PATENTS AS HEDGES

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ABSTRACT

The overriding justification offered for patents has been to optimally induce innovative technological activity by preventing free riding—that is, uncompensated appropriation of innovative information by third parties. Yet, patent law presents several puzzles for its putative free riding rationale. First, ordinary patent infringement has never required copying. Second, recent empirical studies have shown that copying is often costly and time-consuming. Third, there are many costly and risky economic activities subject to free riding that are not protected by patent-like rights. Some commentators have relied upon these doubts of patent law's free riding premise to propose weakening patent rights, such as by requiring copying as an element of infringement. This Article extends the incentive theory of patents to explain why patents should reach wholly independent activity. Leveraging the work of Joseph Schumpeter, I argue that patents best promote innovation when used as "hedges" against potential competition. On this account, innovators who are first to the market can enjoy supernormal profits without patents or other IP rights. Patents reduce the risk of profit erosion from competition—of which free riding is merely one form—and stem the concomitant erosion of profits, thereby increasing incentives to innovate. Nonetheless, overly suppressing competition may dampen innovation and lead to other social costs. Fine-tuning the nature and scope of patent rights therefore requires a delicate balance between these competing forces.

DOI: https://doi.org/10.15779/Z38CJ87M7N

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I. INTRODUCTION

Patent infringement is commonly portrayed as a form of theft.[1] From groundbreaking inventions such as the steamboat,[2] airplane,[3] laser,[4] telephone,[5]

1. *See, e.g.*, Internet Movie Database, Plot Summary, Flash of Genius, https://www.imdb.com/title/tt1054588/ (last visited Dec. 13, 2015) (describing the 2008 film as one in which "Ford [has] stolen [the inventor-protagonist's] design").

2. *See generally* Frank D. Prager, *The Steamboat Interference: 1787-1803*, 40 J. PAT. OFF. SOC'Y 611 (1958).

3. *See* George Bittlingmayer, *Property Rights, Progress, and the Aircraft Patent Agreement*, 31 J.L. & ECON. 227, 230–31 (1988). *See generally* Herbert A. Johnson, *The Wright Patent Wars and Early American Aviation*, 69 J. AIR L. & COM. 21 (2004).

4. *See generally* Gould v. Schawlow, 363 F.3d 908 (C.C.P.A. 1966); NICK TAYLOR, LASER: THE INVENTOR, THE NOBEL LAUREATE, AND THE THIRTY-YEAR PATENT WAR (2000).

5. SETH SHULMAN, THE TELEPHONE GAMBIT (2008) (describing how Alexander Graham Bell may have wrongfully copied part of Elisha Gray's patent application). *See also* The Telephone Cases, 126 U.S. 1, 534 (1888) (consolidating patent infringement cases related

and television,[6] to more mundane ones, like the intermittent windshield wiper[7] and the Monopoly board game,[8] historians, Hollywood, and bloggers alike have documented disputes involving allegations of "stealing" inventions.[9]

Although they eschew the theft terminology, legal scholars have generally grounded the rationale for patents in preventing what otherwise would be low-cost "free riding"—essentially, the copying of inventive ideas.[10] Along this line of reasoning, without some mechanism to prevent free riding, "competition [would] drive prices down to a point where the inventor receives no return on the original investment in research and development."[11] Similarly, economists' "public goods" explanation of patents hinges upon the "non-excludability" of

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to Alexander Graham Bell's patents to "improvements in telegraphy" and "improvements in electric telephony").

6. G.R.M. Garratt & A.H. Mumford, *The History of Television*, 99 PROCS. IEE PART IIIA TELEVISION 25–40 (1952). *See generally* JOSEPH H. UDELSON, THE GREAT TELEVISION RACE: A HISTORY OF THE AMERICAN TELEVISION INDUSTRY, 1925-1941 (1st ed. 1982).

7. John Seabrook, *The Flash of Genius*, NEW YORKER (Jan. 3, 1993), http://www.newyorker.com/magazine/1993/01/11/the-flash-of-genius (discussing, *inter alia*, Bob Kearns invention of the intermittent windshield wiper and the money earned in settlements in patent disputes); FLASH OF GENIUS (Intermittent Productions 2008); Kearns v. Ford Motor Co., 32 F.3d 1541, 1543 (Fed. Cir. 1994).

8. *See* Daniel J. Schaeffer, *Not Playing Around: Board Games and Intellectual Property Law*, 7 LANDSLIDE 40, 42 (2015) (discussing Parker Brothers' patent for the *Monopoly* board game, invented by Charles Darrow).

9. For an example of a typical blog post on this topic, see Chris Barker, *10 Great Business Ideas That Were Actually Stolen*, BUS. CAREER GUIDE (Nov. 10, 2012), http://www.businesscareersguide.com/10-great-business-ideas-that-were-actually-stolen/.

10. A. Samuel Oddi, *Un-Unified Economic Theories of Patents—The Not-Quite-Holy Grail*, 71 NOTRE DAME L. REV. 267, 275–77 (1996) (discussing the "reward theory" of patent law and particularly pointing to support for the reward theory based on preventing "free riding"); Mark A. Lemley, *Property*, 83 TEX. L. REV. 1031, 1032 (2005) [hereinafter Lemley, *Property*] ("Protectionists . . . rely on the rhetoric of real property, with its condemnation of 'free riding' by those who imitate or compete with intellectual property owners."); Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 1084 (1997) [hereinafter Lemley, *Economics of Improvement*] ("[T]he 'reward theory' of patent law is essentially incentive-based: inventors must be rewarded in order to (a) encourage more inventions, or (b) prevent 'free-riding.'"); Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 373 (2010) (noting that patents are "designed" to "prevent free riding") [hereinafter Sichelman, *Commercializing Patents*]; WARD S. BOWMAN JR., PATENT ANTITRUST LAW: A LEGAL AND ECONOMIC APPRAISAL 30–32 (1971) (justifying patent law's reward theory in order to present free riding by "copyists").

11. Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1025 (1989) ("If successful inventions are quickly imitated by free riders, competition will drive prices down to a point where the inventor receives no return on the original investment in research and development.").

information—particularly, the inability to easily prevent others from appropriating information generated by inventors.[12]

Yet, in contrast with copyrights and trade secrets, patent infringement does not require copying.[13] In other words, wholly independent activity by third parties can nonetheless be infringing.[14] Importantly, direct infringement effectively sounds in strict liability; knowledge of the patent is not required.[15]

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12. *See, e.g.*, STEPHEN MARTIN, INDUSTRIAL ORGANIZATION IN CONTEXT 498 (2010) ("[T]he currently most fashionable rationale for the institution of intellectual property is that the public good aspects of information mean some legal support for appropriability is necessary."); JOHN LEACH, A COURSE IN PUBLIC ECONOMICS 173–74 (2004) (explaining how patents are a response to the underproduction of knowledge that would otherwise occur because "knowledge is a public good"); *see also* Lemley, *Property*, *supra* note 10, at 1054 ("Once the information has been disclosed outside a small group, however, it is extremely difficult to control. Information has the characteristics of a 'public good'—it may be 'consumed' by many people without depletion, and it is difficult to identify those who will not pay and prevent them from using the information."). *See generally* Paul Samuelson, *The Pure Theory of Public Expenditure*, 36 REV. ECON. & STAT. 387, 387–89 (1954) (introducing the notion of "public goods").

13. *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 478 (1974). Although trademark infringement nominally does not require copying, whether the alleged infringed appropriated the goodwill of the trademark holder is typically an important factor in the infringement analysis. *See* Barton Beebe, *An Empirical Study of the Multifactor Tests for Trademark Infringement*, 94 CALIF. L. REV. 1581, 1628 (2006) (reporting that the intent of the infringer to appropriate the goodwill of the mark creates "a nearly un-rebuttable presumption of a likelihood of confusion").

14. Technically, patent law doctrine assumes that all infringers are on constructive notice of the patent via its publication. *See* Sontag Chain Stores Co. v. National Nut Co., 310 U.S. 281, 295 (1940) (finding that publication of a patent provides "implied knowledge of the . . . patent"). Additionally, sometimes marking of patented productions by the patentee is said to provide constructive notice. Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1442 n.95 (2009) ("[M]arking may constitute constructive notice of infringement.") [hereinafter Cotropia, *Copying*]. Nonetheless, if an infringer began its activity prior to publication of the patent, disclosure of related information, or any uses or sales of the patented invention—in other words, the infringer simply had no knowledge of the patent or any information relating to it—then it should generally be treated an "independent inventor." *Cf.* Samson Vermont, *Independent Invention as a Defense to Patent Infringement*, 105 MICH. L. REV. 475, 496 (2006) (contrasting "independent inventors" with those entities that are "pirates or firms that attempted to invent around the patent") [hereinafter Vermont, *Independent Invention*].

15. Mark A. Lemley, *Should Patent Infringement Require Proof of Copying?*, 105 MICH. L. REV. 1525 (2007) ("Patent infringement is a strict liability offense.") [hereinafter Lemley, *Should Patent Infringement Require Proof of Copying?*]; Roger D. Blair & Thomas F. Cotter, *Strict Liability and Its Alternatives in Patent Law*, 17 BERKELEY TECH. L.J. 799, 800 (2002) ("Patent infringement is a strict liability tort in the sense that a defendant may be liable without having had any notice, prior to the filing of an infringement action, that her conduct was infringing.") [hereinafter Blair, *Strict Liability*]; Mark A. Lemley, *Inducing Patent Infringement*, 39 U.C. DAVIS L. REV. 225, 235 (2005) ("Direct patent infringement is a strict liability offense."). In contrast,

In this regard, the Supreme Court has couched the role of patents in quite general terms.[16] Specifically, in *Kewanee v. Bicron Oil*, a prominent case that considered the aims of intellectual property law, the Court broadly remarked, "[t]he patent laws . . . [offer] a right of exclusion for a limited period as an incentive to inventors to risk the often enormous costs in terms of time, research, and development."[17] The Court emphasized, "[patent] protection goes not only to copying the subject matter, which is forbidden under the Copyright Act . . . but also to independent creation."[18] Nonetheless, the Court has never explained why patent protection extends to "independent creation."[19]

This disjunction between theory and practice is puzzling: If the aim of patents is to prevent copying and free riding, then why should independent activity be actionable as patent infringement?[20] Earlier scholars have primarily

indirect infringement requires actual knowledge of the patent-at-issue, or at least "willful blindness" to such knowledge. *See* Global-Tech v. S.E.B., 563 U.S. 754 (2011); *cf.* Ted Sichelman, *Patent Law Revisionism at the Supreme Court?*, 45 LOY. U. CHI. L.J. 307 (2013) (arguing that the Supreme Court's decision in *Global-Tech* obfuscated the historical doctrine, which did not require knowledge of the patent as a prerequisite for indirect infringement).

16. *Kewanee*, 416 U.S. at 480.

17. *Id.*

18. *Id.* at 478. *See also id.* at 490 ("While trade secret law does not forbid the discovery of the trade secret by fair and honest means, e.g., independent creation or reverse engineering, patent law operates 'against the world,' forbidding any use of the invention for whatever purpose for a significant length of time.").

19. *Id.*; Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 155 (1989) (discussing how, in contrast to patents, with trade secrets the "public at large remain[s] free to discover and exploit the trade secret through . . . independent creation" but never explaining the rationale behind the different approaches).

20. *See* Lemley, *Should Patent Infringement Require Proof of Copying?*, *supra* note 15 (analyzing the possibility of an independent invention defense); Vermont, *Independent Invention*, *supra* note 14 (concluding that, under certain circumstances, independent invention should bar a finding of patent infringement); Oskar Liivak, *Negligent Innovation,* 48 FLA. ST. U. L. REV. 607 (2021); Adam J. MacLeod, *Patent Infringement As Trespass*, 69 ALA. L. REV. 723, 730 (2018); Patrick R. Goold, *Patent Accidents: Questioning Strict Liability in Patent Law*, 95 IND. L.J. 1075 (2020); Mark A. Lemley & Robin Feldman, *Is Patent Enforcement Efficient?*, 98 B.U. L. REV. 649, 667 (2018); Oskar Liivak, *Rethinking the Concept of Exclusion in Patent Law*, 98 GEO. L.J. 1643, 1647 (2010); Carl Shapiro, *Prior User Rights*, 96 AM. ECON. REV. 92 (2006); Vincenzo Denicolò & Luigi Alberto Franzoni, *Patents, Secrets, and the First-Inventor Defense*, 13 ECON. & MGMT. STRATEGY 517 (2004); Manfredi La Manna, Ross Macleod & David de Meza, *The Case for Permissive Patents*, 33 EUR. ECON. REV. 1427 (1989); Stephen M. Maurer & Suzanne Scotchmer, *The Independent Invention Defense in Intellectual Property*, 69 ECONOMICA 535 (2002); Elisabetta Ottoz & Franco Cugno, *The Independent Invention Defense in a Cournot Duopoly Model*, 12 ECON. BULL. 1 (2004); Emeric Henry, *Runner-up Patents: Is Monopoly Inevitable?*, 112 SCANDINAVIAN J. ECON. 417 (2010); James J. Anton & Dennis A. Yao, *Expropriation and Inventions: Appropriable Rents in the Absence of Property Rights*, 84 AM. ECON. REV. 190 (1994); Stephen M. McJohn, *A New Tool for Analyzing Intellectual Property*, 5 NW. J. TECH. & INTELL. PROP. 101, 116 (2006).

posited that although free riding is the primary concern of patent law, it is often difficult to prove copying in practice, which justifies holding putative "independent" inventors liable for infringement.[21] Yet, the evidentiary-focused view is wanting in an important respect: if the alleged infringer can prove with hard evidence that it *absolutely did not imitate* the patentee's invention, then why shouldn't it escape infringement?[22]

Other theories attempting to explain the conundrum contend that imposing a copying requirement would unduly weaken incentives to innovate.[23] Yet, the costs of intellectual property—including costs to consumers in the form of higher-than-usual ("supracompetitive") pricing,[24] to downstream innovators in the form of transaction costs,[25] and to the public

21. Robert P. Merges, *A Few Kind Words for Absolute Infringement Liability in Patent Law*, 31 BERKELEY TECH. L.J. 1, 1–2 (2016) [hereinafter Merges, *A Few Kind Words*]; Richard A. Posner, *Misappropriation: A Dirge*, 40 HOUS. L. REV. 621, 626 (2003) ("What tips the balance against an independent-discovery defense, however, is the difficulty of determining independent discovery by the methods of litigation and the resulting likelihood that the courts would commit many errors in adjudicating patent infringement claims in cases in which independent discovery was the defense.").

22. The America Invents Act and many foreign patent systems do allow a "prior user" defense that applies when an alleged infringer can show use (typically, commercial use) some period of time prior to the patent's filing date, but do not go so far as to provide immunity from infringement to all independent inventors. *See* 35 U.S.C. § 273 (2011) (setting forth the requirements for the prior user defense under the America Invents Act); *see also* John Neukom, *A Prior Use Right for the Community Patent Convention*, 12 EUR. INTELL. PROP. REV. 165, 165–66 (1990) (discussing prior user rights in Europe).

23. Vermont, *Independent Invention*, *supra* note 14, at 476 ("To weaken patent protection is to increase the risk that inventors will postpone invention."); Lemley, *Should Patent Infringement Require Proof of Copying?*, *supra* note 15 (speculating that an independent invention defense may unduly weaken patent rights); Keith M. Kupferschmid, *Prior User Rights: The Inventor's Lottery Ticket*, 21 AIPLA Q.J. 213, 219 (1993) ("Such a defense would severely weaken the patent and in effect weaken the incentives of the patent system.").

24. Jonathan M. Barnett, *Private Protection of Patentable Goods*, 25 CARDOZO L. REV. 1251, 1269 (2004) ("As a legally created monopoly over an intellectual good, a patent entitlement imposes significant social costs. These costs include: (1) administrative costs (incurred by the patent office and innovators) of prosecuting patents, issuing patents and adjudicating disputes relating to patent infringement, (2) rent-seeking costs incurred by innovators seeking to win a patent, (3) supracompetitive pricing power exerted by the patent holder (or, more specifically, the deadweight loss resulting from the patent holder's output restrictions), and (4) restricted access to the patented good by subsequent improvers."); Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights*, 60 STAN. L. REV. 863, 867 (2007) ("Traditionally, patent scholarship focused, by and large, on the price effects of patent protection. The main problem theorists noted was that patent protection allowed patentees to engage in supracompetitive pricing, generating a social deadweight loss.") [hereinafter Ayres, *Tradable Patent Rights*].

25. *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research,* 280 SCI. 698, 699 (1998) ("Each upstream patent allows its

from administrative and other external costs[26]—can only be justified if intellectual property is essential to incentivizing innovation.[27] Because these theories do not sufficiently explain why and when stronger intellectual property rights are necessary—that is, relative to ordinary market incentives—they do not adequately justify the absence of copying from the elements of patent infringement.[28] In this regard, the "strong patent rights" theories tend to lack substantial empirical support.[29]

Another line of argument in the economics literature is more promising. Namely, the well-known economist Joseph Schumpeter argued that the

owner to set up another tollbooth on the road to product development, adding to the cost and slowing the pace of downstream biomedical innovation."); Lemley, *Economics of Improvement*, *supra* note 10, at 1054 ("[E]ven the average transaction costs associated with an intellectual property license are unlikely to be trivial."); Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 874 (1990) ("A substantial literature documents the steep transaction costs of technology licensing, and there is indirect evidence that these costs increase when major innovations are transferred. Moreover, various studies have indicated that transaction costs tend to be very high if licenses are tailored to particular licensees.").

26. *See* Lemley, *Property*, *supra* note 10, at 1058–59.

27. In this Article, I generally use the term "invention" to refer to the designs and related knowledge required to receive patent protection and associated prototypes, if any. *See* Robert P. Merges, *Commercial Success and Patent Standards: Economic Perspectives on Innovation*, 76 CALIF. L. REV. 803, 807 (1988) [hereinafter Merges, *Commercial Success*] ("[T]he innovation will in all likelihood be different in significant respects from the invention due to the changes necessary to turn the invention into a commercial product."). I use the term innovation to refer to the entire commercial process of inventing and transforming an invention into a commercially viable product or method, plus improvements to the original product or services. *See, e.g.*, Federico Munari & Maurizio Sobrero, *Corporate Governance and Innovation*, *in* CORPORATE GOVERNANCE, MARKET STRUCTURE AND INNOVATION 3 (Mario Calderini et al. eds., 2003) (remarking that innovation starts "with the generation of new knowledge targeted to the discovery of new products and processes, and ending with their commercial exploitation"); *cf.* JOSEPH A. SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT: AN INQUIRY INTO PROFITS, CAPITAL, CREDIT, INTEREST, AND THE BUSINESS CYCLE 66 (Redvers Opie trans., Transaction Publishers 1983) (1934) (contending that innovation consists of novel goods, production methods, markets, production inputs, and forms of organization). I also use the term "innovation" to refer to the commercial product or service used by consumers. *See, e.g.*, Jan Fagerberg, *Innovation: A Guide to the Literature*, *in* THE OXFORD HANDBOOK OF INNOVATION 4 (Jan Fagerberg et al. eds., 2005) ("Invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to carry it out into practice.").

28. *See infra* notes 112–117 and accompanying text. Another line of theories investigates the costs generated by duplicated R&D (rent dissipation theory) and the high costs of coordinating downstream R&D in improving an invention (prospect theory). *See infra* notes 128–154 and accompanying text. I discuss explanatory limitations in these theories below. *See id.*

29. *See infra* note 138 and accompanying text.

suppression of competition is essential to promoting innovation.[30] In Schumpeter's view, monopolists would have greater incentives to innovate because they could recoup all of the profits of their innovations.[31] Patents—as a form of "legal" monopoly—thereby promote innovation.[32]

The Schumpeterian approach, however, suffers from three deficiencies. First, despite the popularity of such an approach, like the "strong IP rights" theories, Schumpeter (and his followers) have not adequately acknowledged the important role that competition can play in promoting innovation.[33] Second, although Schumpeter classified patents as one of several strategies for "insuring or hedging" for investment "under rapidly changing conditions," his remark was casual and brief, and neither he nor Schumpeterian theorists have explained the precise legal role patents play in suppressing competition to promote innovation.[34] In this regard, Schumpeterian theory has not squarely disputed the view that free riding is the primary basis on which to ground patent rights.[35] Indeed, much of Schumpeter's own argument is directed towards the competitive threat stemming from free riding.[36] Third, Schumepterians—as well as the industrial organization literature more generally[37]—although properly characterizing patents as legal monopolies,

30. JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 106 (3d ed. 1950) [hereinafter SCHUMPETER, CAPITALISM] ("[P]erfect competition is not only impossible but inferior . . . ."). *See also* John F. Duffy, *The Marginal Cost Controversy in Intellectual Property*, 71 U. CHI. L. REV. 37, 39–41 (2004) (describing intellectual property as a "special case of natural monopoly").

