ECONOMIC RATIONALES FOR THE PATENT SYSTEM IN CURRENT CONTEXT

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INTRODUCTION

Today's economy is defined by the prevalence of highly complex technology. Society increasingly relies on technological advances to solve some of its most pressing problems and grand challenges. Often, these technological products and processes involve the inventions of many different inventors and build upon existing inventions. At the same time, patent offices all over the world are receiving an increasing number of patent applications from domestic and foreign inventors.[1] Despite this general correlation, it is understood that inventors are not motivated to invent solely because of the rewards offered by the intellectual property system. Inventors are motivated by a myriad of factors in addition to intellectual property rights, including reputational gains, scholarly and industry recognition, and a commitment to advancing their field. Inventors are also motivated by the entrepreneurial opportunities created by inventing and often use patents as a means to advance this goal. Thus, innovative activity would likely occur in the absence of patents, even if it did not occur to the same degree as it would have with the availability of patent protection. As will be explained, patents do play an important role after the creation of new technology in facilitating technology transactions, securing financing for inventors, and enabling greater cooperation and collaboration between inventors and innovative firms.

The traditional reward theory, otherwise commonly referred to as ex ante rationales for patents, is not irrelevant in today's knowledge-based economy. Some inventors are still incentivized, at least in part, by the promise of excluding others from using their technology and the opportunity to charge supra-competitive prices. The patent system provides these benefits in exchange for an enabling disclosure of the inventive technology. However, this rationale only partially justifies the patent system. Instead,

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[1] *See, e.g.*, Jay P. Kesan et al., *Patenting—With Chinese Characteristics* (Univ. Ill. Coll. Law, Legal Studies Research Paper No. 15-12, 2014), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2469957.

scholars and commentators are looking to the benefits provided by patents after they are issued—the ex post justifications for patents.

Understanding whether, when, and how patents incentivize innovation is critical to forming an effective and efficient patent system.[2] Most immediately, an ex ante justification dictates a narrow scope for patents to avoid disincentivizing inventors from creating technology that relates to or improves the original technology.[3] On the other hand, ex post justifications "endorse a greater and perhaps unlimited duration and scope of intellectual property rights" to encourage rights holders to continue to efficiently manage technology.[4] Understanding how the patent system supports invention and innovation may also counter some statements for reforming or minimizing the patent system.[5] This Article examines several theories that explain and justify the role of patents in today's knowledge-based, technology-intensive economy. Part I explains the traditional, ex ante justifications for patents. Part II reviews several ex post justifications for the patent system. Then, Part III looks at how these economic rationales may differ across industries. Finally, Part IV examines the ex post benefits of patents in facilitating private ordering. This Part explains and provides examples of standard setting organizations ("SSOs"), patent pledges, and patent pools. It also examines the ex post benefits of patents derived from the ability to advance creative and flexible licensing arrangements.

I. EX ANTE RATIONALES FOR PATENTS

For decades, patents have been justified as a tool used to incentivize inventors.[6] By securing a patent, the holder can eliminate the risk that his invention will be immediately replicated by others who will free ride on the time, money, and energy that the inventor invested in the invention. The holder also enjoys the ability to charge a supra-competitive price for the invention, which allows him to recoup some of the cost of inventing.[7]

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2 *See, e.g.*, F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 707 (2001); Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 131 (2004); Daniel F. Spulber, *How Patents Provide the Foundation of the Market for Inventions*, 11 J. COMP. LAW & ECON. (forthcoming 2015); *but see generally* JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK (2008); ROBIN FELDMAN, RETHINKING PATENT LAW (2012).

3 Lemley, *supra* note 2, at 131.

4 *Id.*

5 *Id.*; Spulber, *supra* note 2 (manuscript at 2).

6 Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473, 473 (2005); F. Scott Kieff, *IP Transactions: On the Theory & Practice of Commercializing Innovation*, 42 HOUS. L. REV. 727, 732 (2005) ("The bulk of law and economics literature on U.S. IP regimes focuses on a reward theory of patents . . . ."); Lemley, *supra* note 2, at 129-30.

7 Lemley, *supra* note 2, at 131.

Without this incentive, the inventor may never invent and the world would be deprived of his potential creations.[8] Therefore, society is willing to grant the holder these benefits in exchange for the enabling disclosure of the inventive technology.

This rationale is based in large part on the economic theory proposed by political scientist Joseph Schumpeter.[9] In short, Schumpeter, and those inspired by his works, hypothesized that, although it may perhaps seem counterintuitive, a reduction in competition results in an increase in innovation.[10] Therefore, governments could intentionally reduce competition by granting patents in order to generate more innovation. In other words, governments issue patent rights to secure the possibility of monopoly power, and thereby reduce competition based on imitation, but not competition based on innovation. Others refute this theory and argue that competition spurs innovation, as a monopolist lacks the incentive to continue to innovate.[11]

Professors Philippe Aghion, Nick Bloom, Richard Blundell, Rachel Griffith, and Peter Howitt have presented a more nuanced understanding of the relationship between competition and innovation.[12] In an influential 2005 paper, Aghion and his co-workers demonstrated that Schumpeter's hypothesis only applies under certain circumstances, and that the relationship between competition and innovation, when plotted, resembles an in-

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8 *Id.*; *see also* CLOVIS HOPMAN ET AL., CPB NETH. BUREAU FOR ECON. POLICY ANALYSIS, THE RELATION BETWEEN COMPETITION AND INNOVATION: EMPIRICAL RESULTS AND IMPLEMENTATION INTO WORLDSCAN 7 (Memo. No. 242, 2010), *available at* http://www.cpb.nl/en/publication/relation-between-competition-and-innovation-empirical-results-and-implementation-worldsc (explaining that governments are willing to provide patents, despite the fact that they are contrary to competition, because innovation spurs economic growth); *see also* Philippe Aghion et al., *Revisiting the Relationship Between Competition, Patenting, and Innovation*, *in* ADVANCES IN ECONOMICS AND ECONOMETRICS 451, 451(Daron Acemoglu et al. eds., 2013) (describing competition and intellectual property rights as "complementary forces" supporting innovation).

9 *See generally* JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM AND DEMOCRACY (3d ed. 1950).

10 Schumpeter posits that higher competition might reduce expected monopoly rent (post-innovation rent) thus creating lower incentives to innovate. *See generally* Philippe Aghion & Peter Howitt, *A Model of Growth Through Creative Destruction*, 60 ECONOMETRICA 323 (1992); Philippe Aghion et al., *Competition and Innovation: An Inverted-U Relationship*, QUARTERLY J. ECON. 701, 703 (2005) [hereinafter Aghion, *Inverted U-Relationship*] (generally describing empirical work plotting innovation and competition based on Schumpeter's theory); Philippe Aghion et al., *Competition, Imitation and Growth with Step-by-Step Innovation*, 68 REV. ECON. STUD. 467 (2001).

11 Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1604 (2003) (citing Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY 609, 619-20 (Nat'l Bureau of Econ. Research ed., 1962). Burk and Lemley also cite 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) for the argument "that the Internet was as innovative as it was because its architecture required competition rather than monopoly bottlenecks." Burk & Lemley, *supra*, at 1605 n.91.

12 *See generally* Aghion, *Inverted U-Relationship*, *supra* note 10.

verse-U, rather than a downward slope.[13] The right hand side of the slope, where competition is higher, reflects the same effect noted by Schumpeter.[14] Under such circumstances, "laggards" have little incentive to innovate and the Schumpeterian theory seems to apply.[15] However, when competition levels are low, increasing competition actually increases innovation.[16] In these situations, the few market players involved are likely to be highly innovative in order to try to "escape" competition.[17] For example, consider the current race to innovate between Apple, HTC, and Android in the mobile phone industry. Verifiably mapping the relationship between competition and innovation remains one of the most challenging empirical questions in this field of work.

Additionally, a system built to provide ex ante incentives may have negative implications. Inventors have an incentive to claim overly broad patents, augmenting their monopolies and locking others out.[18] By granting one inventor a broad patent, the system essentially deters other potential inventors from working on the same or similar issues. Overall, this can lead to fewer and less valuable inventions.[19] Additionally, patents may incentivize inventors to patent rather than to invent. By making patents so valuable, the system may encourage firms to over-invest in racing to patent, rather than invest less in the same invention with more time.[20]

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13 *Id.* For criticism of Aghion's argument, see HOPMAN ET AL., *supra* note 8, at 11 ("[T]heoretical models such as those by Aghion et al. (2005) . . . provide a useful way of discussing the various mechanisms that could play a role in the interaction between competition and innovation, but their predictions are highly dependent on the details of the models such as the question whether innovation is step-by-step or leapfrogging is allowed, or whether firms are myopic or not. As a result, these models yield very little predictive power, and there is an important role for further empirical research to discern what the relevant economic mechanisms are."). Aghion et al. also relied on the number of patents filed by firms in an industry as the sole measure of innovation. Patents may be an incomplete and imprecise measure of innovation by firms in an industry if they do not patent the results of their research. *See, e.g.*, Michael J. Cooper et al., Measuring Innovation (March 2, 2015) (unpublished manuscript), *available at* http://ssrn.com/abstract=2572815.

