., Evans and Salinger (2005).

64. An additional argument is that a commitment to offer products only as a bundle can make a firm a more formidable competitor, which can make new entry that requires an irreversible investment more difficult. See Whinston (1990, 2001). However, this argument does not have much relevance for the tying allegation in the Microsoft case because Netscape was an established competitor.

65. See, e.g., *US et al. v. Microsoft*, US District Court for the District of Columbia, Civil Action No. 98-1232 (TPJ), Declaration of Carl Shapiro (April 28, 2000) and Declaration of Paul M. Romer (April 27, 2000).

66. Ordover, Saloner, and Salop (1990) and Allain, Chambolle, and Rey (2011, 2016) describe the incentives of an integrated supplier to disadvantage rivals. Carlton and Waldman (2002) and Choi (2004) show that tying (which is closely related to integration) can reduce rival innovation incentives.

67. See, e.g., Bresnahan (2001), Ayres and Nalebuff (2005), First and Gavil (2006), Hovenkamp (2008a), and Shapiro (2009). Herbert Hovenkamp wrote that "the Microsoft case may prove to be one of the great debacles in the history of public antitrust enforcement, snatching defeat from the jaws of victory." Hovenkamp (2008a) at 298.

68. The innovation incentive is not as general as the Cournot complements effect for prices because consumers who purchase operating systems and applications from an integrated supplier could have a low value for improvements at the lower prices that prevail under integrated supply. See the appendix to Farrell and Katz (2000) and the discussion in chapter 2.

69. Shelanski and Sidak (2001) at 30. ("One can easily imagine, to take only one example, that the meaning of 'middleware' would be thoroughly litigated by interested parties, just as the meaning of 'information services' was thoroughly litigated under the Modification of Final Judgment [the AT&T consent decree].")

70. See Farrell and Katz (2000).

71. See Williamson (1979, 1983).

72. According to Statcounter, more than two-thirds of desktop internet use was with Chrome in 2019, compared to less than 15 percent with Microsoft's Internet Explorer and its replacement, Microsoft Edge. See <http://gs.statcounter.com/browser-market-share/desktop/worldwide>, accessed October 15, 2019.

73. Heiner (2012) at 340.

74. *US v. Microsoft*, Findings of Fact at ¶ 407.

75. *US v. Microsoft*, Court of Appeals, 253 F.3d 34, 61 (emphasis added).
76. See, e.g., Shapiro (1999).
77. Hovenkamp (2008b) observes that a corollary of the premise that innovation contributes more to economic growth than price competition is that a restraint on innovation can do much more harm.
78. See Farrell and Katz (2000) and Elhauge (2009).
79. Hesse (2009) at 865–868.

## Chapter 9

1. The author consulted with the FTC in its Google Search investigation. This chapter, which is based in part on Gilbert (2018b), does not address other search-related allegations against Google, including the appropriation of information from websites and restrictions on the use of programs to manage advertising. In a separate case, the EC fined Google €1.49 billion for abusing its market dominance by imposing clauses in contracts with third-party websites which prevented rivals from placing their search ads on these websites. (European Commission Press Release, “Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising,” Brussels, March, 20, 2019.) In another case, the EC fined Google €4.34 billion and ordered the company to end restrictions related to the licensing of its Android mobile operating system. (European Commission Press Release, “Antitrust: Commission fines Google €4.34 billion for illegal practices regarding Android mobile devices to strengthen dominance of Google’s search engine,” Brussels, July 18, 2018.) I briefly discuss the Google Android case in chapter 10. I do not include these cases in part for space reasons, and in part because they raise issues related to tying and exclusive dealing covered in the discussion of the Microsoft antitrust litigation in chapter 8.
2. See Google Ads Help, “Ad Rank,” available at <https://support.google.com/google-ads/answer/1752122>, accessed February 14, 2019.
3. See, e.g., “From ten blue links to integrated information platform,” in Crane (2012).
4. Baye, de los Santos, and Wildenbeest (2016).
5. Google Algorithm Update History, available at <https://moz.com/google-algorithm-change>, accessed October 23, 2019.
6. The update is named for the Google engineer Navneet Panda, who developed the technology embodied in the algorithm. See Brafton, “Google Panda,” available at <https://www.brafton.com/glossary/google-panda/>, accessed January 25, 2019.
7. A Google blogpost stated: “This [Panda] update is designed to reduce rankings for low-quality sites—sites which are low-value add for users, copy content from other websites or sites that are just not very useful. At the same time, it will provide better rankings for high-quality sites—sites with original content and information such as research, in-depth reports, thoughtful analysis and so on” (<https://googleblog.blogspot.com/2011/02/finding-more-high-quality-sites-in.html>, accessed January 25, 2019).
8. E-mail from Google employee, quoted in European Commission, *Google Search (Shopping)*, AT. 39740, Decision, June 27, 2017, at ¶ 382 (“EC Google Shopping Decision”).
9. These statistics come from Statcounter (<http://gs.statcounter.com/search-engine-market-share/>, accessed January 25, 2019). Query shares vary according to device,

location, and how they are measured. Comscore reported that Google accounted for 64 percent of direct search queries by US users in February 2016 (“Comscore releases February 2016 US desktop search engine rankings,” March 16, 2016, available at <https://www.comscore.com/Insights/Rankings/comScore-Releases-February-2016-US-Desktop-Search-Engine-Rankings>).