31. SCHUMPETER, CAPITALISM, *supra* note 30, at 81–106.

32. *See id.* Schumpeterian thinking has featured prominently in the industrial organization literature. *See* Richard C. Levin, Wesley M. Cohen & David C. Mowery, *R&D Appropriability, Opportunity, and Market Structure: New Evidence on Some Schumpeterian Hypotheses,* 75 AM. ECON. REV. PAPERS & PROCS. NINETY-SEVENTH ANNUAL MEETING AM. ECON. ASS'N 20, 20–24 (1985); Kathleen R. Conner, *A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm?,* 17 J. MANAGE. 121, 121–54 (1991).

33. SCHUMPETER, CAPITALISM, *supra* note 30, at 106 (asserting that perfect competition is "inferior in internal, especially technological, efficiency"). *See also* INNOVATION AND GROWTH: SCHUMPETERIAN PERSPECTIVES (F.M. Scherer ed., 1985) (collecting sixteen essays examining Schumpeter's views on innovation). *See generally* Michael A. Carrier, *Two Puzzles Resolved: Of the Schumpeter-Arrow Stalemate and Pharmaceutical Innovation Markets*, 93 IOWA L. REV. 393, 402–05 (2008) (contrasting Schumpeterian with competitive paradigms of innovation).

34. SCHUMPETER, CAPITALISM, *supra* note 30, at 87–88. *See also* Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. U. L. REV. 77, 121 (1999) (noting that "[i]n the specific context of biotechnology, the argument that a patent monopoly provides a hedge against competition and uncertainty in the development process has some merit" but not addressing the specifics of how patents precisely achieve that goal).

35. Schumpeter, *supra* note 30, at 81–106.

36. *See id.*

37. *See infra* notes 38–39, 264–275 and accompanying text.

wrongly views these rights as affording exclusive rights to practice the invention and, hence, real options to commercialize.[38] Rather, patents are merely negative rights to exclude others from practicing the patented invention and, although patents may *indirectly* provide positive rights to exclusively commercialize an invention, they do not always do so.[39]

In this Article, I extend the Schumpeterian approach to offer a novel theory of patent law that extends and refines the free-riding, public goods account.[40] Like the Schumpeterians, I posit that patents are a form of a "hedge"—that is, an economic instrument to reduce risk. However, such a hedge insures against the competitive risk of *any kind*, not merely free riding.[41] Moreover, contrary to the traditional reward theory, patents are not necessary for an inventor to charge supraompetitive prices.[42] Rather, because patents are generally awarded to the first inventor—and that inventor (or its licensees) typically will be the first to commercialize—there will be no competition and, hence, a first-mover advantage for the inventor.[43] During this period, the

38. *See* Nicholas Bloom & John Van Reenen, *Patents, Real Options and Firm Performance*, 112 ECON. J. 97, 97–116 (2002); Alan C. Marco, *The Option Value of Patent Litigation: Theory and Evidence*, 14 REV. FIN. ECON. 323, 323–51 (2005); Marc Baudry & Béatrice Dumont, *Patent Renewals as Options: Improving the Mechanism for Weeding Out Lousy Patents*, 28 REV. INDUS. ORG. 41, 41–62 (2006); Arvids A. Ziedonis, *Real Options in Technology Licensing*, 53 MGMT. SCI. 1618, 1618–33 (2007). *Cf.* Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065 (2007) (presenting the case for underdevelopment of patented inventions using real options theory).

39. *See infra* notes 264–275 and accompanying text. Some legal scholars have recognized the option afforded by patents to "exclude" others from the marketplace, but they have wrongly added other options to the mix, such as the option to commercialize, license, and the like. *See* Amelia S. Rinehart, *Patents as Escalators*, 14 VAND. J. ENT. & TECH. L. 81, 99 (2011) ("[T]he patent owner exercises his option by exploiting his right to exclude, by leveraging the patent to commercialize the technology, by licensing others to compete with him, by foregoing commercialization and licensing for revenue, and/or by litigating to obtain remedies from infringers."); Shaun Martin & Frank Partnoy, *Patents as Options*, *in* PERSPECTIVES ON COMMERCIALIZING INNOVATION 303–05 (F. Scott Kieff & Troy A. Paredes eds., 2011) (recognizing a litigation option value to patents but also a development option value); Christopher Cotropia, *Describing Patents as Real Options*, 34 J. CORP. L. 1127, 1137–38, 1149 (2009) (relying on the exposition by Martin & Partnoy to postulate a commercialization option and a litigation option, though noting that commercialization benefits "do not involve the patent right directly").

40. *See infra* Part II.B.

41. *See id.*; *cf.* Kimble v. Marvel Entm't, LLC, 135 S. Ct. 2401, 2413 (2015) ("The patent laws—unlike the Sherman Act—do not aim to maximize competition (to a large extent, the opposite).").

42. *See id.*

43. *See id.*; *see also* Oskar Liivak, *Maintaining Competition in Copying: Narrowing the Scope of Gene Patents*, 41 U.C. DAVIS L. REV. 177, 212 (2007) ("Potential or actual competition helps to

inventor (or its licensees) can charge supracompetitive prices, even if for a very short period of time.[44]

The patent is a hedge that reduces the risk that the patentee's supracompetitive pricing will be eroded by competitors, because a patent forecloses competitors from making, selling, or using any product or service within the scope of the patent's claims.[45] In this regard, patents are *not* "real call options" to *affirmatively* commercialize the patented good.[46] Instead, they are "real put options" to foreclose competition.[47] Like a financial put option, the holder of a patent can elect to force a third party (here, an infringer) to purchase an asset (here, a retroactive license to the patent); additionally, the patentholder can force the infringer either to cease any further infringement or to continue its license, depending on the circumstances.[48]

In many instances, first-mover advantages—especially those backed by "complementary assets," such as marketing or manufacturing power—can be sufficient to incentivize innovation.[49] Thus, ordinary competitive markets can

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drive the price down to average cost. If the patentee is the first to arrive in some new technological market, then he can start pricing the invention at the monopoly price. In part, these early abnormal profits are the first-mover advantage."). Here I assume that the invention is new and sufficiently differentiated from other products and services so as to provide a market advantage. *See* Greg Vetter, *Patenting Cryptographic Technology*, 84 CHI.-KENT L. REV. 757, 774–75 (2010) (noting the use of patents for product differentiation).

44. *See infra* Part II.B; Liivak, *supra* note 43, at 212.

45. *See infra* Part II.B.

46. *See supra* notes 38–39 and accompanying text.

47. *See* Vermont, *supra* note 20, at 496 n.60 ("[P]atents confer only the right to exclude and not an affirmative right to exploit a patch of technology."); Merges & Nelson, *supra* note 25, at 860–62. *Cf.* Raffaele Oriani & Luigi Sereno, *Advanced Valuation Methods: The Real Options Approach*, *in* THE ECONOMIC VALUATION OF PATENTS: METHODS AND APPLICATIONS 141–59 (Federico Munari & Raffaele Oriani eds., 2011) (explaining that patents provide a put option in the form of litigation but wrongly contending that patents also provide a call option to commercialize the invention).

48. *See generally* IAN AYRES, OPTIONAL LAW: THE STRUCTURE OF LEGAL ENTITLEMENTS 18–19 (2005) (defining a legal put option as "an option to choose court-determined damages . . . or injunctive relief").

49. *See generally* David J. Teece, *Profiting from Technological Innovation*: *Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RSCH. POL'Y 285 (1986) (discussing the benefits of first-mover advantages and complementary assets; a number of surveys indicate that first-mover advantage is more effective than patents in promoting innovation in some industries); Richard C. Levin, Alvin K. Klevorick, Richard R. Nelson & Sidney G. Winter, *Appropriating the Returns from Industrial Research and Development*, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783 (1987); Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 MGMT. SCI. 173 (1986); William L. Baldwin & Gerald L. Childs, *The Fast Second and Rivalry in Research and Development*, 36 S. ECON. J. 18, 21 (1969); Janusz A. Ordover, *Economic Foundations and Considerations in Protecting Industrial and Intellectual Property*, 53 ANTITRUST L.J. 503, 507 (1984).

often lead to the optimal level of innovation.[50] The traditional economic view, however, is that most innovation markets are subject to the so-called "public goods" problem of information assets—namely, the difficulty of excluding competitors from appropriating information about the innovation for their own benefit.[51]

Yet, innovations are not solely composed of information—rather, patents cover tangible products and useable services, and the details surrounding how to build and use these products and services are often not public, not codified, or simply not codifiable.[52] Thus, in practice, patented goods and services are typically not pure public goods, because they are—at least partially—excludable even absent legal protection.[53] The inability of competitors and others to obtain information about the patented good or service will often significantly raise the costs of copying.[54] Indeed, the difficulty of copying has been used to justify weakening of patent rights, or their elimination altogether.[55]

Despite these barriers to imitation, I contend in this Article that market barriers to optimal levels of innovation often remain. Specifically, the general threat of competition to innovators tends to present risks that often do not

50. *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1618 (2003) ("[C]ompanies have ample incentives to develop business methods even without patent protection, because the competitive marketplace rewards companies that use more efficient business methods.").

51. *See generally* JOHN BATES CLARK, ESSENTIALS OF ECONOMIC THEORY 360 (1927) ("Why should one *entrepreneur* incur the cost and risk of experimenting [in making and selling] . . . a new machine if another can look on, ascertain whether the device works well or not, and duplicate it if it is successful?").

52. Dan L. Burk, *The Role of Patent Law in Knowledge Codification*, 23 BERKELEY TECH. L.J. 1009, 1022 (2008) ("[T]he [person of ordinary skill in the art's] ability to make and use the invention described in the patent may also depend upon uncodified information."); Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer*, 100 CALIF. L. REV. 1503 (2012) ("[M]uch scientific and technical knowledge is tacit."). Of course, some areas of knowledge are nearly fully codifiable, such as pharmaceutical drugs, presenting greater free riding concerns. *Id.* at 1528. ("[P]harmaceutical inventions, which tend to be more mature and more easily codified than other types of university inventions.").

53. *Cf.* Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1921–22 (2013) (positing that some inventive goods are "highly excludable under existing technological, normative, and institutional conditions").

54. *See* WILLIAM D. NORDHAUS, INVENTION, GROWTH, AND WELFARE: A THEORETICAL TREATMENT OF TECHNOLOGICAL CHANGE 89 (MIT, 1969) ("It is well known that a firm tries not to disclose key parts of the invention in order to reduce the chance of imitation, thereby reducing the effective diffusion of knowledge.").

55. *See, e.g.*, Lucas S. Osborn, Joshua M. Pearce & Amberlee Haselhuhn, *A Case for Weakening Patent Rights*, 89 ST. JOHN'S L. REV. 1185, 1234 (2015).

justify the *private* costs of innovative activity that is otherwise *socially* desirable.[56] Given the large costs and risks involved in research & development and the commercialization process—as well as the often large differential between the private, market value and the public, social value of technological innovations—patents or some other regulatory exclusivity will often be necessary to maximize social welfare.[57]

Unlike the Schumpeterians, the hedging theory presented here is ultimately agnostic as to whether strong or weak intellectual property rights optimally promote innovation in a given industry, because just as barriers to entry are often essential to innovation, so is competition.[58] As Kenneth Arrow and later scholars have properly recognized, competition can serve several important roles in the innovation process, from increasing the number of potential innovators for a given project to decreasing consumer deadweight losses.[59] Not only will optimal intellectual property rights turn on unique static aspects of industries, they will also vary based on the evolving nature of industries and consumers.[60] Because we cannot be certain of what the future holds in terms of innovation, as well as consumer tastes for innovation, I argue that it is in fact impossible even in principle to discern the ideal contours of intellectual property rights.[61] Instead, we must (rightfully or wrongfully) assume that the future is much like the past, or operate with some rough prediction of what

56. *See infra* Section III.A.

57. *See infra* Section III.B.

58. *See* John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 464 (1997) ("The positive effects of the intellectual property rights on innovation may, thus, not outweigh the negative effects of entry barriers on competition and further research."); *infra* Section III.A.

59. *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *reprinted in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITIES: ECONOMIC AND SOCIAL FACTORS 609, 619–20 (Richard R. Nelson ed., 1962). *See also* Mark A. Lemley & Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 UCLA L. REV. 925, 960–62 (2001) (arguing that the Internet was highly innovative because its architecture required competition rather than monopoly bottlenecks); *infra* note 296 and accompanying text.

60. *See* Lemley, *Property*, *supra* note 10, at 1066 ("The optimal scope, strength, and duration of intellectual property protection depend on the type of creation at issue, on the nature of innovation in the particular industry in question, on the particular kind of invention (and inventor) at issue, and on the market context."); Ayres, *Tradable Patent Rights*, *supra* note 24, at 884 ("[A]ll the important issues of developing optimal intellectual property rights turn on the government's imperfect information—or possibly the question of how best the government might economize on the patentee's (and others') private information.").

61. *Cf.* Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 266 (1994) ("A patent system operates over time. To be an efficient system it must optimize the flow of innovation over time. The patent system must thus balance innovation today against innovation tomorrow.").

the future holds for innovative activity, and attempt to work within the confines of our limited knowledge of the present.[62]

Nonetheless, hedging theory provides a rationale for increasing the strength of patent rights beyond what is justified merely by free riding theories and without resort to prospect or rent-dissipation—which is still squarely within the realm of incentives for innovation theories. Notably, like insurance more generally, purchasing a hedge against competition may—*narrowly viewed*—be a net private and social cost.[63] Yet, like insurance, reducing risk will incentivize the insured party to engage in risky and costly activities—here, research, development, and commercialization—that it otherwise would not have.[64]

The theory of patents as hedges offered in this Article contributes to the literature in three related ways. First, the theory provides a better explanatory account of incentive to innovate rationales for patent law.[65] Second, hedging theory provides a more coherent rationale of why patents rights extend beyond mere free-riding and public goods concerns, thereby implicitly rejecting these dominant models as satisfactory accounts.[66] Unlike "strong patent rights" rationales, hedging theory is grounded on empirical studies, which take into account both the innovation-promoting and innovation-dampening effects of suppressing competition.[67] Third, contrary to the industrial organization literature, the theory provides a more accurate and more detailed description of how patents function as hedges. Patents work essentially as options—not to allow for commercialization, but rather to foreclose competition.[68] In this regard, hedging may often be costly. An important implication of this reflection is that empirical studies purporting to show that patents are net social costs—even if correct (which is doubtful)—cannot be relied upon as a guide to policymaking, particularly because they do not quantify the benefits of patents in reducing risk from competition.[69]

62. *See infra* Section IV.B.
63. *See infra* Section IV.C.
64. *See infra* Section IV.C.
65. *See infra* Part III.
66. *See infra* Parts II–III.
67. *See infra* Parts III–IV.
68. *See infra* Section III.B.
69. *See generally* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK (2008) (purporting to show that patents are an overall net private cost to patent holders based on the use of event studies and estimates of licensing revenues). *But see* Glynn S. Lunney, Jr., *On the Continuing Misuse of Event Studies: The Example of Bessen and Meurer*, 16 J. INTELL. PROP. L. 35 (2008) (criticizing Bessen and Meurer's use of event studies).

The Article proceeds as follows. Part II describes the standard, reward theory of patents, as well as alternative utilitarian theories, including prospect, commercialization, and rent dissipation theories.[70] In so doing, I critique these theories for failing to sufficiently explain why patent infringement extends beyond free riding. Building off Schumpeterian theories of innovation, Part III sets forth a hedging theory of patents, explaining its economic underpinnings and applications in real-world settings. Part IV then explains that competition not only may suppress innovation but also may promote it. It further describes how the ambivalent role of competition in promoting innovation leads to a complex balancing act that patent law must perform to achieve optimal incentives. Indeed, I posit that in a dynamic setting it is theoretically impossible to select an optimal regime. Nonetheless, by making some reasonable assumptions about the evolving nature of innovative industries and consumers, as a practical matter, patents—as well as other forms of intellectual property—can potentially improve social welfare by promoting innovation. In this regard, I conclude by emphasizing the need for robust empirical research to better inform the shaping of intellectual property rights.

II. PUZZLES AND PROBLEMS WITH STANDARD THEORIES OF PATENT LAW

The standard justification for patents in the legal literature is that research and development (R&D) is a costly and risky endeavor that is subject to low-cost copying.[71] Economists similarly focus on the lack of "excludability" of the information generated by R&D, which allows third parties to appropriate such

70. This Article generally omits Lockean, Kantian, and other natural rights theories, because it addresses economic theories of patents. S*ee infra* note 118. In any event, these theories are unlikely to explain the absence of copying as an element of infringement, because independent invention arguably does not "wrongly" interfere with the natural or individual rights of inventors. *See, e.g.*, A. Samuel Oddi, *TRIPS – Natural Rights and a "Polite Form of Economic Imperialism"*, 29 VAND. J. TRANSNAT'L L. 415, 433 (1996) ("*Copying* an invention . . . becomes immoral because it is an incident of a natural property rights entitlement of the inventor.") (Italics added).

71. *See supra* note 10 and accompanying text; Peter S. Menell, *Tailoring Legal Protection for Computer Software*, 39 STAN. L. REV. 1329, 1361 (1987) ("If the costs of emulating are low, the dominant firm might not be able to recover its research and development costs."); Steve P. Calandrillo, *An Economic Analysis of Intellectual Property Rights: Justifications and Problems of Exclusive Rights, Incentives to Generate Information, and the Alternative of a Government-Run Reward System*, 9 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 301, 303 (1998) ("The rationale runs that in the absence of copyright or patent protection covering an individual's or firm's information creation, the low cost of copying such works will induce competitors to enter and 'steal' another's product without penalty. Hence, rivals may profit from another's intellectual efforts without expending any energy or costs other than the relatively minor costs required to duplicate the socially valuable creation.").

information without paying for it.[72] The inability to exclude, coupled with the typically "nonrivalrous" nature of information—namely, its ability to be enjoyed by multiple consumers without diminishing its value—implies that technological information is typically a "public good."[73] Like other public goods, private actors will generally not have sufficient incentives to produce them absent some form of government intervention.[74]

On this standard approach—termed "reward" theory by legal scholars—patents provide legal rights to exclude others from making, using, and selling the patented invention, thereby eliminating—or at least substantially reducing—the benefits to others from copying.[75] This reduction in benefits in turn provides an incentive (a "reward") for firms and individuals to engage in socially valuable R&D.[76] Specifically, by excluding others from appropriating the patentee's inventive efforts, the patentee can recoup profits in the marketplace that are "supernormal," or higher than what the patentee would earn in an ordinary, competitive market.[77]

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72. *See* Arrow, *supra* note 59, at 609 (noting that the fundamental theory behind intellectual property is that without incentives innovators will not innovate because competitors and third parties would free ride off their innovations); David J. Teece, *Competition, Cooperation, and Innovation: Organizational Arrangements for Regimes of Rapid Technological Progress*, *in* ESSAYS IN TECHNOLOGY MANAGEMENT AND POLICY 447, 461 (2003) ("Because of fundamental weaknesses in the system of intellectual property law, leakage and free riding are commonplace.").

73. *See* Paul M. Romer, *Endogenous Technological Change*, 98 J. POL. ECON. 71, 74 (1990) ("By definition, public goods are both nonrival and nonexcludable.").

74. *See* David J. Teece*, Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 302 (1986) ("This will eventually cripple the innovator, unless it is assisted by governmental processes.").

75. *See* Kevin G. Rivette & David Kline, *Discovering New Value in Intellectual Property,* 57 HARV. BUS. REV. 54, 57–58 (1999) ("Hitachi's automotive airflow sensor would be easy for rivals to copy, for example, but the company has built such an effective patent wall around it that rivals were forced to look for more complex and expensive . . . design approaches"); Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, 78 VA. L. REV. 305, 310–14 (1992) (describing the "long intellectual history of reward theory").

76. *See* Arrow, *supra* note 59, at 609 (noting the disincentives to disclose novel information and knowledge in the absence of legal protection to prevent the use of such information and knowledge).