14 Aghion, *Inverted U-Relationship*, *supra* note 10, at 714-16.

15 *Id.* at 716.

16 *Id.* at 715.

17 *Id.* at 715-16.

18 Jay P. Kesan, *Intellectual Property Protection and Agricultural Biotechnology: A Multidisciplinary Perspective*, 44 AM. BEHAV. SCIENTIST 464, 471 (2000) [hereinafter Kesan, *Intellectual Property Protection*]. *See generally* Jay P. Kesan & Andres A. Gallo, *Why "Bad" Patents Survive in the Market and How Should We Change?—The Private and Social Costs of Patents*, 55 EMORY L.J. 61 (2006).

19 Kesan, *Intellectual Property Protection*, *supra* note 18, at 488.

20 *Id.*; *see* Matthew Erramouspe, Comment, *Staking Patent Claims on the Human Blueprint: Rewards and Rent-Dissipating Races*, 43 UCLA L. REV. 961, 962 (1996) (comparing patent races to the gold rush and noting that "[a]lthough a gold rush has its winners, many claims are ultimately unproductive, and thus many prospectors waste valuable resources and go unrewarded. Gold rushes are also unproductive in a broader social sense. Follow-on prospectors bid resources away from higher valued uses outside the prospecting industry to lower valued uses inside it"); *but see* Lemley, *supra* note 2, at 132 n.8 (arguing that "the costs of patent races are substantially overstated" and that "the costs of dupli-

The ex ante justification also fails to explain why inventors invent in some circumstances, and thus, by itself, fails to justify patents. Numerous studies looking at patent systems around the world conclude that, in general, firms do not consider patents alone to be a significant motivation to invent.[21] For example, in a 2008 study conducted by Professors Stuart J.H. Graham, Robert P. Merges, Pamela Samuelson, and Ted M. Sichelman, many executives at startup companies reported that patents provided only a weak incentive to engage in innovative activity.[22] This subjective indication is corroborated by the fact that many early stage companies hold no patents.[23] In another study, more than half of the firms surveyed reported that their inventions would have been created even if there were no patent system.[24] Instead, patents are just one tool considered by inventors for protecting intellectual property.[25] Many rely purely on secrecy. Others are able to capture the value of their invention by being the first to bring the technology to the market, giving them a "head start" advantage over competitors.[26] Economic historian Petra Moser compiled data on new inventions and pa-

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cation of effort must be weighed against the likelihood that we get better results through competition than we would by granting one person the right to invent in a particular field"). *See also* Kieff, *supra* note 6, at 734 (citing JAMES M. BUCHANAN & GORDON TULLOCK, THE CALCULUS OF CONSENT: LOGICAL FOUNDATIONS OF CONSTITUTIONAL DEMOCRACY (1962)).

21 James Bessen & Michael J. Meurer, *Lessons for Patent Policy from Empirical Research on Patent Litigation*, 9 LEWIS & CLARK L. REV. 1, 7 (2005) (reviewing a number of surveys designed to establish a ratio measuring the "incentive effect of patents after taking other incentives into account" and concluding that "patents generally create a premium sufficient to cover [only] a relatively small fraction of the cost of R&D"); Julien Penin*, Patents Versus Ex Post Rewards: A New Look*, 34 RES. POL'Y 641, 647 (2005) (summarizing a number of studies that reach the conclusion that patents alone do not motivate inventors to create).

22 Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1285-87 (2009); *see also* Burk & Lemley, *supra* note 11, at 1592 (noting that enforcement rights must not be the primary reason that many inventors patent, as most patents are never enforced).

23 Graham et al., *supra* note 22, at 1275-77. Note, however, that the majority of startup companies in certain industries (biotechnology and medical devises) do hold patents. *Id.*

24 Penin*, supra* note 21, at 647.

25 Bessen & Meurer, *supra* note 21, at 6 ("Surveys of R&D managers reveal that firms have other, often stronger, R&D incentives stemming from lead time advantage, learning, complementary products, and secrecy."); Petra Moser, *How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World's Fairs*, 95 AM. ECON. REV. 1214, 1215 (2005) [hereinafter Moser, *How Do Patent Laws Influence Innovation?*] ("[I]nventors may be able to achieve conditions similar to patent monopolies by keeping innovations secret, by beating competitors to the market, or by maintaining tight control over assets that are complementary to the commercial exploitation of the innovation.").

26 BIRGITTE ANDERSEN, THE RATIONALES FOR INTELLECTUAL PROPERTY RIGHTS: THE TWENTY-FIRST CENTURY CONTROVERSIES (DRUID Summer Conference Paper, 2003), *available at* http://www.druid.dk/conferences/summer2003/papers/B_ANDERSEN.pdf. "The argument, is that if an inventor is really ahead [of] other inventions, then the time interval before catching up and imitation have happened (which is difficult as it requires learning) should already secure the inventor profits and rent for their contribution . . . ." *Id*. at 6.

tents from the world's fairs.[27] She discovered that patenting was much less prevalent in industries where the technology was more difficult to reverse engineer.[28] For example, food processing, chemistry, mining, and textiles industries had the lowest patent rates for British inventors at the studied fairs.[29] In contrast, manufacturing machinery, which could be easily replicated if a competitor had the opportunity to observe the machine, was much more likely to be patented.[30] However, scientific breakthroughs like the periodic table of elements made it simpler for a competitor to reverse engineer a product, thus lowering the effectiveness of secrecy protections.[31] As predicted, Moser observed that inventors in fields typically reliant on secrecy began patenting at an increased rate after such a breakthrough discovery.[32] In fact, as the next Part demonstrates, one of the better ex post rationales for patents is that they minimize the inefficiencies and costs of secrecy.

II. EX POST JUSTIFICATIONS FOR PATENTS

Even if patents are not needed to incentivize innovation, scholars still believe patents are necessary for other reasons such as increasing economic efficiency. While traditional justifications for patents focus on incentivizing the inventor to create, many new theories focus on incentivizing the efficient and beneficial use, improvement, and commercialization of technology after it has been invented.[33] The traditional perspective regards patents as

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27 *See generally* Petra Moser, *Why Don't Inventors Patent?* (Nat'l Bureau of Econ. Research, Working Paper 13294, 2007) [hereinafter Moser, *Why Don't Inventors Patent?*], *available at* http://www.nber.org/papers/w13294; Moser, *How Do Patent Laws Influence Innovation?*, *supra* note 25 (examining patent data from the world's fairs to determine the effect of patenting on the direction of innovation).

28 Moser, *Why Don't Inventors Patent?*, *supra* note 27, at 7-8.

29 *Id.* at 18.

30 *Id.*

31 *Id.* at 26-29.

32 *Id.* at 29; *but see* B. Zorina Khan, *Inventing in the Shadow of the Patent System: Evidence from 19th-Century Patents and Prizes for Technological Innovations* 4, (Nat'l Bureau of Econ. Research, Working Paper 20731, 2014), *available at* http://www.nber.com/papers/w20731 (noting that the results of Moser's study are "interesting and important" but that "it is difficult to extrapolate from such data to make general statements about the propensity to patent").

33 *See, e.g.*, ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY (2001) (presenting evidence that the markets for technology are large and growing); Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337, 378 (2008) (offering an original perspective on ex post theories involving market experimentation); Lemley, *supra* note 2, at 130; Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 402 (2010) (proposing a separate patent regime for commercialization with weaker protection); David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 288-90 (1986); *see also* Kieff, *supra* note 2, at 710 ("The patent right to exclude competitors who have not shared in bearing [the] initial costs provides incentives for the holder of the invention and the other players in this market

completing their economic function when they are granted.[34] This position ignores the important economic functions performed by patents after they are granted.[35] Patents reduce transaction costs, help convert inventions into transferable assets, promote disclosure, provide a system of certification and standardization, and allow greater divisibility of technology.[36] They also support cooperation and collaboration between innovators, and signal to investors, collaborators, and adopters important information about the technology they represent and the firms that invent that technology.[37] All of these functions make transactions in the marketplace for inventions more efficient, to the benefit of both inventors and consumers.