10. “If you do not like the answer that Google search provides you can switch to another engine with literally one click...,” Testimony of Eric Schmidt, Executive Chairman, Google Inc., Before the Senate Committee on the Judiciary Subcommittee on Antitrust, Competition Policy, and Consumer Rights, September 21, 2011, at 6.

11. See, e.g., Manne and Wright (2011) and Ratliff and Rubinfeld (2014). More generally, the ability to raise prices or exclude competition on one side of a two-sided market depends on reactions by firms or consumers on the other side. See, e.g., Evans and Noel (2005) and Ratliff and Rubinfeld (2010).

12. See, e.g., Patterson (2013). See Darby and Karni (1973) for a discussion of credence goods.

13. Google processes about 3.5 billion search queries every day, which adds up to more than a trillion per year; see Google Search Statistics, available at <http://www.internetlivestats.com/google-search-statistics/>, accessed January 25, 2019. As of the end of 2018, the total number of searches on DuckDuckGo was 26 billion; see <https://duckduckgo.com/about>, accessed January 25, 2019.

14. See also Luca et al. (2015).

15. See, e.g., Allain, Chamolle, and Rey (2011, 2016).

16. Langford (2013) and Stucke and Ezrachi (2016).

17. *US v. Google and ITA Software*, Complaint, US District Court for the District of Columbia, Case: 1:11-cv-00688 (April 8, 2011).

18. The FTC addressed other Google search-related conduct, but it accepted Google’s voluntary agreement to change the challenged practices and did not require a formal consent decree (US Federal Trade Commission, 2013a).

19. *Ibid.*

20. European Commission Press Release, “Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service—Factsheet,” Brussels, June 27, 2017, available at [http://europa.eu/rapid/press-release\\_MEMO-17-1785\\_en.htm](http://europa.eu/rapid/press-release_MEMO-17-1785_en.htm).

21. EC Google Shopping Decision at ¶ 154.

22. *Ibid.* at ¶ 271.

23. *Ibid.* at ¶ 341.

24. *Ibid.* See also European Commission, Summary of Commission Decision of 27 June 2017 Relating to a Proceeding under Article 102 of the Treaty on the Functioning of the European Union and Article 54 of the EEA Agreement, Case AT.39740—Google Search (Shopping).

25. EC Google Shopping Decision at § 7.5.

26. *Ibid.* at ¶ 333.

27. Consolidated version of the Treaty on the Functioning of the European Union—Rules Applying to Undertakings—Article 102 (ex Article 82 TEC). See also Vickers (2005).
28. EC Google Shopping Decision at ¶¶ 593–596.
29. *Ibid.* at ¶ 538.
30. *Ibid.* at ¶ 144.
31. European Commission Press Release, “Antitrust: Commission fines Google €1.49 billion for abusive practices in online advertising,” Brussels, March 20, 2019.
32. *Ibid.*
33. There are exceptions. The US Court of Appeals for the Federal Circuit held that a design change whose intent was to exclude rivals was anticompetitive notwithstanding some evidence that the change was an improvement. See *C.R. Bard, Inc. v. M3 Systems, Inc.*, US Court of Appeals for the Federal Cir. (September 30, 1998). The precedential significance of this case is limited because the anticompetitive allegations were not thoroughly briefed on appeal. The case diverges from traditional US antitrust jurisprudence, which focuses on competitive effects, not intent.
34. *US v. Microsoft Corp.*, 253 F.3d 34, 64 (June 28, 2001).
35. *Berkey Photo v. Eastman Kodak Co.*, US Court of Appeals for the 2nd Circuit, 603 F.2d 263, 286 (June 25, 1979) (emphasis added).
36. In 2010, pharmaceutical companies spent \$27.7 billion on promotion and direct-to-consumer advertising, an amount equal to about 9 percent of their sales (Kornfield, Donohoe, Berndt, and Alexander, 2013).
37. Carrier and Shadowen (2016, 2018) make this argument.
38. Jones and Williams (1998).
39. See, e.g., Newman (2012).
40. See, e.g., *Cal. Computer Prods. v. IBM Corp.*, 613 F.2d 727 (1979) and *Memorex Corp. v. IBM Corp.*, 636 F.2d 1188 (1980) (design changes lowered costs and increased performance). In *Transamerica Computer Co. v. IBM Corp.*, 698 F.2d 1377 (9th Cir. 1983), a district court held that a design change was anticompetitive but the plaintiff did not suffer antitrust injury.
41. *Verizon Communications, Inc. v. Law Offices of Curtis V. Trinko*, US Supreme Court (January 13, 2004). The court did not mention the qualification that the challenged conduct in Trinko occurred in a regulated industry.
42. *In re Apple iPod iTunes Antitrust Litigation*, US District Court for the Northern District of California (May 19, 2011).
43. *In re Apple iPod iTunes Antitrust Litigation*, Verdict Form Re Genuine Product Improvement (N.D. Cal. 2014).
44. See Werden (2006) at 419, which cites Areeda and Hovenkamp (2002).
45. *Allied Orthopedic Appliances, Inc. v. Tyco Health Care Group LP*, 592 F.3d 991, 999 (January 6, 2010) (citations omitted).
46. Ordover and Willig (1981).