77. *See* Burk, *supra* note 52, at 1010 ("[T]he dominant justification for the patent system has shifted toward an economic rationale based upon incentives. Under this prevalent view, the grant of exclusive rights deters quick imitation of the claimed invention and allows a period of supernormal profits that help to recoup the investment made in developing the invention."); Ted Sichelman & Stuart J.H. Graham, *Patenting by Entrepreneurs: An Empirical Study*, 17 MICH. TELECOMM. & TECH. L. REV. 111, 178 (2010) ("[W]e find that startups—like large firms—are primarily motivated to file for patents to prevent copying by competitors, presumably in order to earn supernormal profits.").

This theory has been espoused in scores of treatises, books, and articles.[78] An influential article on the economics of patent law by Kenneth Dam is a typical case in point:

> [I]t is important to recognize the primary problem that the patent system solves. This problem—often called the appropriability problem—is that if a firm could not recover the costs of invention because the resulting information were available to all, then we could expect a much lower and indeed suboptimal level of innovation. In short, the patent system prevents others from reaping where they have not sown and thereby promotes research and development (R&D) investment in innovation.[79]

Mark Lemley has summed up the scholarly zeitgeist well in his reflection that "commentators [have an] almost obsessive preoccupation with identifying and rooting out that great evil of the modern economic world—free riding."[80] Perhaps it is not surprising that the free riding view dominates the discussion—the first patent statute in history, from the Venetian Republic in 1474, is couched in this rationale: "Now, if provision were made for the works and devices discovered by such persons, *so that others who may see them could not build them* . . . more men would apply their genius, would discover, and would build devices of great utility and benefit to our commonwealth."[81]

Yet, if free riding is the central concern of patent law, then why can activity that is clearly *not* free riding still constitute patent infringement? Although there is a substantial scholarly literature on the puzzle of why "independent invention" is actionable as infringement, the explanations are wanting, especially in view of the incentives-focused approach of reward theory.[82] Indeed, the strongest reason offered on this basis is that copying is difficult to prove as an evidentiary matter.[83] As Robert Merges has noted, copying may often be "inadvertent" or done "in obscure and subtle ways, leaving little or no evidence that copying has indeed occurred."[84] Merges bolsters the

78. *See* Michael A. Carrier, *Unraveling the Patent-Antitrust Paradox*, 150 U. PA. L. REV. 761, 820 (2002) ("The standard utilitarian justification for patents is that they address the 'public good' characteristics of inventions by increasing appropriability and preventing imitation by free riders.").

79. Dam, *supra* note 61, at 247.

80. Lemley, *Property*, *supra* note 10, at 1033.

81. Giulio Mandich, *Venetian Patents (1450-1550)*, 30 J. PAT. OFF. SOC'Y 166, 177 (1948) (emphasis added).

82. *See supra* note 20 (cataloguing sources setting forth theories of why patent law eschews independent invention as a defense to patent infringement).

83. *Cf.* Cotropia, *Copying*, *supra* note 14, at 1422 ("We find that a surprisingly small percentage of patent cases involve even allegations of copying, much less proof of copying").

84. Merges, *A Few Kind Words*, *supra* note 21, at 1–2.

evidentiary explanation: allowing an independent invention defense would cause potential infringers to be overly cautious in the receipt of outside information. For instance, potential infringers might set up costly "clean room" approaches in which engineers are walled off from outside information or eschew the use of certain information entirely—which, in turn, would thwart innovative activity.[85]

However, there are already strong incentives not to be labeled a "copyist," because evidence of copying can support a charge of willful infringement, indirect infringement, and simply serve to strengthen a primary charge of infringement in front of a jury.[86] Additionally, in copyright law, copying can be proved merely by demonstrating access to the copyrighted work and substantial similarity of the copied work to the copyrighted work.[87] For this reason, many software companies engage in clean-room approaches to software development.[88] If the free flow of information were a substantial economic concern, presumably such a weak test for copying would not be allowed.

As such, promoting the free-flow of technological information does not appear to answer the question of why an independent invention defense is not generally allowed in patent law. In any event, even if one subscribes to any of the evidentiary-centered views, doing so does not foreclose the possibility that the traditional, free riding, public goods theories of patent law are inadequate. In other words, both an evidentiary theory and a revised incentive theory may explain the absence of copying as an element of patent infringement.

Indeed, there are at least three major reasons why the standard incentive theory is implausible, or at least incomplete.[89] First, as noted earlier—and in contrast to copyright infringement and trade secret misappropriation—

85. *Id.* ("Technological communities thrive on ubiquitous and unregulated communication.").

86. Cotropia, *Copying*, *supra* note 14, at 1436–37 ("[T]erms such as copying come with heavy baggage . . . Allowing the use of the terms is particularly detrimental in jury cases.").

87. Mark A. Lemley & Eugene Volokh, *Freedom of Speech and Injunctions in Intellectual Property Cases*, 48 DUKE L.J. 147, 163 (1998) ("[P]laintiffs need merely show access and sufficient similarities between the two works to raise an inference of copying (and therefore of infringement)."); 4–13 NIMMER ON COPYRIGHT § 13.01 (2015) ("Legions of cases promulgate the twin requirements of access plus substantial similarity.").

88. *See generally* Mamta Garg & Manoj Kumar Jindal, *Reverse Engineering - Roadmap to Effective Software Design*, 1 INT'L J. RECENT TRENDS ENG. 186 (2009).

89. Here, I ignore criticisms that reward theory does not sufficiently account for post-invention activity, such as commercialization, and return to this issue below.

copying is not a prerequisite for patent infringement.[90] Even if a third party is completely unaware of the patent-at-issue—or even the information disclosed in the patent-at-issue—if that third party makes, uses, or sells the patented invention, it will be liable for infringement.[91] Indeed, one recent empirical study found that outside of pharmaceutical litigation, which often involves generic drug copies of branded drugs, copying was discussed in less than five percent of opinions regarding patent infringement.[92] Many believe that an even higher percentage of suits filed by non-practicing entities (NPEs), often termed "patent trolls," are against independent inventors.[93] Despite strong reasons to doubt these claims, it is incontrovertible that a sizable share of infringement does not involve copying.[94]

Second, copying is sometimes very costly, and according to several surveys, is on average a substantial fraction of the patentee's original costs of inventing.[95] In other words, although information may be nonexcludable, the use of that information in implementing a commercially viable invention is

90. Cotropia, *Copying*, *supra* note 14, at 1421 ("To infringe a copyright or trade secret, defendants must copy the protected IP from the plaintiff, directly or indirectly. But patent infringement requires only that the defendant's product falls within the scope of the patent claims.").

91. *See* Lemley, *Should Patent Infringement Require Proof of Copying?*, *supra* note 15, at 1525 ("Patent infringement is a strict liability offense."); Roger D. Blair & Thomas F. Cotter, *An Economic Analysis of Seller and User Liability in Intellectual Property Law*, 68 U. CIN. L. REV. 1, 6 (1999) ("Because patent infringement (like copyright and trademark infringement) is a strict liability tort, the patentee may enjoin the unauthorized manufacture, use, or sale of the invention, regardless of the infringer's state of mind.").

92. Cotropia, *supra* note 90, at 1458. There are a variety of reasons to question the soundness of the particular percentage of copying found in this study, but the generally claim that allegations of copying are relatively low in patent infringement suits seems quite well-founded.

93. Lemley, *Should Patent Infringement Require Proof of Copying?*, *supra* note 15, at 1532 ("But selling patents can also put them in the hands of patent trolls who use those patents to hold up independent inventors that have actually commercialized the technology."); *cf.* Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2148–49 (2013) ("One study found that, in software and computer technology, roughly 97% of patent suits are filed against independent, inventors, not copiers.").

94. *See supra* notes 90–93.

95. *See* Edwin Mansfield, Mark Schwartz & Samuel Wagner, *Imitation Costs and Patents: An Empirical Study*, 91 ECON. J. 907, 909 (1981) (finding in an empirical study that the average ratio of imitation costs to innovation costs was about 65% in various industries where products receive patent protection, but that patents only increased imitation costs on average by about 11%); Glynn S. Lunney, Jr., *Trademark Monopolies*, 48 EMORY L.J. 367, 454 (1999) (discussing the Mansfield et al. study); Glynn S. Lunney, Jr., *E-Obviousness*, 7 MICH. TELECOMM. & TECH. L. REV. 363, 401–03 (2001) (same).

frequently quite costly.[96] Moreover, a large share of essential information regarding an invention may not be codifiable, or may simply be withheld by patentee.[97] In this regard, there is no duty to update a patent disclosure once it is filed, which allows the patentee to develop trade secrets that may provide it an advantage in making, using, and improving its patented invention.[98] Thus, as a practical matter, the fruits of R&D are at least partially excludable, which on the standard approach, weakens the theoretical justification for patents. In other words, the "public goods" rationale for patents omnipresent in the economics literature does not withstand empirical scrutiny, at least as an all-encompassing explanation for patents.[99] In this regard, patents do not protect the *information* generated by inventors—rather, patents provide a right to prevent the manufacture, use, or sale of *tangible embodiments* of inventions.[100] Merely using the information within a patent document—as opposed to the patented embodiment—has never constituted infringement per se.[101] Although innovation may cost more than imitation, the difference does not

96. *See* Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 116 YALE L.J. 1742, 1758 (2007) ("But the resources used to develop and commercialize . . . information *are* rival. They cannot be used by more than one person and are often nonrenewable.").

97. *See supra* note 52.

98. Roy E. Hofer & L. Ann Fitzgerald, *New Rules for Old Problems: Defining the Contours of the Best Mode Requirement in Patent Law*, 44 AM. U. L. REV. 2309, 2337 (1995) ("There is no duty to update the best mode disclosure in an application after its filing date."); 4 ANNOTATED PAT. DIGEST § 27:14 ("After the patent issues, there generally is no duty of disclosure or duty to update the previously submitted disclosures unless the issued patent is put into a reexamination or reissue proceeding."); Engel Indus., Inc. v. Lockformer Co., 946 F.2d 1528, 1534 (Fed. Cir. 1991) ("There is no opportunity for an inventor to include subsequent improvements or modifications in an application or patent after filing.").

99. *See supra* note 12 (setting forth "public goods" rationales for the patent system).

100. *See* 35 U.S.C. § 101 (2012) ("Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."); Application of Sarkar, 588 F.2d 1330, 1333 (C.C.P.A. 1978) ("[I]nventions which Congress is constitutionally empowered to make patentable are tangible embodiments of ideas in the useful, or technological, arts.").

101. Some scholars have asserted that "patents do not protect the concrete or tangible embodiments of an invention, but rather the inventive concept behind it." Emily Michiko Morris, *Intuitive Patenting*, 66 S.C. L. REV. 61, 88 (2014). Taken literally, this claim is incorrect. Although a patent's scope may extend beyond the tangible embodiment invented *by the inventor*, patents never prevent the use of ideas or information in a patent other than in the context of making, using, or selling an embodiment of the invention, or components of such of an embodiment, or indirectly encouraging or aiding in such infringement. *See generally* Markman v. Westview Instruments, Inc., 52 F.3d 967, 980 (Fed. Cir. 1995) ("The written description part of the specification itself does not delimit the right to exclude. That is the function and purpose of claims."); SRI Int'l v. Matsushita Elec. Corp. of Am., 775 F.2d 1107, 1121 (Fed. Cir. 1985) ("Specifications teach. Claims claim.").

appear to justify particularly strong patent rights, at least on the standard, reward theory.[102]

Third, many costly and risky activities are subject to low-cost free riding but do not receive any form of IP protection.[103] For instance, if an enterprising chef opens the first Moroccan restaurant in a town and it turns out to be successful, she cannot prevent anyone else from opening up another one down the street with the same menu items, general décor, and prices.[104] This is so even if it cost as much to start the first restaurant as many forms technological R&D and its risk of failure was just as high.[105] In general, there are many other forms of information generated by commercial activity that are nonexcludable and nonrival—especially pricing and marketing information—and, hence, public goods, that the law does not protect by IP rights.[106]

Several scholars have relied heavily on these three observations to contend that the scope and length of patent protection should be much less than what is provided under current law.[107] For example, if copying is so costly, perhaps

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102. *Cf.* Kevin Rhodes, *The Federal Circuit's Patent Nonobviousness Standards: Theoretical Perspectives on Recent Doctrinal Changes*, 85 NW. U. L. REV. 1051, 1080 (1991) ("The reward theory thus predicts that standards of patentability should restrict the awarding of patents to those cases in which patent rights are absolutely necessary to foster technological innovation.").

103. *Cf.* Sichelman, *Commercializing Patents*, *supra* note 10, at 360 ("Rather, a commercializer will often need to undertake costly and risky scientific testing, market testing, market research, and marketing to determine how to commercialize an invention in the most profitable manner, generating information that—in the absence of robust patent protection—would typically be subject to free riding by others.").

104. *See* Naomi Straus, *Trade Dress Protection for Cuisine: Monetizing Creativity in a Low-IP Industry*, 60 UCLA L. Rev. 182, 186 (2012) ("Oddly, however, our current intellectual property (IP) laws provide little or no protection for the actual dishes Keller creates and serves in the restaurant."). *Cf.* Taco Cabana Int'l, Inc. v. Two Pesos, Inc., 932 F.2d 1113, 1118 (5th Cir. 1991) (where the décor of a Mexican restaurant, including "the shape and general appearance of the exterior of the restaurant, the identifying sign, the interior kitchen floor plan, the decor, the menu, the equipment used to serve food, the servers' uniform and other features reflecting the total image of the restaurant" were protectable by trade dress).

105. T.J. Jacobberger, *The Cost of Opening a Restaurant in San Francisco*, INSIDE SCOOP SF (Jan. 21, 2011), http://insidescoopsf.sfgate.com/blog/2011/01/21/the-cost-of-opening-a-restaurant (estimating that opening a restaurant in San Francisco requires about $ 2.5 million).

106. *See* Sichelman, *Commercializing Patents*, *supra* note 10, at 373 ("[M]uch commercialization is not protectable by patents, copyrights, trademarks, trade secrets, or other forms of market regulation."); Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1099 (2007) ("[S]ome forms of patent development do not entitle the original patent holders to new patents."). *See generally* Mark A. Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 129 (2004) ("Ideas are public goods: they can be copied freely and used by anyone who is aware of them without depriving others of their use.").

107. *See infra* notes 108–111 and accompanying text.

patent rights are not as important to excluding others as commonly believed.[108] Some commentators go so far as to propose that no patent protection is the optimal state of affairs;[109]others simply argue that patent law does not apply particularly well in areas such as software.[110] Regarding the view that patent protection should be weakened, the relatively free market is often a better means of promoting technological innovation than "enclosing" it in property-based confines.[111]

The major theoretical response to critiques suggesting that the patent system be weakened or abolished has mainly been to accept the reward theory and refine its premises. One line of argument admits that copying may be costly on average, but cautions that it is still less than the original cost of invention, especially in certain technological fields.[112] Yet, these arguments clearly counsel for weaker patent protection relative to its theoretical

108. *See supra* note 102.

109. *See* Michele Boldrin & David Levine, *The Case Against Intellectual Property*, 92 AM. ECON. REV. 209, 209 (2002) ("'[I]ntellectual property' has come to mean not only the right to own and sell ideas, but also the right to regulate their use. This creates a socially inefficient monopoly, and what is commonly called intellectual property might be better called 'intellectual monopoly'."); MICHELE BOLDRIN & DAVID LEVINE, AGAINST INTELLECTUAL MONOPOLY (2008) ("[W]ithout patents we would have more, not less, marvelous machines and inventions…[P]atent law is largely the unwelcome consequence of competitive innovation and poor legislation, and not the source of innovation at all.").

110. *See* Pamela Samuelson, Randall Davis, Mitchell D. Kapor & Jerome H. Reichman, *A Manifesto Concerning the Legal Protection of Computer Programs*, 94 COLUM. L. REV. 2308, 2343 (1994) ("The dual character of computer programs—which are both writings and machines at the same time—has presented some difficulties for those wanting to use patent law as a means of legal protection for software innovations."); Burk & Lemley, *Policy Levers in Patent Law*, *supra* note 50, at 1622–23 ("Software patents are important, but the relatively low fixed costs associated with software development, coupled with other forms of overlapping intellectual property protection for software, mean that innovation in software does not depend critically on strong, broad protection.").

111. James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, LAW & CONTEMP. PROBS., Winter/Spring (2003) (likening patents to a "second enclosure movement" analogous to that of real property and challenging the need for such enclosure); Michele Boldrin & David K. Levine, *Against Intellectual Monopoly*, 21 SYRACUSE SCI. & TECH. REP., 130 (2009). *Cf.* J.H. Reichman & Jonathan A. Franklin, *Privately Legislated Intellectual Property Rights: Reconciling Freedom of Contract with Public Good Uses of Information*, 147 U. PA. L. REV. 875, 966 (1999) ("We should not give entrepreneurs legal monopolies (or contractual equivalents) to undertake investments they would make anyway, in their own business interests, because the social costs of such monopolies in lessened competition and other negative collateral effects are almost certain to outweigh the benefits.").

112. *See, e.g.*, David S. Olson, *On NPEs, Holdups, and Underlying Faults in the Patent System*, 99 CORNELL L. REV. ONLINE 140, 148 (2014) ("If the costs of copying are very low, patents may be needed to prevent appropriation of the value of invention without bearing any of the costs.").

baseline.[113] Another approach is to distinguish technological from non-technological innovation on the grounds that technological innovation is more costly and risky (as well as more socially valuable). For example, designing, developing, testing, and marketing a new cancer treatment is much costlier and riskier than creating an innovative restaurant entrée. Relatedly, some scholars argue that adopting an independent invention defense would, generally speaking, weaken overall incentives to innovate.[114] Yet, these "strong" patents rebuttals do not explain exactly why greater incentives are in fact—as an empirical matter—necessary to promote optimal levels of innovation. Nor do they explain how patent law's premise of preventing free riding interacts with the imposition of necessary limits to patent protection.[115] Indeed, on an unbounded strong patents theory, patents would last forever.[116] Rather, meaningful explanations of the boundaries of patent protection are essential to a coherent theory of patent law.[117]

To be certain, several scholars have rejected the standard reward theory of patent law.[118] These approaches primarily rely on—or respond to—Edmund Kitch's "prospect theory," likening patents to historical mineral claim rights, which allowed prospectors to exclude others as they mined their discovered

113. *See id.*

114. *See supra* note 23 and accompanying text; Lemley, *supra* note 23, at 1528 ("[If] an independent invention defense would significantly reduce the incentives to innovate, the potential losses for society are substantial.").

115. *See infra* Section III.A (discussing the ways in which competition may promote innovation).

116. *Cf.* William M. Landes & Richard A. Posner, *Indefinitely Renewable Copyright*, 70 U. CHI. L. REV. 471, 471 (2003) (raising "questions concerning the widely accepted proposition that economic efficiency requires that copyright protection should be limited in its duration").

117. *See infra* Part III.

118. *See, e.g.*, Edmund W. Kitch, *The Nature and Function of the Patent S*ystem, 20 J.L. & ECON. 265, 275–80 (1977); F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 707–12 (2001); John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 443–47 (2004) [hereinafter Duffy, *Rethinking Prospect Theory*]; Michael Abramowicz & John Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337 (2008); F. Scott Kieff & Troy A. Paredes, *An Approach to Intellectual Property, Bankruptcy, and Corporate Control*, 82 WASH. U. L.Q. 1313, 1319 (2004) ("[T]he reward theory fails to explain much of the positive IP law framework."); Ted Sichelman, *supra* note 106, at 364–65 (arguing the reward theory is to blame for under-commercialization); Ted Sichelman, *Markets for Patent Scope*, 1 IP THEORY 42−43 (2010) (cataloguing various scholars who have rejected standard reward theory). Because this article is focused on innovation incentives in an economic context, I do not discuss non-utilitarian theories of patent law. *See, e.g.*, ROBERT P. MERGES, JUSTIFYING INTELLECTUAL PROPERTY (2011); Tom G. Palmer, *Are Patents and Copyright Morally Justified? The Philosophy of Property Rights and Ideal Objects*, 13 HARV. J.L. & PUB. POL'Y 817 (1990); Justin Hughes, *The Philosophy of Intellectual Property*, 77 GEO. L.J. 287 (1988).

vein of minerals.[119] According to Kitch, the "prospect" that patents protect is "a particular opportunity to develop a known technological possibility . . . shortly after its discovery."[120] Prospect theory encompasses two major theoretical prongs.[121] The first is that post-invention commercialization is costly and subject to free riding.[122] In other words, patents in practice do not only incentivize invention but also commercialization of invention.[123]

However, as Michael Burstein has noted, this insight merely expands the traditional reward theory to cover commercialization as well as invention.[124] As such, this prong does not reject the core free-riding premise of reward theory.[125] Yet, it may help to explain why independent invention is not a defense to patent infringement—namely, independent inventors may free ride not off the invention itself, but rather the post-invention commercialization activity of the original inventor, such as regulatory approval, marketing, and the like.[126] Although "commercialization theories" of patents provide a theoretical justification for the lack of an independent *invention* defense, then why not adopt an independent invention *and* commercialization defense?[127] In

119. Kitch, *supra* note 118, at 266, 271–75.

120. *Id.* at 265–67.