To explain their post-grant value, Professor Edmund Kitch compared patents to mineral claims.[38] A mineral claimant cannot initially know whether the land will provide significant returns, but, so long as he claims it first, he is granted the exclusive right to extract what minerals might be had.[39] Similarly, an inventor often files for a patent before he knows the extent of what the technology offers.[40] Regardless of the comparative effort by different inventors that goes into the initial discovery, whoever files first is awarded the patent.[41] In both scenarios, the property right encourages the rights holder to further invest in the property. Policy makers persuaded by this argument would support broad, potentially perpetual patent rights, as such maximizes the holder's continued incentive to invest in the technology.[42] However, this theory assumes that the original investor is in the best position to invest in and commercialize the invention. Often, this is untrue.[43] Additionally, protecting an inventor's exclusive ability to control such an expansive bundle of rights may be anticompetitive.[44]

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to come together and incur all costs necessary to facilitate commercialization of the patented invention.").

34 *See, e.g.*, Spulber, *supra* note 2 (manuscript at 3).

35 *Id.*

36 *Id.* (manuscript at 2-4).

37 *Id.* (manuscript at 3).

38 Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 271 (1977).

39 *Id.*

40 *Id.*

41 *Id.* at 273. The United States shifted from a "first-to-invent" to a "first-to-file" system with the passage of the America Invents Act. This provision is codified at 35 U.S.C. § 102(a)(1) (2012).

42 Lemley, *supra* note 2, at 131; Spulber, *supra* note 2 (manuscript at 3-4).

43 Lemley, *supra* note 2, at 137-38 ("Creators are often terrible managers. They frequently misunderstand the significance of their own invention and the uses to which it can be put. And many patent owners are 'paper patentees' who never even built their invention; giving them control over distribution hardly seems a recipe for success." (footnote omitted)).

44 Kitch acknowledged that "the pre-antitrust, nineteenth-century patent system was probably more of a prospect system than the twentieth-century system has been," but does not view this as a concern. Kitch, *supra* note 38, at 267; *see also* Lemley, *supra* note 2, at 135 ("The argument that a

Similarly, many scholars compare intellectual property rights with real property rights, and stress the importance of private ownership to avoid a tragedy of the commons.[45] With real property, the theory holds that private ownership, and its inherent risks and rewards, incentivizes the owner to make efficient use of the property.[46] Without private ownership, the property is overused or inefficiently used by those who stand to lose nothing once the property value is depleted.[47] Some argue that intellectual property will be squandered the same way if left available to the public.[48] This comparison seems to overlook the critical difference between real and intellectual property—that the use of intellectual property is non-rivalrous.[49] Knowledge and information is not depleted as it is used. Although the consumption of inventions is non-rivalrous, the applications of these inventions may be rivalrous.[50] By adhering to the user-pays principle, firms have an incentive to make efficient decisions regarding the adoption of technologies and efficient decisions to invest in research and development ("R&D").[51]

A. *Patents as the Basis for the Market for Inventions*

More convincingly, many scholars point to the coordination value of patents to justify the patent system.[52] Patents facilitate efficient cooperation

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single company is better positioned than the market to make efficient use of an idea should strike us as jarringly counterintuitive in a market economy.").

45 *See generally* Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968) (explaining the need for private ownership of property to prevent overuse and coining the term "tragedy of the commons").

46 *Id.* at 1245.

47 *Id.* at 1244.

48 *E.g.*, William M. Landes & Richard A. Posner, *Indefinitely Renewable Copyright*, 70 U. CHI. L. REV. 471, 475 (2003) (arguing that copyrights are critical to prevent exploitation of copyrightable material); Gerard N. Magliocca, *One and Inseparable: Dilution and Infringement in Trademark Law*, 85 MINN. L. REV. 949, 975–82 (2001) (arguing that trademarks are needed to prevention exploitation of a mark in such a way that would diminish the mark's value).

49 Lemley, *supra* note 2, at 143; *see also* James Boyle, *The Second Enclosure Movement and the Construction of the Public Domain*, 66 LAW & CONTEMP. PROBS. 33, 41 (2003) ("[A] gene sequence, an MP3 file, or an image may be used by multiple parties; my use does not interfere with yours.").

50 Daniel Spulber, *Prices Versus Prizes: Patents, Public Policy, and the Market for Inventions* 14 (Northwestern Law & Econ. Series, Working Paper No. 14-15, 2014). Lemley characterizes this argument as the fear that, without IP protection, "different people will use an idea until the marginal value of an additional use declines to zero." Lemley, *supra* note 2, at 144. He notes that while this is true, it is not bad for society—it is the natural effect of efficient competition. *Id*.

51 Spulber, *supra* note 2 (manuscript at 50). Spulber compares intellectual property in this context to movies, books, or news media, which are all consumed in a non-rivalrous manner but are subject to private property rights. *Id.*

52 *See* Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 843 (1990) (emphasizing the efficiency gains from the ability to coordinate as opposed to granting strong patent protection to the original inventor); Penin, *supra* note 21, at 648 ("[I]n

and collaboration between inventors, commercializers, and adopters by serving as a definable, transferable asset, by signaling important information regarding the technology and the inventor, by promoting modularity, and by otherwise reducing transaction costs. In serving these roles, patents form the basis of the market for inventions.[53] Since the patents can be transferred openly, the market can more accurately establish the value of the patented technology.[54] These benefits rely on key features of the patent system, namely, exclusion, transferability, disclosure, certification, standardization, and divisibility.[55] This Section examines these features.

A patent, like the title to a vehicle, can be easily transferred, defines the technology represented, and makes it simple for parties to trace ownership.[56] By filing for a patent, an inventor publicly registers his right in a traceable manner, which minimizes the threat of others exploiting the information.[57] Without the patent system, inventors would have to rely on secrecy, including complex, costly confidentiality contracts, to protect their information.[58] Presumably, a reduction in costs spurs an increase in patent transactions. For example, following the passage of the Bayh-Dole Act, universities did not necessarily produce more or better research, but began patenting and licensing at far greater rates.[59] It is believed that this increase

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a knowledge-based economy, in which coordination problems may be more important than appropriation ones, firms use patents not in order to appropriate their innovations and to exclude other firms but rather in order to facilitate coordination with the other actors of innovation."); *see also* F. Scott Kieff, *A* Keirestu *Approach to Patents*, INTELL. ASSET MGMT. 51, 52 (2007) (also noting the how the strong right to exclude can help facilitate constructive coordination among those who seek to commercialize inventions and technology).

53 *See generally* Spulber, *supra* note 2 (describing patents as crucial for transactions in intellectual property); *see also* B. Zorina Khan & Kenneth L. Sokoloff, *Institutions and Technological Innovation During Early Economic Growth: Evidence from the Great Inventors of the United States, 1790-1930*, at 1, (CESifo, Working Paper No. 1299, 2004) (arguing that "defining and enforcing a tradable asset in new technological knowledge is extremely important for fostering a market in technology"); Penin, *supra* note 21, at 649 (explaining how patents facilitate technology transactions).

54 The market guides inventors to invest efficiently in R&D and supplies the patent holder with innovative control. Spulber*, supra* note 2 (manuscript at 2-3).

55 *Id*. at 3. Bessen & Meurer argue that "the patent premium ultimately derives entirely from the rights of exclusion created by the patent grant." Bessen & Meurer, *supra* note 21, at 9.

56 Heald, *supra* note 6, at 480-82 (demonstrating the value of recording a patent interest in comparison to guarding the information as a trade secret and concluding that "the patent title system greatly reduces the cost of identifying the quality of the legal rights the transferor grants and establishes a liability regime that does not require the transferee to enter into a costly array of protective agreements").

57 *Id.*

58 *Id.*

59 *Id.* at 490 (citing Rebecca Henderson et al., *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965-1988*, 80 REV. ECON. & STAT. 119 (1998)); Jay P. Kesan, *Transferring Innovation*, 77 FORDHAM L. REV. 2169, 2193 (2009) (urging universities to go beyond revenue generation by encouraging entrepreneurship and commercialization activities).