47. See Werden (2006) and Melamed (2006).
48. See, e.g., Elhauge (2003).
49. Steve Jobs, *BusinessWeek*, October 12, 2004.
50. US Federal Trade Commission, *In the Matter of Intel Corporation*, Docket No. 9341, Complaint (December 16, 2009).
51. US Federal Trade Commission, *In the Matter of Intel Corporation*, Docket No. 9341, Decision and Order (October 29, 2010). The decree requires only a showing of actual benefits to Intel from a design change; it does not require a balancing of costs and benefits, although the FTC disclosed that a balancing would be appropriate if the design change were challenged under the antitrust laws. See *In the Matter of Intel Corporation*, Docket No. 9341, Analysis of Proposed Consent Order to Aid Public Comment.
52. See, e.g., Werden (2006) at 416.
53. See, e.g., Salop (2006).
54. Vickers (2005).
55. Hovenkamp (2013).
56. Gilbert (2007).
57. European Commission—Fact Sheet, “Antitrust: Commission fines Google €2.42 billion for abusing dominance as search engine by giving illegal advantage to own comparison shopping service,” Brussels, June 27, 2017.
58. See, e.g., Creighton and Jacobson (2012). These authors argue that the Supreme Court opinion in *Verizon v. Trinko* is a departure from prior court decisions that imposed duties on a dominant firm to assist its rivals.
59. *Lorain Journal Co. v. United States*, 342 U.S. 143 (1951).
60. *Otter Tail Power Co. v. United States*, 410 U.S. 366 (1973). A subsequent case that is often cited in the context of allegations of refusals to deal is *Aspen Skiing Co. v. Aspen Highlands Skiing Corp.*, 472 U.S. 585 (1985). That case premised antitrust liability for a refusal to deal on the termination of a profitable prior course of dealing, which is irrelevant for some types of conduct that have anticompetitive consequences. See, e.g. Creighton and Jacobson (2012).

## Chapter 10

1. One estimate is that a modern laptop computer embodies more than 250 technologies defined by standards. See Biddle (2018).
2. This chapter is based in part on Gilbert (2014).
3. See, e.g., Shapiro and Varian (1999a, 1999b).
4. See, e.g., Farrell and Saloner (1985, 1986).
5. Simcoe (2012) shows that commercialization of the internet caused an increase in strategic maneuvering within the IETF and a slowdown in committee decision-making regarding internet standards.

6. See, e.g., Anton and Yao (1995).
7. In 1997, Sun Microsystems applied for and won approval to submit Java to the International Committee for Information Technology Standardization. Sun ultimately abandoned its efforts to certify Java as a public standard over disputes about intellectual property protection. See, e.g., Garud et al. (2002).
8. European Commission, *Google Android*, Case AT.40099, Commission Decision, 18 July 2018 at Section 12.6.1.
9. *Ibid.*
10. European Commission Press Release, “Antitrust: Commission fines Google €4.34 billion for illegal practices regarding Android mobile devices to strengthen dominance of Google’s search engine,” July 18, 2018.
11. ANSI Patent Policy, revised 2016, available at <https://share.ansi.org/Shared%20Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/ANSI%20Patent%20Policy%202016.pdf>.
12. Goodman and Myers (2005). WCDMA and CDMA2000 are third-generation cellular communications technologies. The initials WCDMA stand for “Wideband Code Division Multiple Access.” A patent family includes all the patents registered by one or more common inventors in different countries to protect an invention.
13. See Williamson (1979) and Farrell, Hayes, Shapiro, and Sullivan (2007) for a discussion of the economics of holdup in the context of standard-setting.
14. See Shapiro (2001).
15. See Lemley and Shapiro (2007). Royalty-stacking is an example of the Cournot complements effect discussed in chapter 2.
16. ANSI Patent Policy.
17. See, e.g., Goodman and Myers (2005) and Maskus and Merrill (2013).
18. US Federal Trade Commission, *In the Matter of Dell Computer Corporation*, Complaint, May 20, 1996.
19. US Federal Trade Commission, *In the Matter of Dell Computer Corporation*, Statement of the Commission, June 17, 1996.
20. The author testified on behalf of private plaintiffs adverse to Rambus in a related case.
21. US Federal Trade Commission, *In the Matter of Rambus Inc.*, Docket No. 9302, Opinion of the Commission (August 2, 2006).
22. *Rambus Inc. v. FTC*, US Court of Appeals for the District of Columbia, (April 22, 2008), 522 F.3d 456.
23. 522 F.3d 456, 456 (emphasis in original). “SSO” stands for “standards setting organization,” which is another term for “standards development organization.”
24. The court of appeals in *Rambus* did not directly address whether Rambus might have violated Section 5 of the Federal Trade Commission Act, although it noted that JEDEC’s vague disclosure requirements would cast doubt on such a finding.
25. 522 F.3d 456, 465. Italics in original.