121. *See id.* at 276.

122. *See id.* ("[T]he patent owner has an incentive to make investments to maximize the value of the patent without fear that the fruits of the investment will produce unpatentable information appropriable by competitors.").

123. *See* Kieff, *supra* note 118, at 703 ("[T]he treatment of patents as property rights is necessary to facilitate investment in the complex, costly, and risky commercialization activities required to turn nascent inventions into new goods and services."); Sichelman, *Commercializing Patents*, *supra* note 10.

124. Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEXAS L. REV. 227, 241 (2012) ("[C]ommercialization theorists have successfully focused attention on a more nuanced model of the innovation process than that which underlies the classical incentive or reward theory."). *See also* Michael J. Burstein, *Reply–Commercialization Without Exchange*, 92 TEX. L. REV. 45, 46 (2014) ("To the extent that [commercialization theory] focuses on incentives to commercialize, those incentives are part and parcel of the broader incentives-based theory of intellectual property and subject to that theory's well-developed critiques.").

125. *See id.*

126. *See* Sichelman, *Commercializing Patents*, *supra* note 10; *see also* Ted Sichelman, *Commercializing Information with Intellectual Property*, 92 TEX. L. REV. 35, 42 (2014) ("The multi-faceted nature of technological information exchange arguably does little to protect commercializers against appropriability concerns in activities such as market testing and marketing, distribution, and commercial improvements, because unlike technological information, it appears most commercial information is fairly homogeneous and nonexcludable.").

127. *See generally* Sichelman, *Commercializing Patents*, supra note 118, at 343–44 (noting that firms that are more efficient than the inventor may undertake "independent commercialization efforts").

any event, because of commercialization theory's mooring to free riding, it does not provide a sufficiently generalized theory of patent law.[128]

The second prong of prospect theory asserts that having a single owner over a broad technological prospect via a strong patent right promotes efficient commercialization and further development of the invention.[129] Specifically, patents as prospects allow the patentee to effectively coordinate other actors who provide inputs into commercialization and follow-on invention as well as to send signals to potential competitors not to undertake such efforts, which reduces duplicative efforts and overall "rent dissipation."[130] This "efficient coordination" aspect of prospect theory provides a coherent theoretical reason why patent law extends beyond free riding, whether in the invention or commercialization phase.[131] Specifically, if infringement were coupled to copying, a patentee would not be able to efficiently coordinate post-invention activity because third-party "independent" inventors could intervene

128. *See also infra* notes 135–139 and accompanying text (discussing further limitations of the standard account of commercialization theory).

129. *See* Kitch, *supra* note 118, at 276 ("Once a patent has been issued, other firms can learn of the innovative work of the patent holder and redirect their work so as not to duplicate work already done."); *see also* Dep't of Justice & Fed. Trade Commission, Antitrust Guidelines for the Licensing of Intellectual Property § 2.3 (1995) ("Licensing . . . can facilitate integration of the licensed property with complementary factors of production. This integration can lead to more efficient exploitation of the intellectual property, benefiting consumers . . . [L]icensing also can increase the incentive for [IP] creation and thus promote greater investment in research and development.").

130. Rent dissipation generally refers to "erosion of profits due to another firm . . . competing in the product market," often in a manner that can suboptimally diminish incentives to innovate. *See* ASHISH ARORA, ANDREA FOSFURI & ALFONSO GAMBARDELLA, MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY 179–82 (2001). In this regard, some studies indicate that "patent races" induce too many market actors to duplicate each other's R&D efforts. *See generally* Luís Cabral, *Bias in Market R&D Portfolios*, 12 INT'L J. INDUS. ORG. 533 (1994); Partha Dasgupta, *The Welfare Economics of Knowledge Production*, 4 OXFORD REV. ECON. POL'Y 8 (1988); Partha Dasgupta & Eric Maskin, *The Simple Economics of Research Portfolios*, 97 ECON. J. 581 (1987); Joseph Zeira, *Innovation, Patent Races, and Endogenous Growth* (Kennedy Sch. of Gov't Faculty Research Working Paper Series, Working Paper No. RWP02-047, 2002), http://ksgnotes1.harvard.edu/Research/wpaper.nsf/rwp/RWP02-047$File/rwp02_047_zeira.pdf; Urs Fischbacher & Christian Thöni, *Excess Entry in an Experimental Winner-Take-All Market* (Zurich Inst. for Empirical Research in Econ., Working Paper No. 86, 2002), http://ssrn.com/abstract=282729. Yet, other studies indicate the benefit of multiple different entities competing to produce a given innovation. *See infra* note 305.

131. *See* Lemley, *supra* note 20, at 1531 (recognizing that if patents serve an important role in coordinating follow-on invention, then such coordination would be thwarted by an independent invention defense).

in the coordination process.[132] More generally, third-party intervention thwarts "markets for technology," including the assignment and licensing of the patent[133]—selling a non-exclusive right is arguably more difficult than selling an exclusive one.[134]

As a legal matter, a broad prospect patent cannot foreclose third parties from patenting improvements to the patent, which as John Duffy explains, "undermine[s] the ability of a prospect patent holder to . . . coordinat[e] and contro[l] further investment in the innovation."[135] The ability of the patentee to coordinate parties efficiently is often dubious given high transaction costs in licensing in many fields.[136] Additionally, many inventive firms, especially large ones, commercialize their inventions without any input from third parties, obviating the need for coordination.[137] Moreover, the empirical evidence in favor of Kitch's coordination model is generally lacking.[138] Although Kitch's model may apply to certain industries, such as biotechnology, it does not fully explain why patent law has eschewed

132. *See id.*; Kitch, *supra* note 118, at 277–78 ("[A] patent system lowers the cost of the owner of technological information of contracting with other firms possessing complementary information and resources.").

133. ARORA ET AL., *supra* note 130; Robert P. Merges, *Intellectual Property and the Cost of Commercial Exchange: A Review Essay*, 93 MICH. L. REV. 1570, 1590–91 (1995) (recognizing that patents can lower transaction costs in markets for technology).

134. *See* Lemley, supra note 20, at 1531 ("In comparison, it is harder (though admittedly not impossible) to sell trade secrets, in part because there is no guarantee that the buyer will have any exclusivity.").

135. Duffy, *Rethinking Prospect Theory*, *supra* note 118, at 442–43.

136. Robert P. Merges, *Rent Control in the Patent District: Observations on the Grady-Alexander Thesis*, 78 VA. L. REV. 359, 374 (1992) ("A substantial literature documents the steep transaction costs of technology licensing."); Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473 (2005). *See also* Peter S. Menell & Suzanne Scotchmer, *Intellectual Property*, *in* 2 HANDBOOK OF LAW AND ECONOMICS 1473, 1503 (A. Mitchell Polinsky & Steven Shavell eds., 2008) ("Kitch was the earliest, and perhaps most extreme, licensing optimist."). *See generally* RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 34 (7th ed. 2007) ("[T]he costs of effecting a transfer of rights—transaction costs—are often prohibitive, and when this is so, giving someone the exclusive right to a resource may reduce rather than increase efficiency.").

137. *See* Teece, *supra* note 74 (describing how large firms generally possess the complementary assets necessary to commercialize their own inventions).

138. *See* Duffy, *Rethinking Prospect Theory, supra* note 118; Sichelman, *Commercializing Patents*, *supra* note 10; Merges & Nelson, *supra* note 25, at 870–72; Donald G. McFetridge & Douglas A. Smith, *Patents, Prospects, and Economic Surplus: A Comment*, 23 J.L. & ECON. 197 (1980); Roger Beck, *The Prospect Theory of the Patent System and Unproductive Competition*, 5 RSCH. L. & ECON. 193 (1983).

"independent invention" as a general defense to infringement.[139] Notably, even if the coordination prong of prospect theory turns out to be correct, it does not foreclose a complementary, reward-based theory that explains why independent invention should not generally be a defense to infringement.

One response to the limitations of prospect theory's coordination prong is "rent dissipation" theory, primarily advanced by Mark Grady and Jay Alexander, later refined by Duffy and others.[140] Like Kitch, rent dissipation theorists are concerned with the possibility that the social value of the innovation in excess of one innovator's R&D costs may be eroded by multiple innovators racing to conceive of the invention in the first instance, improve it, or potentially keep it secret.[141] Unlike Kitch, Grady and Alexander do not always view broad patent protection as optimal—for instance, a socially valuable invention that is already perfect, with no possibility for technological improvement—or can only be improved in obvious ways—should not necessarily be patentable.[142] Such an invention provides no signal for later improvements, and patent protection in the form of large rents would merely induce a race among many innovators, leading to duplicated R&D costs that could dissipate all of the social value associated with the invention.[143] Grady and Alexander suggest that their view better explains the case law of patentable

139. *See* Ted Sichelman & Stuart J.H. Graham, *Patenting by Entrepreneurs: An Empirical Study*, 17 MICH. TELECOMM. & TECH. L. REV. 111, 164 (2010) ("Specifically, biotechnology firms place much greater emphasis on patenting to obtain licensing revenue than all other firms, including medical device, (venture-backed) hardware, and software and Internet firms (with these latter segments all roughly clustered together in their rankings)"). Another sector that arguably fits this model is university patenting. The Bayh-Dole Act, which allows universities to patent technology that would arguably have been invented absent the patent system, is premised upon a prospect-style, *ex post* view of patents. *See* Jerry Thursby & Marie Thursby, *Knowledge Creation and Diffusion of Public Science with Intellectual Property Rights* 7 (2007), http://mgt.gatech.edu/directory/faculty/thursby_m/pubs/thursby_thursby_2007.pdf ("[T]he argument pertains not to ex ante incentives for invention, but to incentives ex post for downstream users to invest in commercialization of federally funded inventions."); DAVID C. MOWERY, RICHARD R. NELSON, BHAVEN N. SAMPAT & ARVIDS A. ZIEDONIS, IVORY TOWER AND INDUSTRIAL INNOVATION 59, 86–87 (2004).

140. Grady & Alexander, *supra* note 75; Duffy, *supra* note 118. *See also* Robert P. Merges, *Comment, Rent Control in the Patent District: Observations on the Grady-Alexander Thesis*, 78 VA. L. REV. 359 (1992); McFetridge & Smith, *supra* note 138.

141. *See* Grady & Alexander, *supra* note 140, at 308–09 (positing various forms of rent dissipation).

142. *See id.* at 321–22 ("Inventions with little potential for further improvement are still less likely to receive patents because the prospect of a rent-dissipating race among improvers is unlikely.").

143. *See id.*

subject matter and obviousness, in which seemingly valuable and original inventions are denied patent protection.[144]

As an initial matter, I argue below that rent dissipation theory's implicit assumption that there are always multiple innovators ready to race is not correct. Many inventions are not ideas waiting to be developed, but rather ideas in themselves, only known to the inventor.[145] Moreover, even if the idea is generally known, often innovation markets are illiquid because only one or a few firms can tool up fast enough to develop and commercialize the innovation.[146] These temporal barriers may substantially limit the amount of rent dissipation in R&D races.[147] Moreover, Duffy suggests that Grady and Alexander (as well as Kitch) overlook an important beneficial feature of broad patent protection—inducing inventors to invent *earlier* than they otherwise would have.[148] On Duffy's view, the acceleration of invention and the concomitant acceleration of patent expiration tend to outweigh any cost from rent dissipation.[149]

Despite these limitations, rent dissipation certainly plays a significant role in many R&D processes.[150] Moreover, rent dissipation theory could provide a reason why patent infringement reaches independent activity—namely, the broader the reach of a patent, the more likely it is to deter duplicated efforts, thereby reducing dissipated rents.[151] Yet, previous rent dissipation theorists either assumed that patents were premised on a free riding rationale, or simply abstracted away from the issue.[152] Additionally, as Grady and Alexander make

144. *See id.* Parts IV–VI. For instance, Grady and Alexander explain why the Supreme Court invalidated the highly commercially successful plow shank in Graham v. John Deere on the ground that no further improvements could be made to it, thus solving the apparent puzzle of why the Court essentially ignored its success in making its finding of obviousness. *See id.* at 345–46.

145. *See id.*

146. *See id.*

147. *See id.*

148. Duffy, *supra* note 118, at 443–44.

149. *See id.* at 443–47, 465 ("The prospect features of the patent system are useful not because they eliminate competitive rent dissipation, but because they channel rent-seeking behavior into the third form of rent dissipation—early patenting—which is socially desirable because it dissipates private but not social rents.").

150. *See, e.g.*, Matthew Erramouspe, *Staking Patent Claims on the Human Blueprint: Rewards and Rent-Dissipating Races*, 43 UCLA L. REV. 961, 975 (1996) (presenting evidence of rent dissipation in the field of biotechnology).

151. *Cf.* Grady & Alexander, *supra* note 140, at 347–49 (exploring the role of rent dissipation and patent infringement doctrine).

152. *See id.* at 312 ("We have no quarrel with this version of reward theory and accept it as an inevitable justification for the patent system."); Duffy, *supra* note 118, at 440–42 (noting that both the reward and prospect theories are grounded on the threat of potential appropriation).

clear, sometimes narrower patent protection reduces rent dissipation, because an invention may not signal broad improvements.[153] Thus, any explanatory power of rent dissipation regarding why independent invention should not be countenanced would need to turn on fact-specific inquiries and fine empirical distinctions, which, like coordination theory, are generally lacking in the literature.[154] And, like coordination theory, rent dissipation theory does not foreclose a complementary, reward theory-grounded explanation of why patent infringement should generally encompass independent invention.

In sum, other than for evidentiary reasons, the dominant theories of patenting, from reward theory to commercialization theory to rent-dissipation theory, do not adequately explain—theoretically and empirically—why patent law does not operationalize its free-riding premise. These shortcomings present the question of whether another theory can account for the absence.

III. PATENTS AS HEDGES AGAINST COMPETITION

A. BEYOND FREE RIDING AS THE FUNDAMENTAL ORGANIZING PRINCIPLE FOR PATENTS

1. The Economic Role of Competitive Risk in Innovation Markets

Using the work of Joseph Schumpeter and others in the field of industrial organization as a starting point, I offer a novel explanation of why patent law extends beyond copying that applies to both pre- and post-invention activity. Specifically, I contend that the free-riding theory of patent law is a subset of a more general category of behavior—namely, market competition—that threatens optimal levels of innovation. As I explain further below, patents are a "hedge"—specifically, a real put option[155]—to reduce the risk of competition

153. *See id.* at 348 (explaining why narrow patent scope can reduce rent dissipation).

154. *See supra* notes 137–139 and accompanying text. Indeed, rent dissipation models are consistent with a regime in which multiple innovators are simultaneously awarded patents. *See* Maurer & Scotchmer, *supra* note 20, at 540–42; Manfredi La Manna, Ross Macleod, & David De Meza, *The Case for Permissive Patents*, 33 EUR. ECON. REV. 1427 (1989).

155. As explained further below, a put option provides its holder the right, but not the obligation, to sell an underlying asset at a specified price (the strike price) within a certain period of time (before the expiration date). If the holder of the put option believes the price of the underlying asset is going to fall, they can use the put option as a hedge against that potential loss. *See generally* JOHN C. HULL, OPTIONS, FUTURES, AND OTHER DERIVATIVES (9th ed. 2015). In the context of patents, the asset is the profit stream derived from selling a unique product at a supernormal price, the value of which may diminish from potential competition. The patent is a "real" put option that allows its holder to elect to foreclose competition through an injunction or force an infringing competitor to pay the patentholder prior to patent expiration, thereby diminishing the risk from competition. *See also infra* notes 271–275 and accompanying text.

that could otherwise diminish a patentee's (or its licensees') supernormal profits derived from first-mover advantages and other barriers to entry, such as complementary assets, access to capital, marketing muscle, production capabilities, and distribution networks.[156]

My approach draws on the work of economists, particularly Schumpeter and his followers, who have espoused the view that dampening competition can promote innovation.[157] In this regard, Schumpeter casually remarked that patents act as a form of insurance or a "hedg[e]" for investment under "rapidly changing conditions."[158] Specifically, he contended that:

> The main value to a concern of a single seller position that is secured by patent or monopolistic strategy does not consist so much in the opportunity to behave temporarily according to the monopolist schema, as in the protection it affords against temporary disorganization of the market and the space it secures for long-range planning.[159]

However, Schumpeter and others have not explained in suitable detail how patents work generally to suppress competition, rather than merely free riding, in order to induce innovation.[160] Indeed, much of Schumpeter's and related work focuses on the pernicious effects of imitation.[161] Thus, while the industrial organization literature has envisioned patents as forms of legal monopoly that often confer market power,[162] these descriptions have not

156. *See* Ashish Arora & Marco Ceccagnoli, *Patent Protection, Complementary Assets, and Firms' Incentives for Technology Licensing*, 52 MGMT. SCI. 293 (2006); David J. Teece, *Profiting from Technological Innovation*, 15 RES. POL'Y 285 (1986).

157. SCHUMPETER, CAPITALISM, *supra* note 30; Philippe Aghion, Nick Bloom, Richard Blundell, Rachel Griffith & Peter Howitt, *Competition and Innovation: An Inverted-U Relationship*, Q.J. ECON. 701, 703 (2005) (engaging in empirical analysis of the relationship between innovation and competition partly based on Schumpeter's theory).

158. SCHUMPETER, CAPITALISM, *supra* note 30, at 87–88.

159. *Id.* at 102–03 (describing patents as a "restrictive practice[]" that diminishes competition).

160. *See id.* Indeed, many economists use the number of granted patents to estimate the interaction between competition and innovation. *See* Aghion, *supra* note 157, at 703. However, because patents play a direct role in suppressing competition, and patented inventions are infrequently commercialized, these studies are subject to significant endogeneity and identification problems.

161. SCHUMPETER, CAPITALISM, *supra* note 30, at 81–106.

162. It is important to distinguish a legal monopoly, which is some legal right that allows its holder to exclude third parties that make, use, sell, or perform some other action with respect to the subject matter of the monopoly, and an economic monopoly, which generally is market power so strong that its holder can price its products falling within the scope of a legal monopoly well above marginal cost (including opportunity costs). Legal monopolies, like

suitably explained why legal intervention to suppress competition *per se*—intervention well beyond preventing free riding and associated public goods problems—is necessary to foster innovation.[163] Nor has the industrial organization literature recognized the precise form of patents as "put" options; instead, wrongly labeling patents as "call" options to exclusively commercialize (or license) an invention.[164] As is well recognized in the legal literature, patents afford negative rights to exclude others, not positive rights to exclusively practice the invention.[165]

In this Section, I focus on the claim that optimally incentivizing technological innovation requires suppressing competition beyond the scope of free riding and the related public goods problem. The argument proceeds in three steps. The first step is the well-known fact that much technological innovation often yields social benefits far in excess of private benefits.[166] In

patents, may – but frequently do not – confer an economic monopoly. Economists are often quick to "correct" legal scholars who refer to patents as "monopolies," but the original usage of "monopoly" was indeed the legal monopoly variant, not the economic one. *See generally* HAROLD G. FOX, MONOPOLIES AND PATENTS: A STUDY OF THE HISTORY AND FUTURE OF THE PATENT MONOPOLY 24–26 (1947) (discussing origins of word "monopoly"). A review of the oldest references of the term "monopoly" in Google Books confirms as much.

163. *See generally* Peter Lee, *Reconceptualizing the Role of Intellectual Property Rights in Shaping Industry Structure*, 72 VAND. L. REV. 1197, 1205 (2019) (describing the traditional public goods and free riding approaches of economic and industrial organization theory to patents).

164. *See supra* notes 38–39.