"reflects an increased rate of technology transfer to the private sector, and this has probably increased the social rate of return to university research."[60]

Reliance on secrecy to protect innovation can drive a whole range of business decisions that relate to coordination and private ordering. These range from buy vs. build decisions (i.e., a firm may choose to build its own server farm to avoid potential disclosure of a secret algorithm by implementing it on servers outside its control) to the disclosure of technical information that is essential to complementary products and services. Additionally, in some cases, there are significant direct costs associated with the efforts to maintain secrecy (e.g., active investment in technological protections or product design features to increase the cost of reverse engineering). These activities not only impose direct costs on the product maker, but other ancillary costs in the form of, for example, reduced ability to integrate or repurpose proprietary technologies, reduced availability of complementary products or services, and the like. The existence of a patent system, then, minimizes the inefficiencies and costs associated with the use of secrecy to protect innovation.

The disclosure of technical and legal information that occurs when an inventor files a patent claim that is subsequently published also helps establish a market for inventions and reduces transaction costs.[61] A patent claim includes a disclosure of critical information about the invention and the scope of protection accorded by the issued patent claims.[62] Once the patent is issued, the patentee can enter into negotiations with potential buyers or licensors without risking misappropriation,[63] and without having to regenerate this information every time.[64] Without disclosures, potential inventors are likely to unknowingly duplicate each other's efforts.[65] This could be

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60 Henderson et al., *supra* note 59, at 126.

61 "A time-limited exclusive right to subject matter which was neither known, nor obvious from what was known, *takes nothing from the public which it had before.* As a necessary corollary, the disclosure in a valid patent gives to the public knowledge it did not possess, actually or potentially, and thereby makes for progress." Giles S. Rich, *Laying the Ghost of the "Invention" Requirement*, 41 AIPLA Q.J. 1, 5-6 (2012). Disclosure is important to many inventors, particularly scientists, who are eager to publish their work. The patent system, which requires the inventor to refrain from publishing until the claim is filed, is sometimes seen as inhibiting disclosure, though this fault has been alleviated by the introduction of provisional patenting. 35 U.S.C. § 111(b) (2012) (enacted in 1995).

62 U.S. Patent Act, 35 U.S.C. § 112(a) (2012) ("The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out the invention.").

63 *See generally* Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477 (2005) (recognizing that patents and other IP play an important role in promoting transaction efficiencies by providing protections for the disclosure of information in contract formation and by adding flexibility in contractual enforcement).

64 Kesan, *Intellectual Property Protection*, *supra* note 18, at 489.

65 *Id.*; Kitch, *supra* note 38, at 278.

grossly inefficient and needlessly costly, though it can be argued that a better result is produced when multiple parties are working individually towards the same goal.[66] Disclosure also increases transaction efficiencies by reducing search costs. The United States Patent and Trademark Office ("USPTO") and many private firms provide a searchable database that potential adopters can use to learn about what technologies are available, reducing their search costs.[67] Inventors also benefit from this feature, as it reduces their need to publicize their inventions to potential adopters.[68] Disclosure also increases the amount of information available about a patented technology, reducing the asymmetry of information in negotiations and thus minimizing the chances of adverse selection.[69] Lastly, disclosure "helps third parties avoid making reasonable investment backed expectations in the territory that could be targeted for threat of patent holdup by valid patent claims."[70]

Reliance on the technical disclosure in the patent specification to learn about the patented technology may be somewhat limited.[71] Often the technical information in a patent becomes known to researchers in the field, through publications in journals or conference proceedings by the inventors, long before the patent application is publicly available. In addition, the information in the patent document may only represent a good starting point to do further experimentation, or require additional know-how to realize a product or service that is ready for the market, leading other competitors to discount the information disclosed in the patent. Finally, in some technology sectors, such as software, the enablement and written description requirements may not be adequately policed by the USPTO, resulting in an inadequate technical description in the patent specification.[72]

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66 Lemley, *supra* note 2, at 132 n.8.

67 The USPTO database is available at: http://patft.uspto.gov.

68 Spulber, *supra* note 2 (manuscript at 8-9); *see also* Daniel W. Elfenbein*, Publications, Patents, and the Market for University Inventions*, 63 J. ECON. BEHAV. & ORG. 688, 691 (2007) (noting that "a patent more than doubles the likelihood of finding a license partner").

69 Spulber, *supra* note 2 (manuscript at 9).

70 F. Scott Kieff & Anne Layne-Farrar, *Incentive Effects from Different Approaches to Holdup Mitigation Surrounding Patent Remedies and Standard-Setting Organizations*, 9 J. COMPETITION L. & ECON. 1091, 1101 (2013). Kieff & Layne-Farrar assert, however, that the threat of patent holdout is overstated and note that the current certification and standardization procedures are successful at minimizing this risk. *Id.* at 1101-02, 1104.

71 Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 560 (2009) (stating that technologists may not find pertinent information for their research in patent documents); *see also generally* ROBIN FELDMAN, RETHINKING PATENT LAW 52-53 (2012) (describing the limitations of the disclosure rationale in the patent system); Alan Devlin, *The Misunderstood Function of Disclosure in Patent Law*, 23 HARV. J.L. & TECH. 401, 403 (2010); Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information?*, 25 HARV. J.L. & TECH. 531 (2012) (finding through a survey that a minority of scientists do learn from patents).

72 Jay P. Kesan, *Carrots and Sticks to Create a Better Patent System*, 17 BERKELEY TECH. L. J. 763, 765 (2002) [hereinafter Kesan, *Carrots and Sticks*] (urging the use of representational languages

Disclosure through the patent document issued by the USPTO also serves to certify and explicate the patent claims. Anyone interested in some piece of technology knows from the presence of an issued patent claim that the technology may be useful, novel, and nonobvious.[73] By initially reviewing the patent claims against the prior art, and certainly after a post-issuance patent review, the USPTO saves potential transferees, licensees, or collaborators from having to screen every potential available technology themselves.[74] That said, the concern about the quality of patents issued by the USPTO that implicates the notice and breadth of the patent rights is likely to be an ongoing concern prompting significant research, and proposals for reform.[75] Another fundamental way to improve the quality of issued patents is through structural reform of the USPTO, achieved by appropriately fashioning the incentives within the Office.[76] In theory, the harsh punishments for providing false information in a patent and its prosecution history further ensure that the information disclosed is accurate,[77] though challenges to the veracity of patent applications are rarely successful.[78] Lastly, the

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employed by programmers to describe software functionality in patent specifications to improve software patent disclosures).

73 *See* 35 USC § 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."); *but see* Kesan, *Carrots and Sticks, supra* note 72, at 147 (asserting that it is well recognized that the patent office grants overbroad patents because it lacks sufficient knowledge of the relevant prior art); Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625, 667 (2002) (noting how "[t]he PTO is an imperfect mechanism . . . for assuring that the information contained in a patent is credible").

74 *See* Elfenbein, *supra* note 68, at 691 (noting that "new technology can be difficult to describe and even more difficult to investigate").

75 *See, e.g.*, Peter S. Menell & Michael J. Meurer, *Notice Failure and Notice Externalities*, 6 J. LEGAL ANALYSIS 1 (2014); *see also* Kesan, *Carrots and Sticks*, *supra* note 72, at 787-792.

76 *See, e.g.*, Michael D. Frakes & Melissa F. Wasserman, *Does Agency Funding Affect Decisionmaking?: An Empirical Assessment of the PTO's Granting Patterns*, 66 VAND. L. REV. 67 (2013); Michael Frakes & Melissa F. Wasserman, *Does the U.S. Patent & Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment*, 67 STAN. L. REV. (forthcoming 2015), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2426321; Michael Frakes & Melissa F. Wasserman, *The Failed Promise of User Fees: Empirical Evidence from the United States Patent and Trademark Office*, 11 J. EMPIRICAL LEGAL STUD. (forthcoming), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2295561.

77 Duty to Disclose Information Material to Patentability, 37 C.F.R. § 1.56 (2014).

78 *See* Long, *supra* note 73, at 668-69 (noting that "the inequitable conduct provisions apply only to certain types of information" and "creates an incentive for patentees to remain willfully ignorant of information that might weaken the patent application, thus lowering the information value of the patent"); Kesan, *Carrots and Sticks*, *supra* note 72, at 771 (citing *Kingsdown Med. Consultants, Ltd. v. Hollister Inc.*, 863 F.2d 867, 873 (Fed. Cir. 1988) for the rule that "even gross negligence in failing to disclose prior art is not in itself sufficient to prove an intent to deceive the Patent Office"). The cost of detecting misstatements in a patent claim further reduces the likelihood that the candor of a patent claim is challenged. Long*, supra* note 73, at 669.