26. See, e.g., Galetovic, Haber, and Levine (2015).
27. Galetovic, Haber, and Levine (2015) also claim that holdup is not an economic concern because court decisions that reduce the excessive power of SEP holders have not accelerated innovation in SEP-reliant industries. However, there is not sufficient data to estimate such innovation effects accurately.
28. See, e.g., Carey and Culley (2018).
29. *Allied Tube & Conduit Corp. v. Indian Head*, US Supreme Court (June 13, 1988).
30. Simcoe (2012).
31. Arrow (1950).
32. Many such allegations survive a motion to dismiss or summary judgment, but then are dismissed on the merits after a finding that standards were developed in a process that followed these principles. Examples include *Addamax v. Open Software Foundation*, 888 F. Supp. 274 (D. Mass. 1995), aff'd, 152 F.3d 48 (1st Cir. 1998) (not unlawful to exclude technology from Unix OSF/1); and *Golden Bridge Tech., Inc. v. Nokia, Inc.* (E.D. Tex., Sept. 10, 2007), aff'd *Golden Bridge Tech., Inc. v. Motorola, Inc.*, 547 F.3d 266 (5<sup>th</sup> Cir. 2008) (not unlawful to exclude technology from 3G cellular standards).
33. *GSI Tech., Inc. v. Cypress Semiconductor Corp.*, US Dist. LEXIS 9378 (January 27, 2015). The case ended after the parties reached an undisclosed settlement. Cypress Semiconductor, 2015 Annual Report at 104.
34. See, e.g., *Microsoft Corporation v. Motorola, Inc., et al.*, 2013 US Dist. LEXIS 60233 (W.D. Wash., April 25, 2013); *In re Innovatio IP Ventures, LLC Patent Litig.*, 2013 US Dist. LEXIS 144061 (N.D. Ill., October 3, 2013); and *Commonwealth Sci. & Indus. Research Organisation v. Cisco Sys.* (Fed. Cir., December 3, 2015).
35. VITA Standards Organization, *VSO Policies and Procedures*, September 1, 2015, Revision 2.8.
36. Letter from Thomas O. Barnett, Assistant Attorney General, to Robert A. Skitol, October 30, 2006, available at <https://www.justice.gov/atr/response-vmebus-international-trade-association-vitas-request-business-review-letter>.
37. Letter from Renata B. Hesse, acting assistant attorney general, to Michael A. Lindsay, February 2, 2015, available at <https://www.justice.gov/atr/response-institute-electrical-and-electronics-engineers-incorporated>.
38. See, e.g., Lerner and Tirole (2006) and Chiao, Lerner and Tirole (2017).
39. Contreras and Gilbert (2015).
40. Delrahim (2018a, 2018b).
41. See, e.g., *In the Matter of Negotiated Data Solutions LLC*, Complaint (September 23, 2008) and *In the Matter of Robert Bosch GmbH*, Complaint (November 26, 2012). Issues associated with FRAND licensing agreements are examined at length in Maskus and Merrill (2013).
42. Gilbert (2018a).
43. See Gilbert (2011) and Carlton and Shampine (2013).
44. Contreras and Gilbert (2015) and Lee and Melamed (2016).

45. Ibid.

46. See, e.g., *Ericsson, Inc. v. D-Link Sys.* (Fed. Cir. December 4, 2014), 773 F.3d 1201, 1226, 1231.

47. Ratliff and Rubinfeld (2013) propose a scheme to determine when a patent owner may reasonably request an injunction or exclusion order. Geradin and Rato (2007) argue that a FRAND commitment should not preclude seeking an injunction when good faith negotiations have failed.

48. Merges and Kuhn (2009) at 4.



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