165. See Adam Mossoff, *Exclusion and Exclusive Use in Patent Law*, 22 HARV. J.L. & TECH. 321, 327 (2009) (explaining that a patent provides the right to exclude, but not "the affirmative right to make, use, or sell"); 5 DONALD S. CHISUM, CHISUM ON PATENTS § 16.02[1] (2008); Abrahamowitz, Baudry & Bloom, *supra* note 38.

166. *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1587 (2003) ("It is well established that the social returns to innovation exceed the private returns."); Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 268 (2007) ("There is no question that inventions create significant social benefits beyond those captured in a market transaction."); Nestor E. Terleckyj, *Effects of R&D on the Productivity Growth of Industries: An Exploratory Study* (Nat'l Planning Ass'n, Report No. 140, 1974); M. Ishaq Nadiri, *Innovations and Technological Spillovers* (Nat'l Bureau of Econ. Research, Working Paper No. 4423, 1993), https://www.nber.org/system/files/working_papers/w4423/w4423.pdf; Edwin Mansfield, John Rapoport, Anthony Romeo, Samuel Wagner & George Beardsley, *Social and Private Rates of Return from Industrial Innovations*, 91 Q.J. ECON. 221, 233–34 (1977); Leo Sveikauskas, *Technology Inputs and Multifactor Productivity Growth*, 63 REV. ECON. & STAT. 275, 277 (1981); Akira Goto & Kazuyuki Suzuki, *R&D Capital, Rate of Return on R&D Investment and Spillover of R&D in Japanese Manufacturing Industries*, 71 REV. ECON. & STAT. 555, 563 (1989); Jeffrey I. Bernstein & M. Ishaq Nadiri, *Interindustry R&D Spillovers, Rates of Return, and Production in High-Tech Industries*, 78 AM. ECON. REV. 429 (1988); Frederick Scherer; Jeffrey Bernstein & M. Ishaq Nadiri, *Product Demand, Cost of Production, Spillovers, and the Social Rate of Return to R&D* 4 (Nat'l Bureau of Econ. Research, Working Paper No. 3625, 1991); *see* Using Linked Patent and R&D Data to Measure Interindustry Technology Flows, *in* R&D, PATENTS, AND

this regard, public goods typically confer substantial positive externalities, and while I argued earlier that innovative products and services are not pure public goods, the information embodied in innovations partakes of attributes of traditional public goods.[167] Like public parks or educational institutions, innovations like the computer, automobile, and penicillin provide benefits well beyond the private value captured by the inventors and commercializers of these products.[168] When private returns are substantially less than social returns, often society must—typically via government intervention in the market—take action to ensure that the optimal level of valuable innovative activity occurs.[169]

The second step involves an elementary proposition of economics: in order for a rational market actor to engage in costly and risky activity, it must earn a suitable risk-adjusted return on its investment in time, money, and other resources.[170] For a nearly riskless activity, such as depositing money into

PRODUCTIVITY 450 (Zvi Griliches ed., 1984); *see also* Zvi Griliches, *The Search for R&D Spillovers*, 94 SCANDINAVIAN J. ECON. 29, 43 (Supp. 1992) ("In spite of [many] difficulties, there has been a significant number of reasonably well done studies all pointing in the same direction: R&D spillovers are present, their magnitude may be quite large, and social rates of return remain significantly above private rates.").

167. Brett M. Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINN. L. REV. 917, 967 (2005)("[T]he production of public goods has the potential to generate positive externalities for nonpaying consumers (incidental beneficiaries or free riders), and the production of nonmarket goods generates diffuse positive externalities, often realized by nonparticipants or nonconsumers."). *See supra* note 12.

168. PAUL N. EDWARDS, *From "Impact" to Social Process: Computers in Society and Culture*, *in* HANDBOOK OF SCIENCE AND TECHNOLOGY STUDIES 257 (Sheila Jasanoff et al. eds., 2011) (assessing the societal impact of computers); H.B. Brown, *The Status of the Automobile*, 17 YALE L.J. 223 (1908) (assessing the impact of the introduction of automobiles in society); W. Brian Arthur, *The Structure of Invention*, 36 RSCH. POL'Y, 274 (2007) (describing commonalities among how radical novel technologies come into being, including the invention of penicillin).

169. *See* Bronwyn H. Hall, *The Private and Social Returns to Research and Development*, *in* TECHNOLOGY, R&D, AND THE ECONOMY 140, 140 (1996) (explaining that "[t]he principal argument for government intervention in industrial innovation has always been the potential gap between the private and social returns to innovative activity").

170. *See* JOHN CRAVEN, INTRODUCTION TO ECONOMICS: AN INTEGRATED APPROACH TO FUNDAMENTAL PRINCIPLES 248 (Basil Blackwell ed., 1984) (stating that rewards must be commensurate with risks to induce firms to act); Lemley, *Free Riding*, *supra* note 12, at 1050 ("economic theory properly requires . . . the capture of returns sufficient to recoup the investment"); Kapczynski & Syed, *supra* note 53, at 1908 ("Conventional economic actors will only produce a good when they can appropriate sufficient returns to recoup the capitalized costs of providing the good."). In some instances, innovators are motivated by non-economic considerations, but surely these motivations are insufficient to motivate the socially optimal level of innovation.

savings accounts, the returns are very low—sometimes, close to zero.[171] On the other hand, venture capitalists—who invest in startups, which tend to fail at a rate of 80% or higher—often look for ten-fold or greater returns on their investments.[172]

Ordinary market activity in equilibrium typically demands normal, competitive returns, but not supernormal returns, because the risk undertaken is precisely "normal," that is, ordinary given the opportunity costs relative to available alternatives. For instance, if I open a nondescript coffee and donut cart on a street corner in a metropolitan area because I see lines at similar stands nearby, I am likely in the short-run to earn an ordinary, competitive return. In this instance, I undertake ordinary risk that other coffee and donut carts will pop up, crowding out my revenues and profits,[173] but presumably startup and entry costs are low, and I can at least earn most of these fixed costs back with a "first-mover" advantage before additional carts appear.[174] I may even engage in some mild form of innovation by adding new snacks or drinks to maintain profits, which other cart vendors may imitate.[175] Additionally, if there is too little profit with more coffee carts on the street—especially when they add my new snacks to their menus—I know the newcomers will likely exit before I do during this period of "shakeout," in which some firms will leave the market from an inability to earn sufficient profit.[176] In the long run,

171. For historical rates of treasury bills, see *Interest Rate Statistics*, U.S. DEP'T TREASURY, https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/Historic-LongTerm-Rate-Data-Visualization.aspx (last visited June 11, 2023).

172. Benjamin E. Gaddy, Varun Sivaram, Timothy B. Jones & Libby Wayman, *Venture Capital and Cleantech: The Wrong Model for Energy Innovation*, 102 ENERGY POL'Y 385, 390 (2017) (showing failure rates of 75-90% among venture capital backed startups in software, medical technologies, and cleantech). *See* Colin M. Mason & Richard T. Harrison, *Is it worth it? The rates of return from informal venture capital investments*, 17 J. BUS. VENTURING 211 (2002); *see also* Tyzoon T. Tyebjee & Albert V. Bruno, *A Model of Venture Capitalist Investment Activity*, 30 MGMT. SCI. 1051 (1984) (describing a five-step process used by venture capitalists in risk assessment).

173. *See* ALEXANDER ELDER, COME INTO MY TRADING ROOM 59 (2002) ("Imagine you're . . . running a fruit and vegetable stand. You take a risk each time you buy a crate of tomatoes. If your customers do not buy them, that crate will rot on you. That's a normal business risk.").

174. *See* SCHUMPETER, CAPITALISM, *supra* note 30, at 88 ("Every successful corner may spell monopoly for the moment.").

175. *See generally* Toshihiko Mukoyama, *Innovation, Imitation, and Growth with Cumulative Technology*, 50 J. MONETARY ECON. 361 (2003) (discussing the interaction of innovation with imitation).

176. *See generally* Steven Klepper, *Entry, Exit, Growth, and Innovation over the Product Life Cycle*, 86 AM. ECON. REV. 562, 565 (1996) (describing typical industry lifecycle patterns).

the market will enter equilibrium, and I will earn ordinary, competitive profits.[177]

Thus, *ordinary* market activity—even if it is costly, risky, and subject to free riding—will typically not require supernormal returns to induce it.[178] Moreover, the level of private production of ordinary market activity will generally be optimal, because the social gains from this activity tend not to exceed the private gains, at least by much.[179] As such, intellectual property rights or other regulatory exclusivities (other than perhaps trademarks to prevent consumer confusion) are generally unnecessary to promote ordinary market activity, at least in equilibrium.[180]

Technological innovation, on the other hand, has a much higher failure rate,[181] and thus presents much greater risk than ordinary market activity.[182] This includes technological, regulatory, and commercial risk.[183] For instance,

177. *See generally* Kenneth J. Arrow & Gerard Debreu, *Existence of an Equilibrium for a Competitive Economy*, 22 ECONOMETRICA 265 (1954) (providing "proofs" of equilibrium in an integrated model of production, exchange, and consumption).

178. *See* Ted M. Sichelman, *Taking Commercialisation Seriously*, 33 EUR. INT. PROP. REV. 200, 201 (2011) ("[A]lthough the manufacture and sale of non-innovative, ordinary commercial products, such as paper clips, will involve risks—generally, only ordinary returns are needed to induce a commercializer to take those risks.").

179. *Cf.* Richard R. Nelson, *The Simple Economics of Basic Scientific Research*, 67 J. POL'Y ECON. 297 (1959) (explaining that scientific R&D is different from most other economic endeavors in that the social value it produces exceeds the benefits its producers can capture in the market).

180. *See supra* note 169.

181. A study estimated that one-third of all new technological product launches fail. Robert G. Cooper & Elko J. Kleinschmidt, *New Products: What Separates Winners from Losers*, 4 J. PROD. INNOV. MGMT. 169, 170, 174 (1987). Of course, many fewer products make it from the lab to the store shelf. Sichelman, *Commercializing Patents*, *supra* note 10, at 360–61 ("[P]roduct innovation is plagued by high risks: both the large amounts at stake and the high probability of failure" (internal citations omitted).

182. *See generally* Emmett Eldred & Michael McGrath, *Commercializing New Technology-I*, 40 RSCH. TECH. MGMT. 41, 45 (1997) (describing how the development of new technology entails more uncertainty than usual product development); Mariana Mazzucato & Massimiliano Tancioni, *Innovation and Idiosyncratic Risk: An Industry- and Firm-level Analysis* 17 INDUST. & CORP. CHANGE 789 (2008) (finding a statistically significant relationship between firm-level R&D intensity and firm-level volatility of returns); Gerard J. Wedig, *How Risky is R and D? A Financial Approach*, 72 REV. ECON. & STAT. 296, 303 (1990) (concluding as an empirical matter that investment in R&D is riskier than in other assets).

183. *See* Thomas M. Jorde & David A. Teece, *Rule of Reason Analysis of Horizontal Arrangements: Agreements Designed to Advance Innovation and Commercialize Technology*, 61 ANTITRUST L.J. 579, 583 (1993) ("[C]ommercialization is both costly and risky, perhaps even more so than R&D activity."); Eldred & McGrath, *supra* note 182, at 41 ("Realizing the promise of new technologies through their commercialization into new products is far from

in the pharmaceutical industry, roughly only one in 5,000 compounds screened at the discovery phase ultimately are approved for commercial use.[184] Of course, not all innovation is equally risky—for example, minor changes to an existing software application may be relatively straightforward.[185] Yet, when compared to other forms of investment in the market, innovative technological activity tends to be riskier.[186]

Thus, on average, for technological innovation to be undertaken, innovators will generally require higher returns than those generated by ordinary market activity.[187] Will the market provide such returns? At first glance, one might argue that if market players in a risky industry require greater returns, they will price accordingly so that their profit is commensurate with the risk undertaken. Otherwise, these market actors will exit the market.[188] Thus, in equilibrium, although some industries are riskier than others, the riskier industries will earn greater profits on average than in other industries—but still *normal* profits from a competition perspective.[189]

However, like rent dissipation theories, this neoclassical model of raising prices to account for greater risk assumes that potential innovators are roughly

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easy."); Josh Lerner, *The Returns to Investments in Innovative Activities: An Overview and an Analysis of the Software Industry*, *in* MICROSOFT, ANTITRUST AND THE NEW ECONOMY: SELECTED ESSAYS 467 (David S. Evans ed., 2002) ("By their very nature, efforts to accomplish significant innovations are associated with high levels of uncertainty.").

184. *See* Barbara M. Bolten & Tracy DeGregorio, *Trends in Development Cycles*, 1 NATURE REV. DRUG DISCOVERY 335, 336 (2002) ("The attrition rate of compounds during the long and risky drug development process is enormous, with roughly 1 in 5,000 compounds that are screened in early-stage discovery making it through to approval."); John DiMasi, Henry Grabowski & Joseph Vernon, *Returns on R&D for 1990s New Drug Introductions*, 20 PHARMACOECONOMICS 11, 23 (2002) ("Many of the uncertainties that exist for a new [pharmaceutical] product (i.e. its clinical profile in terms of risks and benefits, the introduction of substitute products, the size of market demand, etc.), are usually not resolved until late in the R&D process.").

185. *See* Burk & Lemley, *supra* note 50, at 1622–23 ("Software patents are important, but the relatively low fixed costs associated with software development, coupled with other forms of overlapping intellectual property protection for software, mean that innovation in software does not depend critically on strong, broad protection.").

186. *See supra* notes 181–185. Moreover, innovation—because it is quite new—can lead to products and services that are unregulated one day but regulated the next (or impose large tort liability). The possibility of regulation—and its attendant costs and delays—as well as tort liability, further reduces the expected returns to investment in innovation.

187. *See supra* note 170.

188. *See generally* Franco Modigliani & Merton H. Miller, *The Cost of Capital, Corporation Finance and the Theory of Investment*, 48 AM. ECON. REV. 261 (1958) (offering a model of "risk premiums" that are required in return for investment in risky ventures).

189. *See generally* Eugene F. Fama & Kenneth R. French, *The Cross-Section of Expected Stock Returns*, 47 J. FIN. 427 (1992) (discussing how stock market returns relate to industry risk in markets in equilibrium).

similar. It also implicitly assumes that there is a sufficient supply of potential innovators to engage in socially valuable activity. Both of these assumptions are arguably wrong in most situations. Rather, at least in many technological industries, there is a limited set of potential firms and individuals that can realistically bear the cost and have a sufficiently high likelihood of success—especially given the rapid pace of technological change—in inventing and commercializing particular classes of technological innovations.[190] In actuality, the costs for all but a small number of potential innovators are often too large to invest sufficiently in R&D and commercialization.[191] This stems from limitations in capital and know-how, regulatory barriers, long-term industry trends, and mere randomness.[192] In general, technological innovators who can invest sufficient resources will be fairly low in number and mainly heterogeneous in nature.[193]

Because innovation is often a very risky as well as an uncertain endeavor—in the Knightian sense—this heterogeneity may lead to an undersupply of potential innovators. Specifically, in face of this uncertainty and risk, less efficient, more risk-averse innovators may not be able to earn sufficient returns to justify innovation investments when more efficient, less risk-averse competitors are also racing to develop the same innovation (even absent free riding).[194] In other words, given the large competitive threat, some innovators

190. *See generally* Michael E. Porter, *The Five Competitive Forces That Shape Strategy*, 86 HARV. BUS. REV. 78, 80–83 (2008) (describing the dynamics of market entry in technology and other industries).

191. *See generally* Wesley M. Cohen & Daniel A. Levinthal, *Absorptive Capacity: A New Perspective on Learning and Innovation*, 35 ADMIN. SCI. Q. 128, 136 (1990) (contending that only firms that have already invested in learning and innovation can effectively recognize, assimilate, and apply new knowledge).

192. *See generally* JOHN SUTTON, TECHNOLOGY AND MARKET STRUCTURE (1998).

193. *See generally* Maryann P. Feldman & Richard Florida, *The Geographic Sources of Innovation: Technological Infrastructure and Product Innovation in the United States*, 16 ANNALS ASS'N OF AM. GEOGRAPHERS 210, 214 (1994) (describing the specialization required for various locales to become innovation centers in particular technological industries).

194. *See* Aghion et al., *supra* note 157 at 701–02. There is a further wrinkle of importance in this description of innovation and risk. Large firms, which tend to be necessary to commercialize and disseminate innovative technologies, are composed of individual actors, who often are risk-averse. Indeed, larger firms arguably tend to employ the most risk-averse individuals. Because these highly risk-averse individuals make decisions regarding innovative activity, they will demand an even greater return in the marketplace. Although firms' shareholders may be relatively risk-neutral, as a growing body of literature ably demonstrates, there are substantial barriers between shareholders and managers that create high agency costs, preventing firms from making optimal decisions on behalf of the shareholders. In this regard, I disagree with the sentiment of F.M. Scherer, Lemley, and others that "nominally rational corporations . . . systematically overinvest in high-risk, high-reward activities." Lemley, *supra*

at the margins will drop out of the race.[195] Thus, contrary to the standard neoclassical model, which assumes an infinite supply of homogeneous innovators willing to enter the race for the proper potential fee, markets for innovation—at least for highly valuable innovations—can be fairly illiquid.[196] Because innovation involves different approaches, often stemming from random variation and at least partial serendipity among innovators, a smaller group of potential innovators—all other factors equal—will arguably decrease the odds of success.[197] This implies that there will be random pockets in which innovation will be undersupplied, particularly for high-value innovations.

Heterogeneity in the potential pool of innovators might not be an acute problem if innovations' private and social values were generally equivalent. Indeed, the neoclassical model works fairly well in ordinary, competitive markets because small deviations from homogeneity and competition tend to be unimportant in terms of social welfare.[198] Yet, as described earlier, the social benefits from innovative technological activity often far exceed the private benefits.[199] The ensuing questions are quite difficult to answer: Exactly how much more innovative technological activity is needed beyond what is induced

note 17, at 1529 (citing F.M. Scherer, The Innovation Lottery, in EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY 3 (Rochelle Cooper Dreyfuss et al. eds., 2001). Although independent inventors may do so, corporations—especially large ones—tend towards less risky, incremental innovation that generally is of less social value than riskier, disruptive innovation. *See* Rebecca M. Henderson & Kim B. Clark, *Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms*, 35 ADMIN. SCI. Q. 9, 11 (1990); CLAYTON M. CHRISTENSEN, THE INNOVATOR'S DILEMMA: WHEN NEW TECHNOLOGIES CAUSE GREAT FIRMS TO FAIL (1997).

195. *See* Arrow, *supra* note 59, at 610–14 (arguing that risk-aversion will lead to under-investment in invention); Josh Lerner, *Patenting in the Shadow of Competitors*, 38 J. L. & ECON. 463 (1995) (finding that firms with high litigation costs tend to avoid patenting in product markets comprising other firms that have low litigation costs).

196. *See* GEORGE J. STIGLER, THE ORGANIZATION OF INDUSTRY 124 (1968) ("The prospects of monopoly pricing will lead to such a scale of investment in producing knowledge that it will return only the competitive rate of return on average."); Yoram Barzel, *Optimal Timing of Innovations*, 50 REV. ECON. & STAT. 348, 349 (1968) ("[C]ompetition among potential innovators may deprive innovations of all their special economic value.").

197. *See* Thomas M. A. Fink, M. Feeves, R. Palma & R. S. Farr, *Serendipity and Strategy in Rapid Innovation*, 8 NATURE COMMC'NS 2002, 2003 (2017) ("In science, many of the most important discoveries have serendipitous origins.").

198. *See* Arnold C. Harberger, *Monopoly and Resource Allocation*, 44 AM. ECON. REV. 77, 84 (1954).

199. Of course, there are many other activities for which the social benefits far exceed the private benefits, but arguably innovative technological activity results in this divergence much more consistently than the vast majority of economic activities.

by private incentives?[200] And what additional incentives are needed to generate it? Economists have often assumed that private actors should internalize all of the social benefits of innovation to induce optimal levels of it.[201] In contrast, Mark Lemley has argued that we should only provide returns exactly necessary to induce optimal levels of technological innovation and that these returns need not distribute all of the social value of an innovation to the innovators—leaving some surplus on the table for consumers may just do as well in incentivizing innovation.[202]

Unlike much of the theoretical debate regarding patent law, it is unnecessary to resolve this debate to appreciate the importance of suppressing competition to induce technological innovation. Given technological innovation's often substantial costs and risks—particularly the risk of competition—coupled with its substantial social benefits, ordinary market incentives are unlikely to absorb society's total demand for technological innovation.[203] Rather, in order for innovators to have sufficient incentives to innovate, their returns must be supracompetitive.