USPTO provides parties with a reliable means to track the assignment of patent rights.[79]

The standardized nature of patents also facilitates trade in inventions. A patent itself is a "standardized document[] with an application number, a bar code, an application date, a date of the grant, names of inventors, names of assignees, a title, an abstract, citations to prior patents, and formal specification of claims."[80] Because all patents contain the same elements, those transacting in patents are well trained to understand what each element entails and how to use that information. Transacting parties can easily incorporate these elements into their transfer agreements, thereby reducing contracting costs.[81] Additionally, this uniformity makes it easier for a potential transferee or investor to compare different patents and transactions.[82]

Armed with a patent as a transferable asset, inventors can more efficiently work with commercializers and collaborators.[83] Consider an academic researcher who creates some technology. The researcher likely lacks the ability to commercialize the technology himself, as does the university that likely owns the patent rights.[84] The owner of the patent rights may not even know who is interested in commercializing the technology. Similarly, independent inventors often lack the funding to produce and market their innovations. By patenting their technology, inventors can enlist the assistance of other entities, like technology transfer offices that specialize in locating interested parties and can turn the technology over for commercialization. By selling their patents, inventors can focus on their specialty, appropriate the benefits of their efforts, and allow their innovations to be efficiently commercialized.[85]

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79 35 U.S.C. § 261 (2012) ("An assignment, grant, or conveyance [of a patent] shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent and Trademark Office within three months from its date or prior to the date of such subsequent purchase or mortgage."). The recording requirement, however, applies only to when the entire bundle of rights is transferred, and thus does not include licensing agreements. 37 C.F.R. § 3.1 (2014); Spulber, *supra* note *2* (manuscript at 13).

80 Spulber, *supra* note 2 (manuscript at 23); *see also U.S. Patent & Trademark Office*, USPTO, http://www.uspto.gov (last visited May 31, 2015).

81 *See* Spulber, *supra* note 2 (manuscript at 24) ("Standardization allows buyers and sellers to focus their attention on the idiosyncratic features of the transaction at hand.").

82 *Id.* at 25.

83 *See* Penin, *supra* note 21, at 642 ("Nowadays, the consensus that emerges from empirical studies is that in a knowledge-based economy patents assist the collective process of innovation by easing technology trading and inter-firm collaborations.").

84 Thomas Hellmann, *The Role of Patents for Bridging the Science to Market Gap*, 63 J. ECON. BEHAV, & ORG. 624, 626 (2007); Elfenbein, *supra* note 68, at 692 ("Universities and national labs . . . rarely become directly involved in the commercialization process. Rather the dominant mode through which these entities have participated in commercialization is through licensing intellectual property rights to established firms, start-ups, and faculty-directed ventures.").

85 Khan, *supra* note 32, at 17-18; *see also* Khan & Sokoloff, *supra* note 53, at 18 (comparing the early U.S. patent system with those in Europe and noting that "[a] market orientation enabled patentees

Similarly, innovation is more efficient when numerous parties can specialize in component pieces that contribute to one collaborative project, rather than having to create each product on their own. Today's technology market is replete with examples of such projects. For example, an Apple iPhone is made up of at least fifteen principal components created by at least eleven different technology companies.[86] In this way, patents appropriate the value added to a final product at each step along a value chain. Consider a bottle of canola oil that a consumer might purchase at a grocery store. Behind the seemingly simple, inexpensive final product are many patented technological advances.[87] A life sciences firm first developed the canola seed through R&D.[88] The seeds are purchased by suppliers who sell them to farmers.[89] The farmers plant the seeds using certain machinery, such as combines equipped with global positioning systems.[90] The harvested crop is then sold to a processor, and finally to a distributor before coming to rest on the store shelf.[91] Each of these steps involves patented technology. The patent rights attached to each component ensure that the various contributors will not lose the value of their input.

Additionally, the component makers can cooperate with other firms to make the components compatible, without the need for complex contracts to maintain confidentiality, thereby overcoming economist Kenneth J. Arrow's information disclosure paradox.[92] This modularity allows parties to

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to extract income (or raise capital) from their ideas by selling them off to a party better positioned for commercial exploitation, and thereby encouraging a division of labor that helped creative individuals specialize in their comparative advantage"). *See also* Kesan, *Intellectual Property Protection*, *supra* note 18, at 472 (explaining how public-private licensing agreements have been hugely beneficial in the biotechnology industry, as public entities (i.e., universities) are often willing and able to undertake research considered too risky by private firms).

86 *Apple Doesn't Make the iPhone*, PRODUCTS REV. CAN. (Aug. 13, 2011), http://www.productreviewscanada.com/2011/08/apple-doesnt-make-iphone.html. It has been estimated that up to $120 from the sale of every smartphone can be attributed to patent licensing costs. Ann Armstrong et al., The Smartphone Royalty Stack: Surveying Royalty Demands for the Components Within Modern Smartphones 2 (May 29, 2014) (unpublished manuscript), *available at* http://ssrn.com/abstract=2443848. However, this estimate is likely overstated. Keith Mallinson, *Stacking the Deck in Analysis of Smartphone Patent Licensing Costs*, WISE HARBOR (Sept. 19, 2014), http://www.wiseharbor.com/pdfs/Mallinson%20on%20Intel%27s%20Smartphone%20Royalty%20Stack%2019Sept2014.pdf. Even if the true patent licensing costs are far less than this estimate, it is clear that they are significant.

87 *See* Kesan, *Intellectual Property Protection*, *supra* note 18, at 466-68 (charting how value is added through the application of patented technology at each step of a value chain).

88 *Id.* (see Figure 1).

89 *Id.*

90 *Id.*

91 *Id.*

92 Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 615 (Nat'l

bargain for exactly the technology they need,[93] and fosters greater interaction between inventors of complementary technologies.[94] Without patents, firms would be more likely to rely on vertical integration—making each component themselves, or acquiring outside component makers—which would be significantly less efficient.[95] With patents, society benefits from the more efficient creation of a product made with component pieces that are likely superior to those that would be created without their makers' abilities to specialize.[96] Similarly, patent protection allows technology firms to collaborate with one another through joint R&D by reducing the risk of misappropriation and minimizing the need for costly contracting.[97] How firms utilize private ordering to maximize the benefits of collaboration is further discussed in Part IV.

B. *Patents as Signals*

Patents are also valuable because they serve critical signaling functions.[98] When an inventor files his patent, the patent claim is publicly published.[99] This public disclosure sends important signals to potential com-

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Bureau of Econ. Research ed., 1962) (stating that, absent legal protection, sellers will not disclose information to buyers, and as a result, buyers will not be able to value that information, leading to the information paradox); Kitch, *supra* note 38, at 277-278 (noting the difficulty of entering into contracts regarding trade secrets as "[d]isclosure of the secret imperils its value, yet the outsider cannot negotiate until he knows what the secret is"); *see also* Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 258 (2012) (highlighting a range of strategies including intellectual property protection for engaging in information exchange); Kesan, *Intellectual Property Protection*, *supra* note 18, at 489 (also noting the difficulty of selling a secret).

93 Spulber, *supra* note 2 (manuscript at 11).

94 Henry E. Smith, *Institutions and Indirectness in Intellectual Property*, 157 U. PA. L. REV. 2083, 2095-96 (2009).

95 Vertical integration may still be necessary to avoid patent holdout in some circumstances. Kieff & Layne-Farrar, *supra* note 70, at 1094-96. Cahoy and Glenna consider vertical integration as a form of private ordering that can be beneficial overall in that it allows technology not otherwise available to enter the market. Daniel R. Cahoy & Leland Glenna, *Private Ordering and Public Energy Innovation Policy*, 36 FLA. ST. U. L. REV. 415, 440-41(2009). Vertical integration is designed to increase efficiency. It is not necessarily less efficient compared to transactions involving patents in all circumstances.

96 Spulber, *supra* note 2 (manuscript at 26-27). Spulber compares the ability of firms to specialize their R&D in this manner to the division of labor. *Id.* (manuscript at 27).

97 Penin, *supra* note 21, at 650. For a discussion on the importance of coordinated R&D in the agricultural biotechnology industry, see Kesan, *Intellectual Property Protection*, *supra* note 18, at 470.

98 *See generally* Long, *supra* note 73. For a criticism of this theory, see Bessen & Meurer, *supra* note 21, at 9 n.37 ("We are skeptical of the empirical significance of patent signaling . . . . Patent applications are too costly compared to other signals . . . to justify patenting."). Even if the signaling value of patents does not completely justify patenting on its own, this valuable function ought to be recognized when considering policy options.

99 *See Patent Full-Text Database*, USPTO, http://www.uspto.gov/patft/index.html (last visited May 31, 2015).

mercializers, other inventors, complementary asset holders, and investors.[100] Without the patent rights, inventors may rely on secrecy to protect their inputs. Additionally, the standardized form of a patent claim ensures a degree of credibility, and makes it easy to compare claims.[101] High signaling value may explain why some industries that focus on other strategies, like first mover advantages, still seek patents.[102]

As mentioned, it can be difficult for inventors to know who in the market may be interested in their technology—whether for the purposes of licensing, commercializing, or collaborating. By disclosing their technology, inventors put other parties on notice about it and its capabilities.[103] Complementary asset holders can more easily identify one another, which reduces transaction costs.[104] Likewise, inventors and commercializers are more efficiently matched. In fact, patent ownership in the academic context "more than doubles the likelihood of finding a license partner."[105] This signaling function advertises the patented technology and the patent holder and can help firms attract collaborators and recruit new researchers.[106] Patents also signal to the industry and other inventors the status of research in a given area, allowing other inventors to identify what problems have not been solved, and thus indicate to others available areas for research.[107]

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100 Long, *supra* note 73, at 627-28 ("If an easily measurable firm attribute such as patent counts is positively correlated with other less readily measurable firm attributes such as knowledge capital, then patent counts can be used as a means of conveying information about these other attributes. . . . Alternatively, firms can use the patent document itself to convey information that would not be as credible when revealed in other contexts.").

101 *Id*. at 636-37 (noting that "[because] the penalties for intentionally misrepresenting material information in a patent are severe, observers know that the information contained in a patent has some credibility").

102 *Id.* at 642 (considering, as an example, the semiconductor industry).

103 Andrew Beckerman-Rodau et al., eBay v. MercExchange *and* Quanta Computer v. LG Electronics, 4. J. BUS. & TECH. L. 5, 14 (2009) (transcribing remarks by F. Scott Kieff: "Think about a beacon. Turn out all of the lights in this room, give me a flashlight, and everyone knows exactly where I am. Not only that, everyone knows where everyone else who will be interested in that flashlight is. If you come to the beacon, you find the guy holding the beacon and all the other folks interested in doing deals with that person. . . . [I]n order to have a contract, you have to start to talk—and patents get those conversations started.").

104 Penin, *supra* note 21, at 642.

105 Elfenbein, *supra* note 68, at 691.

106 Penin, *supra* note 21, at 648; *see also* Lawrence M. Sung, *The New Private Ordering of Intellectual Property*, 4 J. BUS. & TECH. L. 1, 3 (2009) (quoting remarks from Thomas Woolston, CEO of MercExchange: "[W]e have raised money on the strength of our IP, and we have hired people on the strength of our IP . . . ." (alternation in original)).

107 Kesan, *Intellectual Property Protection*, *supra* note 18, at 489; Long, *supra* note 73, at 648 (explaining how review of a firm's patent portfolio can reveal "what lines of research the firm is undertaking and what the firm does and doesn't consider valuable, outline a research trajectory that adumbrates fields the firm may be branching into next, disclose how fast the firm is proceeding within a particular area of research, and reveal other valuable dynamic information").

Patents also signal to investors. This is both an ex ante and ex post value of patents.[108] Knowledge that a patent will help secure investment incentivizes inventors to create, but patents also help firms attract investors unrelated to the invention itself. Obtaining a patent alone indicates some level of competent management and foresight.[109] Patent counts are also considered as indicators of other desirable firm attributes, including firm productivity, innovative activity, firm size, knowledge capital, and productivity of R&D spending.[110]

C. *Patents as Tools for Financing and Bargaining*

In addition to attracting investors through signaling, patents help firms obtain financing by providing financial separation between inventors and their inventions, and by serving as collateral.[111] Spulber compares patents to corporate securities to demonstrate how a patent serves to separate ownership and control of technology.[112] In this way, "[t]he patent owner can obtain returns from the patented invention while delegating control over usage to licensees who employ the technology."[113] Inventors can use this separation by transferring the patent rights in exchange for financing while retaining use of the technology for themselves or for licensees. Patents can also be used as collateral for obtaining financing.[114] Similarly, patents serve as an asset that can be leveraged if the venture fails.[115] The value of patents to investors, however, varies significantly by industry and by investor type.[116] For example, in a 2008 study conducted by Graham, Merges, Samuelson, and Sichelman (the "2008 Berkeley study"), 60 percent of surveyed software firms reported that venture capital investors consider patents im-

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108 *See generally* Ariel Pakes, *Patents as Options: Some Estimates of the Value of Holding European Patent Stocks*, 54 ECONOMETRICA 755 (1986); *see also* Bessen & Meurer, *supra* note 21, at 10 n.39 ("Commentators note that patents are assets that help start-ups get funding. We agree but note that this is not an independent source of patent value. Financiers value patents because of the exclusionary rights they provide.").

109 Graham et al., *supra* note 22, at 1306; Stuart J.H. Graham & Ted Sichelman, *Why Do Start-Ups Patent?*, 23 BERKELEY TECH. L. J. 1063, 1078 (2008) ("[E]ven if the patents cannot increase a company's profitability, they may signal to outsiders that the company is engaging in the sorts of practices that successful companies generally conduct or may serve as a proxy for internal firm resources that are otherwise difficult to quantify."); Long, *supra* note 73, at 637; Penin, *supra* note 21, at 648.

110 Long, *supra* note 73, at 651-52. "[P]atent ownership by corporations contributes significantly to their market value." Spulber, *supra* note 2 (manuscript at 39). "Patented inventions serve as 'growth opportunities . . . .'" *Id.* (manuscript at 40).

111 Spulber, *supra* note 2 (manuscript at 39).

112 *Id.* (manuscript at 24).

113 *Id.* (manuscript at 33).

114 *Id.* (manuscript at 39).

115 Graham & Sichelman, *supra* note 109, at 1078-79.

116 Graham et al., *supra* note 22, at 1308-09.

portant, while 73 percent of surveyed biotechnology firms and 85 percent of surveyed medical device companies reported that patents were considered important by venture capital investors.[117] Overall, firms seeking venture funding appear to patent more prior to actively seeking funding, compared to firms seeking other forms of funding.[118]

Lastly, patents serve as valuable legal bargaining chips for licensing and for litigation. Firms build strong patent portfolios, including patents they might not otherwise want or need, to be able to trade those patents for others.[119] As such, patents also serve as a defense mechanism. The threat of suit or countersuit for infringement is often sufficient to dissuade other parties from filing an infringement suit or to persuade them to accept a settlement.[120] In fact, the 2008 Berkeley study indicates that many startups primarily hold patents as leverage.[121]

Any discussion of patent licensing raises the question of patent intermediaries and their role in the patent system.[122] Firms that do not manufacture products have become important players in the patent litigation system. Companies that manufacture products embodying their patents urge that patent plaintiffs that do not manufacture products are fundamentally different. These intermediaries, often-called non-practicing entities ("NPEs"), patent assertion entities ("PAEs"),[123] patent monetization entities ("PMEs"),[124] or simply patent trolls, come in various forms. They range from universities, failed startups, and individual inventors to companies formed by private parties and venture capitalists seeking to exploit the inventions of others.[125] For those who view patents as economic instruments designed to provide rewards to inventors, it is important to separate these specific categories of PAEs.

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117 *Id.* at 1307.

118 *Id.* at 1280; Long, *supra* note 73, at 642-43 (noting that the signaling function of patents may explain why startups and firms that are not publicly traded are more eager to patent than established firms).

119 Penin, *supra* note 21, at 649.

120 *See* Kieff, *supra* note 6, at 744 (explaining that the threat of injunction serves as a catalyst to compel technology companies to collaborate).

121 Graham et al., *supra* note 22, at 1300-01.

122 *See, e.g.*, Christopher A. Cotropia et al., *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649 (2014); Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117 (2013); Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 BERKELEY TECH. L.J. 1583, 1588 (2009).

123 *See generally* Colleen V. Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297 (2010).

124 *See generally* Sara Jeruss et al., *The America Invents Act 500: Effects of Patent Monetization Entities on US Litigation,* 11 DUKE L. & TECH. REV. 357 (2012).

125 Some studies have tried to classify parties using a dozen entity status categories. *See, e.g.*, John R. Allison et al., *Extreme Value or Trolls on Top?: The Characteristics of the Most-Litigated Patents*, 158 U. PA. L. REV. 1 (2009).

Most recently, there has been sustained criticism of PAEs. Several academics have argued that PAEs are bad, that their conduct is costly, and that they are socially harmful to the economy. Academics have contended that PAEs cost the economy tens of billions of dollars, based upon a confidential survey of defendants.[126] Defenders of PAEs have offered several benefits that arise from the presence of PAEs in the marketplace. They claim that PAEs provide insurance and liquidity in the marketplace for patents.[127] They permit inventors who are otherwise excluded from the marketplace, because, for example, they may be individuals who cannot manufacture products or companies that tried, but failed, to manufacture products or to obtain some returns based on their innovations and investments. While the debate over patent trolls and their specific behavior in litigation is far from resolved, it is not the focus of this Article.