First-mover advantage and complementary assets—such as market advantages in distribution, production, marketing, and capital aggregation—provide innovators with a first layer of supernormal returns.[204] Like the coffee cart example, innovators who invent and commercialize products and services that are truly novel and nonobvious will—absent patent protection—be in a unique position in the marketplace simply by being the first. If the novel, nonobvious innovation has no close substitutes, the innovator will immediately enjoy supernormal profits, even if for a very limited period of

200. *Cf.* Merges & Nelson, *supra* note 25, at 875 ("Property rights that are too narrow will not provide enough incentive to develop the asset.").

201. *See, e.g.*, Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 34 (1991) (stating that for "fully efficient incentives," each innovator "must earn the entire social surplus of his innovation"); Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J. L. & ECON. 525, 530 (2001) ("Under the patent system, the incentive to invest is always inadequate because monopoly profits are less than social surplus."); *cf.* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 348 (1967) ("A primary function of property rights is that of guiding incentives to achieve a greater internalization of externalities.").

202. *See* Lemley, *Property*, *supra* note 12, at 1057 ("Economic theory offers no justification for awarding creators anything beyond what is necessary to recover their total average costs.").

203. *See* Nelson, *supra* note 179 (explaining that when the social benefits of an activity exceed its private returns in the market, some additional mechanism may be necessary to incentivize the activity).

204. *See* Teece, *supra* note 49 (describing the importance of "complementary assets" in profiting from technological innovation).

time.[205] Indeed, such profits are often called "Schumpeterian" profits.[206] Again, like the coffee cart example, if R&D and commercialization costs (including the costs of failure) are low, then the innovator may be able to earn a sufficient risk-adjusted return on its investment merely from its first-mover advantage and complementary assets.[207] If the risk of competition is low, the first-mover period may be fairly long absent any patent or other intellectual property protection.[208]

However, if R&D and commercialization costs are high, complementary assets are weak, and first-mover advantages are minimal, then often it will be difficult for the innovator to earn a sufficient risk-adjusted return on its investment. First-mover periods may be short because of the threat that a third party can copy or reverse engineer the innovation—or appropriate information relating to the commercialization of the innovation—at a relatively low cost.[209] Yet, first-mover advantages—particularly absent complementary assets to protect those advantages—can be quickly eroded *simply because it is likely a third party will independently develop the innovation*.[210] Thus, optimal risk-adjusted returns to technological innovation must take into account *independent* invention, and not merely free riding.

2. Free Riding vs. Competition

There are at least six potential counterarguments to the previous line of argument. First, if the innovator market is so illiquid, one may question whether projects with high R&D and commercialization costs are likely to attract multiple, independent innovators—if not, then perhaps legal protection

205. The reference to an "innovator" here need not be a single entity. For instance, an inventor may contract or license an invention for commercial production and sale to third parties – in which case, the entire group would enjoy potential first-mover advantages that are potentially reinforced by complementary assets.

206. *See generally* William D. Nordhaus, *Schumpeterian Profits in the American Economy: Theory and Measurement* (Nat'l Bureau of Econ. Research, Working Paper No. 10433, 2004).

207. In certain industries, network effects may further cement a first-mover advantage. *See* Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CALIF. L. REV. 479, 530 (1998) ("Network effects may actually enhance this technological first-mover advantage, because the tipping effect may produce a rapid supracompetitive return before imitators can effectively reverse engineer.").

208. *See* Marvin B. Lieberman & David B. Montgomery, *First-Mover Advantages*, 9 STRATEGIC MGMT. J. 41, 42, 44–47 (1988).

209. *See* Osborn et al., *supra* note 55 at 1232–33.

210. *See* Constantinos C. Markides & Paul A. Geroski, FAST SECOND: HOW SMART COMPANIES BYPASS RADICAL INNOVATION TO ENTER AND DOMINATE NEW MARKETS 120–31 (2005) (explaining that besides "imitative" second-movers, there are also "fast" second-movers, which need not copy from the first-mover, but may enter a new product and quickly erode any benefit to the first-mover).

beyond that necessary to prevent free riding is not so essential. The response is that although high costs will certainly reduce the number of potential entrants, these costs will have less of an effect for the most valuable innovations in the marketplace. High market-value innovations arguably will be high social-value innovations.[211] Moreover, a small number of the most valuable innovations often account for a disproportionate amount of market and, hence, social value.[212] As such, high development and commercialization costs are unlikely to provide a sufficient barrier to entry.

Second, one may also doubt the social value of an innovation that another can independently develop so close in time to the original innovation—indeed, simultaneous invention is often evidence of obviousness.[213] However, invention is often serendipitous in time and its nearly coincidental occurrence does not necessarily signal low social value.[214] (Of course, simultaneous invention may be driven by a race for a patent, but the arguments here are meant to abstract away from the possibility of patent protection.[215])

211. *See generally* Dietmar Harhoff, Francis Narin, F. M. Scherer & Katrin Vopel, *Citation Frequency and the Value of Patented Inventions*, 81 REV. ECON. & STAT. 511, 511 (1999) (noting that high citation counts can indicate both high market and social value).

212. *See* Alexander E. Silverman, *Myth, Empiricism, and America's Competitive Edge: The Intellectual Property Antitrust Protection Act*, 43 STAN. L. REV. 1417, 1432 n.63 (1991) ("A very small percentage of patents commands the lion's share of the economic value; the remaining patents are worth little.") (citing a variety of sources).

213. Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 712 (2012) ("While patent law is based on the belief that important inventions are exceptional—that is, not obvious to most people in the field—the history of major inventions doesn't bear out that belief. The overwhelming majority of inventions, including the overwhelming majority of so-called 'pioneering' inventions, are in fact developed by individuals or groups working independently at roughly the same time."); *In re* Merck & Co., Inc., 800 F.2d 1091, 1098 (Fed. Cir. 1986) ("Neither are we persuaded by appellant's contention that the Board erred in relying on the contemporaneous independent invention of others to support its holding of obviousness.").

214. *See generally* ROBERT K. MERTON, THE SOCIOLOGY OF SCIENCE: THEORETICAL AND EMPIRICAL INVESTIGATIONS 279–308 (1973) (casting doubt on the assertion that simultaneous scientific discovery necessarily indicates low social value).

215. Lemley *supra* note 213, at 712 ("Invention might be motivated, or at least hastened, not merely by the hope of reward but by the fear of losing a race to a competitor who in turn obtains a dominant patent."); Daralyn J. Durie & Mark A. Lemley, *A Realistic Approach To The Obviousness Of Inventions*, 50 WM. & MARY L. REV. 989, 1007 n.96 (2008) ("[I]t may be that simultaneous invention resulted from a patent race that would not have occurred in the absence of the prospect of a patent reward."). For a discussion of patent races, see generally SUZANNE SCOTCHMER, INNOVATIONS AND INCENTIVES 100–03, 112–14, 120–23 (2004); Partha Dasgupta & Joseph Stiglitz, *Uncertainty, Industrial Structure, and the Speed of R&D*, 11 BELL J. ECON. 1, 11–12 (1980); *see also* Pankaj Tandon, *Rivalry and the Excessive Allocation of Resources to Research*, 14 BELL J. ECON. 152 (1983) (suggesting that incentives of firms in competition with each other result in such firms producing duplicative R&D outcomes).

Additionally, firms and individuals may have difficulty estimating the market value of an innovation.[216] In this case, by sheer randomness, some innovations will be produced by multiple independent innovators. This variance in independent innovation will create risks of competition for the original innovator, which may dampen incentives for innovative activity in ways that cannot always easily be priced into the good or service or insured against in the private market. Finally, even if a competitor does not copy from the original innovator per se, the simple fact that the original innovator has produced a working invention or commercially viable product may provide valuable information that reduces the risk to the competitor.[217] In other words, the mere fact that "it can be done" may substantially decrease a competitor's perceived risk of failure, spurring it to enter the market and compete in a manner that reduces the original innovator's profits.[218]

Third, Robert Merges has argued that the "need for market exclusivity" is based on the assumption that inventions "culminate in a single market-covering patent" and hence the need does not necessarily apply to "one component of . . . multi-component technologies."[219] Although the standard story for exclusivity turns on a patent covering a discrete product, the cost, risk, and competition rationales presented earlier typically apply equally to or nearly to the same extent as patents covering a single or a few components of complex products. In some instances, an inventor can commercialize a component and sell that directly to an integrator that combines the component

216. *See generally* Zvi Griliches, Bronwyn H. Hall & Ariel Pakes, *R&D, Patents, and Market Value Revisited: Is There a Second (Technological Opportunity) Factor?* (Nat'l Bureau of Econ. Research, Working Paper No. 2624, 1988) (examining factors including patenting activity as a metric in assessing the market value of innovations and finding "little evidence of a second factor which can be clearly identified with technological opportunity").

217. *See* Sichelman, *Commercializing Patents*, *supra* note 10, at 360–61; Sichelman, *Taking Commercialisation Seriously*, *supra* note 178, at 201.

218. *See* Scotchmer & Maurer, *supra* note 20, at 543 ("[M]erely knowing that someone has invented a product can be important for expected costs of duplication in cases where significant *ex ante* doubts exist about whether the proposed product can be made at all.").

219. Merges, *supra* note 21, at 4. Merges argues that another assumption of the market exclusivity story is that it applies solely to "very high-cost research projects." *Id.* at 4. I agree, with the caveat that this statement is not particularly meaningful without defining "very high." Merges appears to assume that "very high" is on the order pharmaceutical innovation, which is on the order of $1 billion per successfully commercialized small molecule drugs. *Id.* at 4. Clearly, the exclusivity function of patents plays an important role well below these levels of R&D and commercialization. Of course, many R&D projects are less than $1 million, and whether the blunt instrument of patent protection is always sensible for such small projects is questionable.

with other parts to form a complex product.[220] Yet, even in instances in which the component must be manufactured alongside unpatented components—in a competitive market, an inventor undertaking risky and costly R&D must typically enjoy supernormal returns to justify its investment. As noted earlier, the fact that a patentee licenses, rather than commercializes, the underlying invention does not negate the benefits to innovation from suppressing competition.[221] Hence, the observation that much invention today involves aspects of multi-component products does not defeat the need for exclusivity in the form of a hedge against risk of competition.[222] The optimal mix of remedies available to the patent holder of a component may arguably vary from those available to a holder over a discrete product, but such differences do not defeat the need for some form of protection against the erosion of supernormal profits to spur optimal levels of R&D and commercialization for components of complex products.[223]

Fourth, copying is required to show infringement for other areas of intellectual property law that concern innovative activity, namely trade secret and copyright law, seemingly rebutting the need for patent rights to capture independent invention.[224] However, trade secrecy and copyright doctrines can adequately be explained on other grounds. For trade secrecy, dispensing with copying would require some mechanism to capture the scope of the trade secret right, which would be difficult as an evidentiary matter without some government-administered registration system, which would undermine the secrecy of the underlying information.[225] Additionally, trade secret law often concerns the aggregation of information that is otherwise public, but in its assembled form can qualify for trade secret protection—such as customer lists,

220. *See generally* Sebastian K. Fixson, *Product Architecture Assessment: A Tool to Link Product, Process, and Supply Chain Design Decisions*, 23 J. OPERATIONS MGMT. 345 (2005) (examining modular, component-based approaches to product design and manufacturing).

221. *See supra* notes 43-44 and accompanying text.

222. Damien Geradin & Anne Layne-Farrar, *Patent Value Apportionment Rules for Complex, Multi-Patent Products*, 27 SANTA CLARA COMPUT. & HIGH TECH. L.J. 763, 763 (2011) ("The vast majority of the products developed by the information technology ("IT") industry are technologically complex, incorporating hundreds or thousands of different components, and many of these components read on an increasingly large number of patents held by a number of third parties.").

223. *See generally* Ted Sichelman, *Purging Patent Law of "Private Law" Remedies*, 92 TEX. L. REV. 517 (2014).

224. *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 474–75 (1974).

225. 4 LEGAL COMPLIANCE CHECKUPS § 29:6 (2022) ("There is no procedure for somehow 'registering' a trade secret to enhance or perfect the right in a trade secret. Rather, trade secret rights are established and maintained by following reasonable procedures to maintain the secrecy."); Duncan M. Davidson, *Common Law, Uncommon Software*, 47 U. PITT. L. REV. 1037, 1058 (1986) ("Registration normally would vitiate trade secret protection.").

marketing data, and the like.[226] Precluding the independent assembly of such information would arguably be economically inefficient and, hence, trade secret law would likely need to adopt some form of patent law's nonobviousness doctrine to separate truly innovative information from mere aggregation of public domain information.[227] This is especially so under an absolute liability regime not requiring copying for infringement, because this would entail abandoning the reverse engineering defense, which serves as a sort of obviousness gating function in trade secret law.[228] Thus, for reasons other than incentivizing innovative activity, requiring copying in trade secret law is sensible. As for copyright law, true independent creation within the scope of the rights afforded by copyright law is quite rare.[229] Indeed, copying serves as a strong proxy for bounding copyright scope by prophylactically removing from infringement the independent creation of "ideas" (which is likely to be common), reducing massive information costs in discerning the idea/expression dichotomy in copyright law.[230] So, like trade secret law, other reasons justify copying as an element of copyright infringement.

Fifth, some have argued that the divide between the legal monopoly afforded by perfect exclusivity and the duopoly (or oligopoly) that would likely arise from imperfect exclusivity or even a "free" market is quite narrow.[231] More specifically, if the difference between monopoly profits earned under a patent regime that did not countenance any form of competition and oligopoly profits earned in a regime that allowed independent creation is small, then

226. Andrew Beckerman-Rodau, *The Choice Between Patent Protection and Trade Secret Protection: A Legal and Business Decision*, 84 J. PAT. & TRADEMARK OFF. SOC'Y 371, 379 (2002) ("[C]ourts have held customer lists, in some cases, to be trade secrets. Additionally, pure information, such as marketing data, ideas, formulas and negative data, are potentially protectible as trade secrets but ineligible for patent protection.").

227. *See* John Gladstone Mills, Donald Cress Reiley & Robert Clare Highley, 1 Pat. L. Fundamentals § 4:8 (2d ed. 2023) ("Most courts have emphatically rejected the notion that anything like an unobviousness standard applies to trade secrets.").

228. Robert G. Bone, *A New Look at Trade Secret Law: Doctrine in Search Of Justification.* 86 CALIF. L. REV. 241, 265 (1998) ("[T]he inventor's commercial success through secrecy shows that the invention was in fact nonobvious, and deserved a patent, since others presumably took a long time to reinvent it.").

229. John F. Duffy, *Inventing Invention: A Case Study of Legal Innovation*, 86 TEX. L. REV. 1, 9 (2007) ("By contrast, in the copyright area, claims of true independent duplication are much more rare.").

230. Lemley, *Economics of Improvement*, *supra* note 10, at 1014 ("[C]opyright protection does not extend to the ideas, facts, or functional elements of a work, but only to the author's original expression of those ideas or elements."). *See* 17 U.S.C. § 102(b) (1990).

231. *See* Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985, 1031–32 (1999).

incentives to innovate would continue to be high and substantial costs could arguably be averted.[232] However, such a statement depends on a complex analysis of profit under various forms of duopoly, which can vary widely by industry and invention.[233] In view of the substantial divide between private and social returns for many valuable inventions, at least as a first cut—that is, absent strong evidence otherwise—it seems plausible to assume that the move from monopoly to duopoly or oligopoly would unduly diminish incentives to innovate on the whole. Of course, this is an empirical question at root, and perhaps the answer turns the other way.[234] Unfortunately, there is no sufficient evidence at the moment to know. Ultimately, even if the evidence showed negligible differences in profit, it is conceptually clearer to assume a baseline of absolute exclusivity tempered by safety valves for competition, as I describe in the next Part.[235]

Sixth, in many instances inventors who patent inventions have no intent to commercialize them, including through third-party licensees. In many cases, these are preemptive patents that merely prevent competitors from commercializing potential design-arounds to the inventor's other patented products.[236] Alternatively, some inventors may patent yet lack the financial wherewithal or incentive to commercialize or license the patented invention.[237] In yet other cases, patents may be obtained merely for defensive, marketing, or other reasons seemingly unrelated to commercialization. Yet, even in these situations of "paper patenting," the hedging role of patents plays a useful and often important economic function.[238] In the case of preemptive patenting, patents create an even stronger hedge against competition relative to the original patented product by foreclosing substitutes for that product. Defensive patenting also operates to maintain market advantages in the marketplace by reducing the risk that profits are diminished not by ordinary product competition, but instead by competition for IP that leads to rents in the marketplace. Patenting for marketing and vanity purposes do not easily fit

232. *See id.*

233. *See* Lemley, *supra* note 20, at 1527 n.9 ("[E]conomic theory is all over the map in predicting price under duopoly, with estimates ranging from close to monopoly pricing to pure competitive pricing."); Burk & Lemley, *supra* note 110, at 1580–95 (explaining how different industries respond to the patent system differently).

234. *See* Vermont, *Independent Invention*, *supra* note 14 (arguing that duopoly would not unduly diminish incentives in the situation of independent invention).

235. *See infra* Section III.A.

236. *See* Richard J. Gilbert & David M. G. Newbery, *Preemptive Patenting and the Persistence of Monopoly*, 72 AM. ECON. REV. 514, 514 (1982).

237. *See* Sichelman, *supra* note 10 at 343.

238. *Cf.* John F. Duffy, *Reviving the Paper Patent Doctrine*, 98 CORNELL L. REV. 1359, 1362–63 (2013).

in the hedging paradigm, but these uses are quite minimal.[239] In any event, the hedging theory presented here is not meant to be an exhaustive explanatory theory for patenting, but rather one complementary to other important functions of patenting.

In sum, if society seeks to incentivize optimal levels of innovative technological activity—namely, levels that generate the greatest level of social benefits relative to the costs of innovation—then it must generally provide supernormal returns greater than those offered solely by first-mover advantages and complementary assets. Importantly, because competitive risk stems not solely from copying and related public goods concerns, these supernormal returns must take into account the risk of competition generally, and not merely the threat of free riding.[240] As a baseline, these returns should derive from fully exclusive levels of profits.

B. HEDGING AGAINST COMPETITION IN ORDER TO SPUR INNOVATION

Delivering the supernormal profits that are required for innovators to optimally engage in innovative activity need not stem from market-based rewards.[241] For example, the government or private parties could offer prizes, subsidies, or tax credits to innovators.[242] Alternatively, the government could

239. Patent assertion entities (PAEs) are typically special purpose business entities that acquire patents merely to license and assert them in litigation. But, as I explain further below in the context of the broader category of non-practicing entities (NPEs), even for PAEs, patents still perform a useful economic hedging function by providing at least some compensation back to the original inventor (and, possibly, commercializer) as well as by lending credibility to the general threat of patent infringement suits against would-be infringers. Of course, the costs from the assertion of weak patents must be taken into account, but there is no a priori reason to believe that non-commercializing entities are a net social cost and the empirical evidence for such is wanting in my opinion, at least outside of PAEs seeking very low-value settlements on a recurring basis. This is particularly so in view of the much wider net cast by hedging theory for the economic benefits of patents. *See infra* notes 276, 320-325 and accompanying text.

240. *See infra* notes 316–321.

241. *See* ROBERT P. MERGES, PETER S. MENELL, MARK A. LEMLEY, & SHYAMKRISHNA BALGANESH, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE 26 (2022) ("Numerous institutional mechanisms exist for addressing the public goods problem inherent in the production of ideas and information—direct government funding of research, government research subsidies, promotion of joint ventures, and prizes.").