III. APPLICATION OF ECONOMIC JUSTIFICATIONS TO VARIOUS INDUSTRIES

The applicability of these justifications appears to vary significantly depending on the industry.[128] Understanding these variations is important as changes to the patent system may alter the direction of innovative activity.[129] Most notably, several scholars have found that patents remain critical in the biotechnology and medical industries and that the traditional ex ante justification applies strongly to these industries.[130] Firms in these industries rely heavily on preventing competitors from copying their technology.[131] These firms also report that they are more motivated to patent in order to secure investment and gain liquidity than firms in other industries.[132] Given the impressive amount these firms are able to charge for their patented products, it is unsurprising that intellectual property protection incentivizes

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126 *See generally* James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. REV. 387 (2014); for a critique of the methods used in that study, see generally David L. Schwartz & Jay P. Kesan, *Analyzing the Role of Non-Practicing Entities in the Patent System*, 99 CORNELL L. REV. 425 (2014).

127 *See generally* Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457 (2012); Stephen H. Haber & Seth H. Werfel, *Why Do Inventors Sell to Patent Trolls? Experimental Evidence for the Asymmetry Hypothesis* (Apr. 27, 2015) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2552734.

128 Burk & Lemley, *supra* note 11, at 26-27. The importance of patent protection has varied by industry throughout history. Moser, *How Do Patent Laws Influence Innovation?*, *supra* note 25, at 1220-22.

129 Moser, *How Do Patent Laws Influence Innovation?*, *supra* note 25, at 1233.

130 Burk & Lemley, *supra* note 11, at 24-25; Graham et al., *supra* note 22, at 1302-03; Penin, *supra* note 21, at 647.

131 Graham et al., *supra* note 22, at 1302.

132 *Id.* at 1302-03.

invention in the medical industry.[133] However, ex post justifications appear to apply as well. In this field, private investment is crucial for conducting basic research. Patents assist in securing such investment by "serv[ing] as an important R&D coordination mechanism."[134] Patents also provide biotechnology firms with an incentive to take on the large risks associated with commercialization in this field.[135]

Patents are used differently in the software and information technology sectors. Some consider patents altogether less valuable to the software industry.[136] Unlike a pharmaceutical product (e.g., a drug), which typically involves a handful of patents, software products incorporate hundreds of patents. This means the price of the product is divided into significantly smaller shares to compensate each inventor. Some also note that software inventors are less concerned that others will copy their inventions than inventors in other industries.[137]Additionally, there is the popular notion that software demands far less input in terms of complexity and financing, and thus requires or deserves less protection.[138] While this may be true in some instances (e.g., some basic smartphone applications), software is often quite complex and expensive. In particular, consider software platforms like iOS, Windows, or PlayStation. These platforms are highly complex and require substantial investment.[139] Such investment will only occur if the investor can obtain a suitable return. Not only are some information technology ("IT") companies among the top investors in R&D, but when their R&D

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133 For example, the cost for atorvastatin (the leading cholesterol lowering drug popularly known as Lipitor) fell from five dollars per tablet to thirty-one cents per tablet when the patent expired and generic versions became available. Michael Rosenblatt, *The Real Cost of "High-Priced" Drugs*, HARV. BUS. REV. (Nov. 17, 2014), https://hbr.org/2014/11/the-real-cost-of-high-priced-drugs.

134 Kesan, *Intellectual Property Protection*, *supra* note 18, at 470.

135 Kieff, *supra* note 2, at 725 ("According to the commercialization view . . . it is precisely th[e] combination of high initial commercialization costs and risks facing the first mover and low marginal costs facing a second mover that makes the biotechnology industry a particularly strong candidate for patent protection.").

136 *See, e.g.*, Graham et al., *supra* note 22, at 1262.

137 *Id.* ("[P]atents are much less important as a means by which most software firms—the majority of which hold no patents—capture competitive advantage from their innovations.").

138 *See id.* at 1308 (demonstrating that software companies consider attracting financing to be a less compelling reason to patent than do biotechnology and medical device companies).

139 Microsoft ranked fourth among top R&D spenders across industries in 2014, spending more than a number of pharmaceutical firms. Michael Casey & Robert Hackett, *The 10 Biggest R&D Spenders Worldwide*, FORBES (Nov. 17, 2014), http://fortune.com/2014/11/17/top-10-research-development/. The company spent roughly $11.4 billion on R&D in 2014 and offered at least twenty software products in addition to its line of Xbox games and mobile phone apps. Microsoft Corp., Annual Report (Form 10-K) (Feb. 28, 2015); *Software & Apps*, MICROSOFT, http://www.microsoft.com/en-us/default.aspx (last visited Feb. 11, 2015). Meanwhile, pharmaceutical giant Eli Lilly spent about $4.9 billion on R&D in 2014 and offered twenty-six pharmaceutical products. Eli Lilly Co., Quarterly Report (Form 10-Q) (Oct. 29, 2014); *Our Current Products*, LILLY, http://www.lilly.com/products/human/Pages/Our-Current-Products.aspx (last visited Feb. 11, 2015).

investment is measured on a per-product platform (rather than a per-patent platform) basis, it can be equivalent to or greater than the cost of developing a new pharmaceutical product. If this is true, and if the incremental innovations in IT products are necessary to their functionality or market viability, then it is irrelevant whether a company spends $1 billion to generate a few patentable inventions embodied in a new drug, or $1 billion to generate hundreds of inventions embodied in a complex IT product. The fact that there is less R&D investment attributable to each patented invention in an IT company does not mean that any of the inventions (let alone the worth of all of them in billions of dollars) would have occurred in the absence of patent incentives. Additionally, software technology is used across a wide variety of applications. As explained above, patents enable inventors to more easily and efficiently license their technology to the multitude of innovators interested in incorporating it into their products.[140] Patents also facilitate greater cooperation between software and complementary asset developers through standards, discussed further in the following Part.[141] For these reasons, patents remain an important part of the mix of tools used to appropriate benefits from technology in the software industry.

Inventors in the software industry also rely on trade secrets and first mover advantages. In software, or any network industry, the value of the product to the consumer increases the more other consumers also use the product.[142] For example, Microsoft Word is more valuable to one individual if his co-workers also use Microsoft Word, because they can then share documents more easily. The consumer loses this benefit if he switches products. Therefore, even if a later inventor creates a better word-processing application, consumers are unlikely to switch. Thus, there is a significant advantage to being the first to bring a product to market. Inventors in the software industry also rely heavily on copyrights and trade secrets.[143] Sole reliance on these tools, however, would be inefficient. It would be much more difficult for inventors to license their technology to other innovators and to collaborate with other developers as patents enable inventors to specify and monetize their contributions. It would also cause a host of employment complications, as employers would have to rely on complex confidentiality contracting.

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140 *See supra* Part B.

141 *See infra* Part IV.

142 *See* Daniel F. Spulber, *Unlocking Technology: Antitrust and Innovation*, 4 J. COMPETITION L. & ECON. 915, 916-17 (2008) (explaining the phenomena of network externalities and technology lock-in). Spulber argues that the purported problem of technology lock-in is overstated and that government intervention is inappropriate. *Id.*

143 Burk & Lemley, *supra* note 11, at 1622 n.152 (noting that "[c]opyright law is the predominant protection for software" and that "trade secret and contract law also provide protection"). *Id.* at 1690-91 (noting that disclosure is less relevant in the software industry because "the Federal Circuit does not require would-be patentees of software inventions to disclose the implementing source code or, for that matter, very much at all about their inventions").

The traditional justification also fails to explain academic research. Scientists at universities invented technology for years without any opportunity to patent.[144] Since the passage of the Bayh-Doyle Act,[145] most researchers pledge their patents to the university and appear to be more motivated by non-monetary goals.[146] Instead, the ex post justifications explain the benefits of filing for patents enjoyed by the university. Not only can patenting help the university bring in revenue, but it also helps the technology transfer offices and corporate firms interested in commercializing university technology locate one another.[147] Even if firms subsequently develop technology through in-house R&D that is patented by a university, the firms may value the patent rights obtained by the first inventor at the university. Additionally, where the researcher maintains his own patent rights, the patent serves the critical role of a definable marker, giving the inventor the assurance that he will receive adequate recognition and compensation for his invention when it is licensed to a firm with the capacity to use it to bring a product or service to market, often in conjunction with hundreds of other patented technologies.[148]

IV. EX POST JUSTIFICATIONS AND PRIVATE ORDERING

These coordination, monetization, and signaling effects of patents facilitate private ordering.[149] Armed with a discrete, transferable, certified patent certificate, inventors can collaborate with one another to increase the productivity of their technology, and benefit consumers overall.[150] Private ordering, in this context, refers to "circumstances where parties, given extant legal and regulatory regimes, order the substance of their affairs and

144 Hellmann, *supra* note 84, at 625.

145 35 U.S.C. §§ 200-212 (2012) (enacted in 1980).