242. *See id.*; Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303, 308 (2013) ("Grants and tax credits provide rewards ex ante, before the results of R&D are known. By contrast, prizes and patents provide rewards ex post, after an R&D project has produced a novel discovery."); Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 235 (2003) ("Proponents of patent prizes have sought to avoid the deadweight losses associated with intellectual property protection by recommending that a

provide some form of legal exclusivity in the market.[243] Patents fall into this category.[244] Unlike prizes, subsidies, or tax credits, patents reward inventors through a market selection mechanism.[245] Although there is some circularity in the patent system's level of rewards because the value of an invention in the market depends on the strength of its patent rights, when compared with prizes, subsidies, or tax credits, patents tend to provide financial gains for commercializers of patented products and services that are more commensurate with private market value.[246] Yet, because of the exclusionary power of a patent—assuming the patent provides some market power (as many patents do not)[247]—the patentee will generally price above marginal cost, resulting in not only supernormal profit, but also deadweight losses by pricing out consumers who otherwise could have purchased the patented goods in an ordinary, competitive market.[248] This is the standard intellectual property

centralized governmental spending program replace a market-based incentive."); Benjamin N. Roin, *Unpatentable Drugs and the Standards of Patentability*, 87 TEX. L. REV. 503, 560 (2009) ("Rather than relying on patent reforms to promote the development of socially valuable drugs that currently cannot be patented, Congress itself could finance the development of those drugs.").

243. In addition to patents, legal exclusivities include government-sanctioned monopolies and other regulatory exclusivities. For instance, pharmaceutical companies are provided data exclusivity when a drug is approved from Food and Drug Administration (FDA), which in effect provides market exclusivity, for a limited period of time. *See* Rebecca S. Eisenberg, *Patents, Product Exclusivity, and Information Dissemination: How Law Directs Biopharmaceutical Research and Development*, 72 FORDHAM L. REV. 477, 481–84 (2003); William E. Ridgway, *Realizing Two-Tiered Innovation Policy Through Drug Regulation*, 58 STAN. L. REV. 1221, 1236–39 (2006).

244. *See, e.g.*, Pfaff v. Wells Electronics, Inc., 525 U.S. 55, 63 (1998) ("[T]he patent system represents a carefully crafted bargain that encourages both the creation and the public disclosure of new and useful advances in technology, in return for an exclusive monopoly for a limited period of time.").

245. *See generally* Hemel & Ouellette, *supra* note 242 (contrasting non-market and market-based incentives, including patents, to promote innovative activity).

246. Of course, if the commercializer is not the original inventor, it can distribute a portion of its gains to the original inventor through a variety of mechanisms. *See* Sichelman, *Commercializing Patents*, *supra* note 10.

247. *See, e.g.*, HERBERT HOVENKAMP, ECONOMICS AND FEDERAL ANTITRUST LAW § 8.3, at 219 (1985) ("Many patents confer absolutely no market power on their owners. . .. The economic case for 'presuming' sufficient market power . . . is very weak."); 1 HERBERT HOVENKAMP ET AL., IP AND ANTITRUST: AN ANALYSIS OF ANTITRUST PRINCIPLES APPLIED TO INTELLECTUAL PROPERTY LAW § 4.2 (suggesting the rarity of situations in which patents confer market power); Salem M. Katsh, Jack E. Brown & F.M. Scherer, *Panel Discussion: The Value of Patents and Other Legally Protected Commercial Rights*, 53 ANTITRUST L.J. 535, 547 (1984) ("Statistical studies suggest that the vast majority of all patents confer very little monopoly power.").

248. *See* Sichelman, *Commercializing Patents*, *supra* note 10, at 358.

trade-off between providing incentives to innovate and widespread dissemination of innovations.[249]

On the hedging theory offered in this Article, this tradeoff is countenanced, in Thomas Jefferson's words, as an "embarrassment" not merely to prevent free riding, but rather competition in any form, even fully independent development of the innovation.[250] If an innovator is truly first to sell or use its innovation (either itself or through others), then as mentioned, it will enjoy a first-mover advantage for some limited period of time, even if very brief, which will provide it supernormal profits.[251] However, the innovator risks depreciation of these profits via competition, particularly if the innovator does not hold strong complementary assets, such as efficient manufacturing, strong marketing, or access to large amounts of capital.[252] A competitor may produce the same or better innovation, either by copying *or* by developing the innovation wholly independently. If the competitor can offer a lower price, more value, or use its complementary assets to gain a competitive advantage, it may force the original innovator out of the market or severely reduce its revenues and associated profits.[253] Of course, this risk exists for any market activity, but for ordinary market activity these risks tend to be sufficiently rewarded by ordinary market returns. For innovative activity, ordinary market returns will generally be insufficient.[254]

249. *See id.*

250. Lemley, *Property*, *supra* note 10, at 1031 ("Thomas Jefferson was of the view that '[i]nventions . . . cannot, in nature, be a subject of property;' for him, the question was whether the benefit of encouraging innovation was 'worth to the public the embarrassment of an exclusive patent.'").

251. *See supra* note 205. In this regard, if there are sufficiently close substitutes for the product that prevent any supernormal profits, then it is doubtful the product is "innovative" in any meaningful sense. Although "commercial" utility is not currently a requirement under patent laws of most nations, it was a requirement in Venetian Republic, the earliest patent system on record, and hedging theory indicates that at least a weak form of commercial utility is sensible as a policy matter. Moreover, such an approach properly views patents not merely as incentivizing R&D, but also commercialization. *See* Ted Sichelman & Sean O'Connor, *Patents as Promoters of Competition: The Guild Origins of Patent Law in the Venetian Republic*, 49 SAN DIEGO L. REV. 1267, 1269 (2012).

252. *See* Teece, *supra* note 49, at 289 (describing the importance of "complementary assets" in profiting from technological innovation); Jorde & Teece, *supra* note 183, at 590 ("Particularly for small firms, innovation may require accessing complementary assets that lie outside the organization.").

253. *See* Teece, *supra* note 49 (presenting examples of how innovators lost to competitors that offered superior products, lower pricing, or better marketing and distribution).

254. *See supra* notes 178–188 and accompanying text.

The core of hedging theory is that patents, as government-backed legal monopolies, act as a form of insurance against competition.[255] In economic terms, patents provide a hedge that reduces the patentholder's risk that competition will diminish any supernormal profits enjoyed by it, either directly or via licensing, as a first-mover.[256] In this sense, patents are not necessary for supernormal profits, as they are often described.[257] Rather, a true "first" innovator can presumptively enjoy supernormal profits from the start, using complementary assets to maintain and extend these profits. Patents further extend the period of supernormal profits by providing an option to prevent potential competition from third parties. Specifically, this option acts as a hedge by affording the patent holder a legal right to exclude competitors over the patented product or process from the market, or require them to pay damages as a penalty for infringement, reducing the level of risk that the innovator's supernormal profits will be eroded by market competition.[258] By acting as hedges against profit erosion, patents help ensure that technological innovators have appropriate incentives to undertake costly and risky activities that are socially valuable.[259]

In contrast to hedging theory, many commentators have described patents as exclusive "options" to commercialize a patented invention.[260] For instance, according to Rita McGrath and Atul Nerkar, "a patent confers on the firm the right but not the obligation to make further investments, culminating in a decision whether to commercialize its knowledge or not. Investments made towards commercializing the knowledge underlying the patent are analogous to the exercise price on the real option."[261] These views, however, do not

255. *Cf.* IRVING FISHER, ELEMENTARY PRINCIPLES OF ECONOMICS 331 (1912) (arguing that patents encourage investment of capital into industries otherwise characterized by "cutthroat competition").

256. *See* Peter N. Golder & Gerard J. Tellis, *Pioneer Advantage: Marketing Logic or Marketing Legend?*, 30 J. MKTG. RSCH. 158, 161 (1993) (describing several forms of free riding that can erode first-mover and other "pioneer" advantages). Importantly, patents do not guarantee that competition will be foreclosed. Rather, patents are "probabilistic rights" in the sense that showing infringement, validity, and enforceability of a given patent will typically be difficult. *See generally* Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSP. 75 (2005).

257. *See supra* note 72.

258. *See supra* notes 40–51 and accompanying text.

259. *See* Emmanuel Dechenaux, Brent Goldfarb, Marie C. Thursby & Scott Shane, *Appropriability and the Timing of Innovation: Evidence from MIT Inventions* 24 (2003), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=404820 ("Our empirical results provide strong support for the view that the ability to appropriate returns [from post-invention patent protection] is important for inventions whose success is highly uncertain.").

260. *See supra* note 38.

261. Rita Gunther McGrath & Atul Nerkar, *Real Options Reasoning and a New Look at the R&D Investment Strategies of Pharmaceutical Firms*, 25 STRATEGIC MGMT. J. 1, 6 (2004).

accurately characterize the legal rights afforded by a patent.[262] In short, modern-day patents merely provide *negative* rights to prevent others from making, using, or selling the patented invention, but do not offer positive rights to the patentee to engage in these activities.[263]

In many situations, a patentee will not be able to commercialize its patented invention for at least three reasons.[264] First, other patents may cover a portion of the patented invention.[265] For instance, if Inventor A patents the wheel and Inventor B patents the buggy, Inventor B will not be able to commercialize the buggy absent a license from Inventor A.[266] This situation is fairly common for multi-component products and leads to so-called problem of "blocking patents."[267] Blocking patents also arise when a later inventor improves upon an earlier invention, foreclosing the earlier inventor from commercializing the improvement, even though the improvement technically lies within the scope of the earlier inventor's patent claims.[268] Second, an inventor may be effectively blocked by market forces, such as by lack of access to essential complementary assets held by competitors, sufficient capital to commercialize or even seek licenses for the invention, or other, more valuable opportunities.[269] Third, commercialization may be foreclosed by other laws, such as environmental and other regulatory laws.[270]

Thus, patents are not, as typically claimed, real call options to commercialize, but rather real put options to prevent commercialization by others, that is, as hedges against competition.[271] As noted earlier, a real put

262. *See supra* note 39 and accompanying text; *infra* notes 255-60 and accompanying text.

263. *See supra* note 38-39.

264. *See infra* notes 265-270.

265. *See* Bruce W. Burton, Scott Weingust & Alton L. Hare, *The Attorney's Role in Assisting Clients with Patent Valuation*, LANDSLIDE MAGAZINE 27, 29 (2015) ("[P]atents grant only an exclusionary right, not a right to practice. This permits the scenario where patentee A cannot commercialize products or services covered by the claims of its patent because patentee B has a patent with claims that encompass some element of the claims of patentee A's patent, and vice versa.").

266. *See id.*

267. Merges & Nelson, *supra* note 25, at 860–62 (describing blocking patents); Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75 (1994).

268. *See* Arora, supra note 130 at 179–82.

269. *See* Sichelman, *Commercializing Patents*, *supra* note 10 at 362–76.

270. For instance, patentees of pharmaceutical drugs cannot generally commercialize the drugs without approval from the FDA. *See* Rebecca S. Eisenberg, *The Role of the FDA in Innovation Policy*, 13 MICH. TELECOMM. & TECH. L. REV. 345 (2006).

271. Because patents do not necessarily provide for exclusive use over the patented good, they are quite different from ordinary property. *Cf.* Daniel Spulber, *Competition Policy and the*

option in the intellectual property context provides its holder the ability to force infringers either to pay money damages or cease infringement.[272] A real call option to exclusively commercialize is typically afforded by the inventor (or its licensees)[273] being first to market—not by a patent right.[274] To the extent such commercial exclusivity exists prior to issuance of a patent, the negative rights afforded by a patent may extend the exclusivity—indirectly providing exclusive rights to commercialize—but patents generally do not create market exclusivities in the first instance.[275]

Importantly, this characterization applies even to patents held by non-practicing entities (NPEs) that are indeed first inventors, because even

Incentive to Innovate: The Dynamic Effects of Microsoft v. Commission, 25 YALE J. REG. 247, 267 (2008) ("For an intellectual product to be considered IP . . . [i]ts owner must have exclusive rights to the choice of how to use the intellectual product."). This is yet another argument against the standard public good-excludability paradigm for explaining and justifying patents. In other words, patent law does not erect an ironclad fence around the inventor's claims so as to convert an otherwise public good into an excludable private one in which the owner can do as it pleases behind the fence.

272. *See supra* note 48 and accompanying text.

273. *See* ARORA ET AL., *supra* note 130, at 32–40 (pointing to more than 15,000 licensing transactions worldwide with a total value of over $320 billion in the period 1985-1997); KEVIN G. RIVETTE & DAVID KLINE, REMBRANDTS IN THE ATTIC: UNLOCKING THE HIDDEN VALUE OF PATENTS 5 (1999) (estimating that the licensing market grew 700% from $15 billion in 1990 to well over $100 billion in 1998); Katherine J. Strandburg, *Users as Innovators: Implications for Patent Doctrine*, 79 U. COLO. L. REV. 467, 484 (2008) ("[P]atents encourage invention primarily by excluding competitors (and thus driving up profits for patent-holding manufacturers) or by facilitating a market for licenses and assignments so that inventors can sell their ideas to others.").

274. *See supra* notes 43–44 and accompanying text.

275. *See id.* One notable exception is the use of patents under the "*Metallizing* rule" to usurp exclusivity from a holder of a trade secret. In this instance, a commercializer that is first-to-market and maintains an invention as a trade secret may lose its ability to make, use, and sell the invention to a third party that independently discovers and patents the invention. *See* Dmitry Karshtedt, *Did Learned Hand Get It Wrong?: The Questionable Patent Forfeiture Rule of Metallizing Engineering*, 57 VILL. L. REV. 261, 262 (2012) (explaining and critiquing this rule). However, the *Metallizing* rule can be viewed through the lens of hedging theory—specifically, the hedge afforded by patent is so strong that it reduces competitive risk not only from potential future competition, but also from pre-existing competition that is "secret." Instead of viewing the rule of *Metallizing* as justified on the importance of invention disclosure, one can ground it on the importance of notice to a potential inventor. Much like property recording systems, notice in this instance economizes on transaction costs by providing signals to would-be inventors that an invention is already available in the marketplace. Such notice does not turn on the full disclosure of the invention sufficient to enable a skilled technician to make and use the invention but rather on disclosure sufficient merely to alert others of the type and nature of the invention. The prior user defense of the AIA, noted earlier, provides a limited exception from the *Metallizing* rule. *See* 35 U.S.C. § 273 (2011) (setting forth the requirements for the prior user defense under the America Invents Act).

independent development and use of an NPE's patented invention deprives the patentee from earning supernormal profits via its current or prospective licensees.[276] In this regard, optimal incentives for innovation are essential regardless of the business model of the patentee, and the hedge against competition afforded by patents is a tradeable right that can reduce risk for any potential commercializer of the invention, regardless of whether the commercializer is the inventor.[277] In other words, by affording a valuable, tradeable hedge against competition, patent law broadly incentivizes R&D and commercialization efforts regardless of the business structure or strategy of the inventor.

Precision in the characterization of the patent right is important, because viewing patents through the lens of option theory "provides a framework to produce new perspectives on patents" that links to an expansive economics, business, and financial literature, thereby providing a richer framework to analyze the economic value of patents.[278] One immediate interest in this endeavor is determining the "price" of purchasing the patent put option.[279] Patent law doctrines contain a variety of "gating" functions that set the option price fairly high in order to ensure that the inventions that receive exclusionary rights are indeed socially valuable.[280] Novelty and non-obviousness requirements ensure that the invention is sufficiently original so that government interference with ordinary market mechanisms is necessary.[281] Disclosure doctrines, such as enablement, require that the inventor disclose enough about an invention in a patent—namely, sufficient to enable one of ordinary skill in the art to make and use the invention without undue

276. Even if all potential commercializers forgo licensing, as long as those commercializers were not the first to invent, they deprive the NPE of potential supernormal profits, reducing the incentive to invent.

277. *See* Sichelman, *supra* note 223, at 550–52 (arguing that generally NPEs and operating companies should "earn exactly the same return on their efforts" in order to promote optimal levels of innovation).

278. Christopher Cotropia, *Describing Patents as Real Options*, 34 J. CORP. L. 1127, 1149 (2009).

279. *Cf. id.* at 1135–37 (attempting to estimate the price of purchasing a call option to commercialize a patented product or service).

280. *See* Emily Michiko Morris, *Intuitive Patenting*, 66 S.C. L. REV. 61, 81 (2014) ("The patentability requirements of novelty, non-obviousness, utility, and full disclosure (particularly enablement) serve a critical role in adjusting the ever present tension in patent law between stimulating innovation by protecting inventors, and impeding progress by granting patents when not justified by the statutory design.") (citing Bilski v. Kappos, 130 S. Ct. 3218, 3229 (2010)) (internal quotation marks omitted).

281. *See* 35 U.S.C. §§ 102, 103 (2012) (setting forth novelty and nonobviousness requirements).

experimentation—to justify the scope of the rights afforded to the inventor.[282] Patentable subject matter limitations exclude classes of inventions—such as those too closely relating to abstract ideas, natural laws, and natural phenomena—with large potential social costs.[283] Limited patent terms of twenty years help to diminish consumer deadweight losses and incentivize improvements to the invention by placing it into the public domain.[284] The high cost of enforcement and the possibility that the patent will be nullified in post-grant proceedings at the Patent Office provides a further gating function by setting a high effective "exercise price" of the option.[285]

In sum, hedging theory explains why patent infringement as an economic matter extends beyond free riding, both at the level of invention and commercialization, without resorting to Kitchian coordination and related rent-dissipation rationales.[286] Because competition may stem from free riding *or* wholly independent activity, in order for patent law to provide optimal incentives—at least for most classes of high-cost, high-risk activity—it must partly suppress competition of any form in order to ensure adequate supernormal returns.[287]

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282. *See* 35 U.S.C. § 112(a) ("The specification shall contain a written description of the invention . . . in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.").

283. *See* Ass'n for Molecular Pathology v. Myriad Genetics, Inc., 133 S. Ct. 2107, 2116 (2013) (citing Mayo Collab. Servs. v. Prometheus Lab'ys, Inc., 566 U.S. 66, 70 (2012)) ("We have long held that [Section 101] contains an important implicit exception[:] Laws of nature, natural phenomena, and abstract ideas are not patentable.") (internal quotation marks omitted); Mark A. Lemley, Michael Risch, Ted Sichelman & R. Polk Wagner, *Life After Bilski*, 63 STAN. L. REV. 1315, 1330–32 (2011) (noting the potential social costs that could arise if certain classes of inventions were patentable).

284. *See* Andrew W. Horowitz & Edwin L.-C. Lai, *Patent Length and the Rate of Innovation*, 37 INT. ECON. REV. 785, 785 (1996) (finding that patents with very long terms would reduce overall innovation, because although they would induce the development of more significant innovations, they would tend to reduce the frequency of innovation more so); Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1106 (2007) ("If a patent term is too short, the patentee might have socially insufficient incentives to develop the patent by engaging in nonpatentable research and commercialization activities, but if it is too long, excessive deadweight loss will result.").

285. *See* Rebecca S. Eisenberg, *Patent Costs and Unlicensed Use of Patented Inventions*, 78 U. CHI. L. REV. 53, 56 (2011) ("[P]atent enforcement costs tend to shelter low-value uses from patent assertion").

286. *See supra* notes 129–154 (describing coordination and rent-dissipation explanations of patent law).

287. Yet, free riding will tend to diminish profits more so than independent invention. Thus, while a hedging theory may explain why patent infringement extends beyond copying, there are economic reasons to distinguish copying from independent invention in evaluating the appropriate remedy for infringement.

IV. THE BENEFICIAL ASPECTS OF COMPETITION AND THE IMPOSSIBILITY OF OPTIMAL INCENTIVES

A. "MIXED" COMPETITION THEORY OF INNOVATION

Suppressing competition is not the entire story for patent rights, because competition can often help promote innovation, particularly in two instances. First, as explained earlier, innovators are not an infinite resource.[288] Instead, there is typically a small set of potential firms and individuals who can realistically bear the cost and have a sufficient likelihood of success in inventing and commercializing particular classes of innovations.[289] Given the illiquidity and heterogeneity of most inventor markets, traditional neoclassical theories that predict the number of innovators that will enter a "patent race" will be so large so as to "dissipate" all producer surplus available from the patent are often incorrect.[290]

Contrary to these models, different innovators frequently cannot undertake R&D efforts toward a given innovation at the same or similar costs.[291] The costs for all but a small number of potential innovators are usually too large to profitably enter a patent race.[292] Often the cost of merely identifying the innovation subject to the race is so large that, as a practical matter, there is only one innovator that can supply it within a reasonable time frame.[293] To the extent patents provide market power to certain firms in a given industry or sector, those firms may crowd out other firms—and, relatedly, may erect barriers to entry for new firms—further diminishing the number of firms that innovate in a given industry or sector.[294] All things equal, the fewer the

288. *See supra* notes 190–193 and accompanying text.

289. *See id.*

290. *See id.*

291. *See id.*

292. *See id.*

293. *See generally* Stanley S. Reynolds & R. Mark Isaac, *Stochastic Innovation and Product Market Organization*, 2 ECON. THEORY 525, 539–42 (1992) (examining an "environment in which only a single firm can successfully innovate").

294. *See* Lerner, *supra* note 195, at 464–65 (finding that incumbent patenting in the biotechnology industries can deter other firms from entering). *See generally* Christopher Harris & John Vickers, *Patent Races and the Persistence of Monopoly*, 33 J. INDUS. ECON. 461, 461–62 (1985) (asserting that in a patent race, the potential challenger may anticipate that the incumbent will win, in which case challenger will not enter the race); Mark R. Patterson, *Patent Races with No Entrants* 1 (Fordham Law & Econ., Research Paper No. 22, 2002), https://ssrn.com/abstract=336220 (stating that an inventor who would have won the race may exit after suffering early setbacks because the inventor is unaware that competitors may have suffered similar setbacks).

number of innovating firms in a given industry, the less innovation will occur.[295]

Although Schumpeter and his exponents have argued that a monopolistic industry structure may yield more innovation than a competitive one, some scholars—such as Arrow—have espoused the opposite.[296] And still others have argued that Schumpeter's and Arrow's views may both be correct, asserting that the relationship between competition and innovation is an inverted "U-shape" (see Figure 1).[297]

295. *See also* JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 399 n.23 (1988) ("[T]he existence of several independent research programs is not bad per se, because 'two chances are better than one.'").

296. *See* Arrow, *supra* note 59, at 619–20; Morton I. Kamien & Nancy L. Schwartz, MARKET STRUCTURE AND INNOVATION 75–90 (1982) (contending that monopolist firms may ultimately spend less on R&D); F.M. Scherer & David Ross, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 660 (3d ed. 1990) (disapproving Schumpeter's "less cautious" followers); Howard A. Shelanski, *Competition and Deployment of New Technology in U.S. Telecommunications*, 2000 U. CHI. LEGAL F. 85, 85 (concluding that competition motivated innovation more than monopoly in multiple empirical studies of the telecommunications industry); Lemley, *Economics of Improvement*, *supra* note 10, at 1042–44.

297. Aghion et al., *supra* note 157, at 702–05 (finding in a general empirical study that maximal incentives for innovation lie somewhere between a low and high level of competition). *See also* Peter Lee, *Churn*, 99 WASH. U.L. REV. 1 (2021) (describing the beneficial role for innovation that patent law may play by promoting some competition).

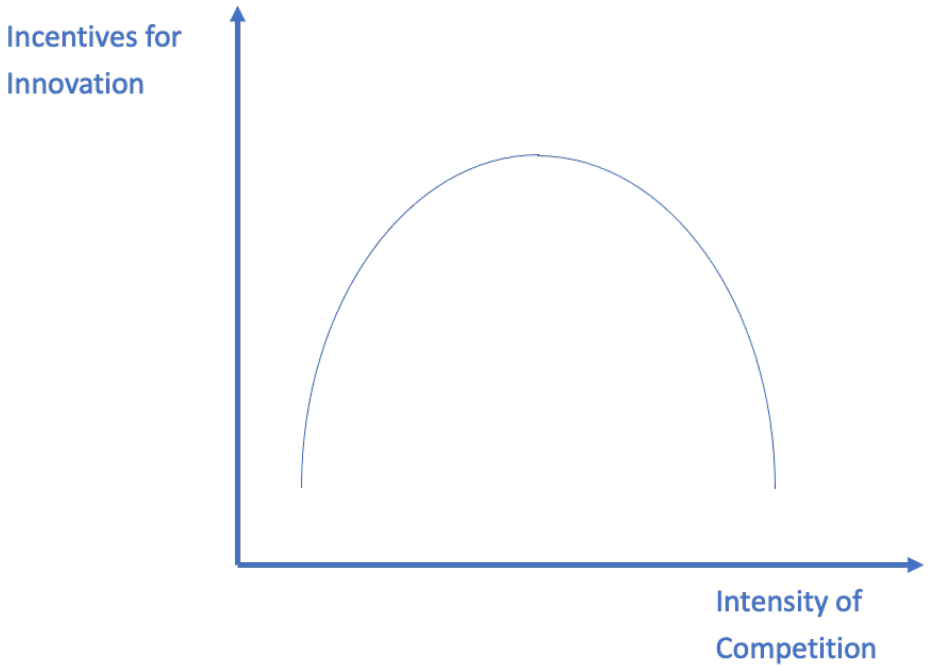

Figure 1. Possible Relationship between Innovation Incentives and Intensity of Competition.[298]

Whatever the precise optimum, it is important to remain cognizant of the role suppressing competition to inflate innovator returns might play along the temporal dimension: ex ante, it increases the number of potential innovators, yet ex post, it has the exact opposite effect. This dueling aspect of patents may help explain the Schumpeter-Arrow debate's general intractability.

Second, more competition may promote greater commercialization of invention as well as follow-on innovation, especially in markets with high transaction costs in licensing.[299] This view directly conflicts with Kitch's

298. *See* Aghion et al., *supra* note 157 at 720.

299. *See generally* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, *in* 1 INNOVATION POL'Y & ECON. 120 (2001) (describing how a "patent thicket [is] a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology"); *cf.* Blair, *Strict Liability*, *supra* note 15, at 818 ("The transaction costs of and other obstacles to licensing can be burdensome for a number of reasons, including asymmetric information; the potential for competition from substitutes for the patented invention; the interdependence of potential licensees' demand curves; and the fact that licensees are free to challenge the patent's validity.").

coordination thesis.[300] Specifically, if the costs of bargaining are high enough to prevent licensing and related deals, the threat of an infringement suit may prevent others from improving or commercializing the original invention.[301] In this regard, suppressing independent competition may be particularly problematic when the costs of providing notice of relevant patents to potential infringers are high.[302] The nature and extent of "notice externalities" created by the patent system is debatable, but surely some pockets of notice failure exist.[303] Thus, in high-transaction cost settings, weaker patent rights—and in turn, more competition—may lead to more downstream innovation and commercialization.[304] Even in industries without high transaction costs, more cutthroat competition may yield greater incentives for market actors to innovate and therefore "escape" the "neck-and-neck" daily race so as to increase profits, despite the limited time afforded by first-mover advantages and complementary assets.[305]

Besides these innovation-side dynamic costs of patents, suppressing competition increases deadweight losses that generate static costs by reducing consumer welfare.[306] For certain innovations, such as pharmaceutical drugs, consumer deadweight losses often are quite large. According to a government study, generic drugs in a mature market are typically 15% of the pre-generic entry price of branded drugs and obtain 90% market share.[307] If a

300. Dan L. Burk & Brett H. McDonnell, *The Goldilocks Hypothesis: Balancing Intellectual Property Rights at the Boundary of the Firm*, 2007 U. ILL. L. REV. 575, 587 (2007); Wendy Seltzer, *Software Patents and/or Software Development*, 78 BROOK. L. REV. 929, 961 (2013) ("Kitch's theory draws heavily on the Coasean counterfactual, in which transaction costs are low and information easily available."); F. Scott Kieff, *The Case for Registering Patents and the Law and Economics of Present Patent-Obtaining Rules*, 45 B.C. L. REV. 55, 65 (2003) ("Kitch's response was to argue that the coordination costs are likely to be low in such early stages because there are likely to be only a small number of players then. But this response does not fully answer the problem. As Abramowicz correctly points out, the transaction costs may be high in such a community because the members may have significant cognitive biases. The transaction costs to coordinating may also be high if the racers do not know about each other.").

301. *See* Sichelman, *Commercializing Patents*, *supra* note 10 at 362–70.

302. Peter S. Menell, & Michael J. Meurer, *Notice Failure and Notice Externalities*, 5 J. LEGAL ANALYSIS 1, 10 (2013) ("Inadequate notice poses a risk of trespass or infringement upon other resource developers. Inefficient notice regimes raise development costs and generate wasteful litigation.").

303. *See id.* at 33 ("The imprecision of patent claim scope in the software and business method fields is so bad that many developers ignore patents at the front-end and deal with licensing and litigation.").

304. *See* Sichelman, *Commercializing Patents*, *supra* note 10 at 362–76.

305. Aghion et al., *supra* note 157, at 714.

306. *See supra* note 24.

307. FEDERAL TRADE COMMISSION, PAY-FOR-DELAY: HOW DRUG COMPANY PAY-OFFS COST CONSUMERS BILLIONS 8 (2010).

pharmaceutical would have been created and disseminated regardless of the patent, competition would substantially drive down price.[308] Thus, in addition to providing dynamic innovation benefits, competition will typically yield static benefits for consumers.[309]

B. THE IMPOSSIBILITY OF OPTIMAL INCENTIVES IN INTELLECTUAL PROPERTY

Taken as a whole, the importance of suppressing competition—and not just free riding—coupled with the potential costs from doing so present what I believe is an intractable problem in setting the appropriate balance in a dynamic setting to incentivize innovation through intellectual property (and this concern extends beyond patents).[310] Even if we had perfect information regarding current and all prior technology—including social value, private value, risks, costs, and the like—this intractability would nonetheless arise.[311]

Specifically, the uncertainty regarding the social value of what the future might bring technologically will always make it impossible to know whether

308. CONG. BUDGET OFFICE, HOW INCREASED COMPETITION FROM GENERIC DRUGS HAS AFFECTED PRICES AND RETURNS IN THE PHARMACEUTICAL INDUSTRY 13 (1998), cbo.gov/publication/10938 ("Considering only drugs sold through retail pharmacies, the Congressional Budget Office (CBO) estimates that the purchase of generic drugs reduced the cost of prescriptions (at retail prices) by roughly $8 billion to $10 billion in 1994."); Michael A. Carrier, *A Real-World Analysis of Pharmaceutical Settlements: The Missing Dimension of Product Hopping*, 62 FLA. L. REV. 1009, 1034 (2010) ("Allowing the patent holder to claim antitrust immunity for its contracts as if they were litigated injunctions, while evading the risk of patent invalidation, deprives consumers of significant benefits from price competition in the pharmaceutical industry.") (internal quotations omitted).

309. *Cf.* Carl Shapiro, *Patent System Reform: Economic Analysis and Critique*, 19 BERKELEY TECH. L.J. 1017, 1041 (2004) ("Given the benefits to consumers and competition when invalid patents are struck down, relying on dual public and private action to challenge patents seems highly desirable, much as we have dual enforcement of the antitrust laws."). *See generally* Northern Pacific Railway Co. v. United States, 356 U.S. 1, 4 (1958) ("[U]nrestrained interaction of competitive forces will yield the best allocation of our economic resources, the lowest prices, the highest quality and the greatest material progress."). A related static cost, namely administering the patent system, is also reduced by furthering competition. *See* Barnett, *supra* note 24 (noting administrative costs).

310. *See* Steven C. Salop & R. Craig Romaine, *Preserving Monopoly: Economic Analysis, Legal Standards, and Microsoft*, 7 GEO. MASON L. REV. 617, 648–49 (1999) (noting the complications that arise in a dynamic analysis of innovation); *see generally* Robert Pitofsky, *Antitrust and Intellectual Property: Unresolved Issues at the Heart of the New Economy*, 16 BERKELEY TECH. L.J. 535, 540-41 (2001) (noting the importance of innovation in a "dynamic economy").

311. *Cf.* Cass R. Sunstein, *Legal Interference with Private Preferences*, 53 U. CHI. L. REV. 1129, 1159 (1986) (noting the difficulties in economic modeling when there are "endogenously changing tastes," even in the presence of perfect information).

the structure of current intellectual property rights is optimal.[312] The level at which we suppress competition today will affect the nature of future innovation, and it is impossible to balance the value of innovation today with an unknown value tomorrow.[313] Thus, intellectual property is caught in a double-bind: an intellectual property "impossibility" theorem.[314] The only practical approach is to assume that the changes arising tomorrow relative to the state of the world today are roughly the same as the changes that arose today relative to yesterday. While practical, it is unlikely to appropriately balance the pro- and anti-innovative effects of decreased competition.

Ultimately, on a hedging view, intellectual property rights should begin at exactly that point where supernormal returns are absolutely necessary to incentivize socially desirable innovation over some reasonably short time period (e.g., twenty years), premised on the assumption that progress is fairly stable over long periods of time. These supernormal returns are generated by providing exclusionary legal rights that suppress competition, not just free riding.[315] As such, antitrust or competition law should play little to no role *within the proper scope* of the rights afforded by a properly issued patent. On the other hand, outside of these confines—for instance, for ordinary market activity—antitrust should generally play an active role, promoting strong competition, at least where the market cannot do so without regulatory intervention.[316] Unfortunately, given limited information and high information costs, it is often difficult, if not impossible, to determine the "proper" scope of patent rights.[317] Instead, patent law operates more along a fuzzy spectrum—

312. *See* Daniel J. Solove, *Privacy and Power: Computer Databases and Metaphors for Information Privacy*, 53 STAN. L. REV. 1393, 1452 (2001) ("Because this value is linked to uncertain future uses, it is difficult, if not impossible, for an individual to adequately value her information.").

313. *See* Richard A. Posner, *Antitrust in the New Economy*, 68 ANTITRUST L.J. 925, 938 (2001) (noting how the "rapid[ity] of innovation" may "make[] the future wholly uncertain").

314. *Cf.* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 34–35 (1991) (explaining the "double marginalization" that occurs between a first and second innovator because it is "impossible to give the surplus to both parties" in a manner that results in socially optimal incentives to innovate).

315. *See supra* Part II.

316. *See* Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 146 (1989) ("The Patent Clause itself reflects a balance between the need to encourage innovation and the avoidance of monopolies which stifle competition without any concomitant advance in the 'Progress of Science and the useful Arts.'"); Louis Kaplow, *The Patent-Antitrust Intersection: A Reappraisal*, 97 HARV. L. REV. 1813, 1829-37 (1984).

317. Herbert Hovenkamp, *Patents, Property, and Competition Policy*, 34 J. CORP. L. 1243, 1248 (2009) ("Insofar as competition policy is concerned, some of the biggest shortcomings of the patent system relate to its status as a system of property rights. The problems relate to two very general subjects that are well known to property lawyers: boundaries and priority . . .

where patent law ends and antitrust law begins can be quite a fraught process for those involved. [318] Patent and antitrust law may conflict in these boundary zones in ways that cannot be resolved in any determinate manner.

C. EXPLAINING AWAY "PATENTS AS A SOCIAL COST"

Several scholars have recently questioned whether patents—at least in their current form—yield any net social benefits.[319] In an influential study, James Bessen and Michael Meurer conclude that patent litigation overall yields at least a net private cost outside of the chemical and pharmaceutical industries. Furthermore, they contend that these costs outweigh any benefits from the value of patents in the marketplace, as determined in essence from renewal rates and aggregate estimated licensing fees.[320] As such, they assert that "patents likely provide[] a net disincentive for innovation for the firms who fund the lion's share of industrial R&D; that is, patents tax R&D."[321] Although there are notable flaws in this study, making its conclusions somewhat suspect,[322] even supposing their findings are correct, the hedging theory presented here runs counter to their conclusion that patents act as a "tax" on R&D.

Rather, like the purchase of insurance more generally, an innovative firm that purchases a hedge against competitive threats to its own or its licensees' profit stream would be expected to spend a significant sum to acquire and exercise the hedge.[323] Yet, because the hedge reduces risk in the overall innovative process, particularly in the commercialization of invention, it provides significant private and social economic value that is not captured by the valuation methods used by Bessen and Meurer. Specifically, because

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[M]uch of patent/antitrust doctrine arises from the fact that these ordinary and essential property limitations are so poorly defined within the patent system."); Craig Allen Nard, *Legal Fictions and the Role of Information in Patent Law*, 69 VAND. L. REV. 1517, 1535 (2016) ("The *Morse* case also highlights a broader policy issue in patent law: the determination of optimal claim scope—a very difficult endeavor.").

318. *See generally* Lee, *supra* note 297 (discussing the intersection of patents and antitrust in the context of Schumpeterian theory).

319. *See* Bessen & Meurer, *supra* note 69, at 5; MICHELE BOLDRIN & DAVID K. LEVINE, AGAINST INTELLECTUAL MONOPOLY (2008); Richard Stallman, *Patent Law Is, at Best, Not Worth Keeping*, 45 LOY. U. CHI. L.J. 389 (2013).

320. *See* Bessen & Meurer, *supra* note 69, at 99–118.

321. *Id.* at 144.

322. *See, e.g.*, Glynn S. Lunney, Jr., *On the Continuing Misuse of Event Studies: The Example of Bessen and Meurer*, 16 J. INTELL. PROP. L. 35, 37, 49–56 (2008).

323. Cindy W. Ma & Algis T. Remeza, *Life is Full of Derivatives*, 25 No. 3 FUTURES & DERIVATIVES L. REP. 7 (2005) ("However, the only sure way to lock in a price is to sell it, which may not be possible. A put option can prevent losses from a stock price decline, but put options alone are costly.").

renewals occur well after the point at which hedging risk is most important, patent values derived from renewal rates are very unlikely to reflect the economic value provided by firms using patents as hedges.[324] Similarly, one would not necessarily expect litigation to provide net positive returns to patentholders. Rather, because patentholders are repeat players—and the credible threat of litigation increases the value of patents as a hedge in the market—litigation may in fact be an expense that firms tolerate in return for ensuring that patents properly function as hedges.[325] In sum, by shifting from a static, neoclassical view that patents generate incentives by providing market power to price above competitive rates to a dynamic, Schumpeterian view that patents are primarily hedges to reduce risk of profit erosion from competition, the appropriate economic measure of how well patents perform their economic function itself shifts considerably.

V. CONCLUSION

At this point in the Article, one may quip that I have "hedged" against my own thesis of patents as tools to *suppress* competition in order to promote innovation by stressing the importance of *promoting* competition for the same end.[326] Unfortunately, my general view is that at least at present, there is no sufficiently rigorous theory to offer us a way out of the competition dilemma in innovation, other than in certain industrial pockets in which the answer is fairly clear. Rather, achieving the optimal balance between suppressing and promoting competition in the innovation process can only be answered by rigorous empirical research.

Armchair and even mathematically grounded theorizing will arguably be inadequate for the task, as there are many relevant variables that likely interact

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324. *See* Jonathan M. Barnett, *supra* note 309, at 1280 ("[L]ow renewal rates may have little to say about the relative effectiveness of patent protection to the extent that they simply reflect the fact that innovations are patented early in the innovative process and most turn out to have no or limited commercial application."). Another problem with renewal valuation is that given the relatively low cost of renewal, it becomes difficult to estimate the value of very high-valued patents, which may account for the very large percentage of overall patent value. *See* Mike Lloyd, *Tell Me Again-Why Should I Spend Money on Filing Patents?,* 45 LES NOUVELLES 37, 38 (2010) ("Valuing patents based on patent renewal data suffers from a major drawback in that the renewal fee becomes the minimum value of the renewed patent. This may systematically understate the value of the retained patents.").

325. *Cf.* James F. McDonough III, *The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy*, 56 EMORY L.J. 189, 216 (2006) ("By creating a credible threat of litigation, making patents more liquid, and setting market clearing prices, the patent market becomes more efficient.").

326. *See supra* Part III (explaining the importance of competition to the innovative process).

in a nonlinear fashion to generate interdependencies so fine that small changes in one parameter may radically shift optimal policy approaches. Moreover, legal systems operate across broad swathes of technologies and across many products and methods within a technological sector.[327] Patent agencies and courts cannot customize the law for each and every case based on a trove of facts. It is simply too expensive, and it is unclear that even with an unlimited budget, institutional competence would be sufficient to do so.

Thus, calls for a broad "independent invention" defense—that is, preferencing the role of competition in the innovation game—appear premature because they all turn on fairly simplistic theoretical models or assumptions about the patent system that simply cannot be borne out by our current knowledge of the innovation process. Here, my aim has been to provide an expanded theoretical lens—namely, viewing patents as hedges—in order to mount a defense of the long-historical baseline that patent infringement captures wholly independent activity.

327. Dan L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1156 (2002) ("Patent law has a general set of legal rules to govern the validity and infringement of patents in a wide variety of technologies."); Burk & Lemley, *Policy Levers in Patent Law*, *supra* note 50, at 1577 ("This seeming paradox—a monolithic legal incentive for wildly disparate industries—is resolved by the realization that, despite the appearance of uniformity, patent law is actually as varied as the industries it seeks to foster.").