146 Hellmann, *supra* note 84, at 625, 635.

147 *Id.* at 635.

148 *Id.* at 639.

149 *See* Cahoy & Glenna, *supra* note 95, at 446 (noting the key role of disclosure in private ordering and that private ordering is only possible if transaction costs are manageable). However, even with current disclosure requirements, it may be difficult to identify all relevant patents in densely patented field. *Id.*

150 *See id.* at 436 ("The notion that private industry is inclined to collaborate to resolve patent barriers is not surprising. There is an obvious advantage to coordinating with other market participants to identify and address intellectual property rights that might complicate the introduction of new technology, particularly if a major player does not own it. The difficult task is to do it in a way that does not risk antitrust exposure."). The federal government also recognizes the benefits of collaboration and has set forth guidelines explaining how agencies weigh the procompetitive benefits of collaboration against potential anticompetitive concerns. FED. TRADE COMM'N & U.S. DEP'T OF JUSTICE, ANTITRUST GUIDELINES FOR COLLABORATIONS AMONG COMPETITORS (2000), *available at* http://www.ftc.gov/sites/default/files/attachments/press-releases/ftc-doj-issue-antitrust-guidelines-collaborations-among-competitors/ftcdojguidelines.pdf.

transactions as they see fit and resort to the judicial system for enforcement."[151] Private ordering in the patent realm serves to reduce the risk of holdouts, which reduces transaction costs.[152] By leveraging social, peer, and industry pressure, rights holders and organizations can encourage patent holders to cooperate with others up front.

Private ordering often occurs in the form of standard setting. Because many products and applications require the same technology as one component, it is more efficient for companies to work together to create one standard for that component technology rather than for each company to develop its own version of the technology. Once the standard is developed it can be used across applications.[153] In order to collaborate in this manner, technology companies employ SSOs.[154] SSOs are private entities that facilitate coordination between various technology firms to establish technology standards.[155] Engineers work through the SSO to develop a standard specification.

Once the specification is complete, the companies involved are typically expected to disclose which, if any, of their contributions are patented. Patents involved in a standard are generally classified as standard essential patents ("SEPs"), nonessential patents, or option patents. In addition to disclosing their relevant patents, companies are typically required to commit to licensing their SEPs on fair, reasonable, and non-discriminatory ("FRAND") terms.[156] In essence, the SEP holders are required, in most cir-

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151 F. Scott Kieff & Troy A. Paredes, *Engineering a Deal: Toward a Private Ordering Solution to the Anticommons Problem*, 48 B.C. L. REV. 111, 114 n.15 (2007).

152 Kieff & Layne-Farrar, *supra* note 70, at 1102. *See also generally* Kieff & Paredes, *supra* note 151 (proposing a private ordering mechanism to avoid hold out by patent owners).

153 Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CALIF. L. REV. 1889, 1892-93 (2002) [hereinafter Lemley, *IPRs & SSOs*].

154 *Id.* at 1893.

155 Examples of SSOs include: the European Telecommunications Standards Institute (ETSI), the Institute of Electrical and Electronics Engineers (IEEE), the Internet Engineering Task Force (IETF), and the World Wide Web Consortium (W3C). RICHARD S. GRUNER ET AL., TRANSACTIONAL INTELLECTUAL PROPERTY: FROM STARTUPS TO PUBLIC COMPANIES (LexisNexis, 3d ed. forthcoming 2015). For a detailed examination of SSOs, see generally Lemley, *IPRs & SSOs*, *supra* note 153.

156 Often, what constitutes fair, reasonable, and nondiscriminatory licensing terms in a given context is left for the courts to decide. GRUNER ET AL., *supra* note 155. Judge Robart, U.S. District Court for the Western District of Washington, set forth a number of factors for determining what is FRAND based on the factors for determining a reasonable royalty established in *Ga. Pacific Corp. v. United States Plywood Corp*., 318 F. Supp. 1116 (S.D.N.Y. 1970). *Id.* (discussing Microsoft Corp v. Motorola, Inc., 2013 WL 2111217, at *42-44 (W.D. Wash. Apr. 25, 2013)). Whether these factors are appropriate continues to be a subject of debate. *Id.* (citing as examples Richard Epstein & David J. Kappos, *Legal Remedies for Patent Infringement: From General Principles to FRAND Obligations For Standard Essential Patents*, 9 COMPETITION POL'Y INT'L 69, 78 (2013); Damien Geradin, *The Meaning of "Fair and Reasonable" in the Context of Third-Party Determination of FRAND Terms*, 21 GEO. MASON L. REV. 919, 948 (2014); Daryl Lim, *Standard Essential Patents, Trolls, and the Smartphone Wars: Triangulating the End Game*, 119 PENN. ST. L. REV. 1 (2014); J. Gregory Sidak, *The Meaning of FRAND, Part I: Royalties*, 9 J. COMPETITION L. & ECON. 931 (2013)).

cumstances, to waive their right to seek injunctive relief for the use of the patented technology.[157] Often, participating firms will place the patents used in the standard into a pool, allowing adopters to license all of the patents as a collection.[158]

Patents are critical to this process, which is considered efficient and beneficial not only to the companies involved, but to consumers as well. Companies would have no reason to collaborate with others—likely competitors—without the guarantee of recognition and compensation for their contributions. [159] The standard features of a patent, discussed *supra*, also make it easier for patent owners to convey information about their technology to SSOs and to identify essential patents.

Standards are often used to produce interoperable technology, meaning consumers benefit from the ability of their various products to interact with each other.[160] For example, the DVD-ROM standard specification ensures that DVD discs are readable by DVD players.[161] Standards also reduce the cost for consumers of transitioning from an old technology to a newer version, and allow developers to specialize. With some component pieces tak-

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157 While it is fairly well established that SEP owners must license their patent to other standard members on FRAND terms, whether FRAND commitments are enforceable when the patent is transferred is an unsettled question. *See* Jay P. Kesan & Carol M. Hayes, *FRAND's Forever: Standards, Patent Transfers, and Licensing Commitments*, 89 IND. L.J. 231, 254-56 (2014) (discussing the advantages and disadvantages of considering FRAND commitments as an encumbrance that runs with the patent). Scholars also debate whether FRAND commitments can be enforced by third parties. *Id.* at 263-66.

158 For example, over twenty corporations contributed intellectual property to the LTE (Long Term Evolution) standard used in mobile phones, laptop computers, media players, and other portable devices. *4G LTE Standard Essential Patents Candidates Evaluation 3Q 2014*, INNOVATION FRONTLINE (Aug. 3, 2014), http://techipm-innovationfrontline.blogspot.com/2014/08/4g-lte-standard-essential-patents.html. Via Licensing offers all the essential patents for this standard in a single patent pool, which many high profile mobile communications companies have licensed. *Long Term Evolution: Standards-Essential Patent Licensing*, VIA LICENSING, http://www.vialicensing.com/lte/index.aspx (last visited Jan. 24, 2015).

159 Standards, however, may create their own hold-out problems. Kirti Gupta, *The Patent Policy Debate in the High-Tech World*, 9 J. COMPETITION L. & ECON. 827, 847 (2013) (implying that standards distort the inventive value of many patented technologies because many "SEPs derive their value primarily due to being included in the standard (called their holdup value) and would have none or little inventive value had they not been chosen to be included in the standard"); Kieff & Layne-Farrar, *supra* note 70, at 1107 (explaining how "standard[s] can 'lock in' manufacturers and patentees, creating a circumstance ripe for opportunistic behavior," but asserting that the imposition of adequate intellectual property rights policies by SSOs mitigates this risk).

160 Lemley, *IPRs & SSOs*, *supra* note 153, at 1893 ("Telephones talk to each other, the Internet works, and hairdryers plug into electrical socks because private groups have set 'interface' standards, allowing compatibility between products made by different manufacturers.").

161 *See DVD Patent Joint Licensing Program Frequently Asked Questions*, DVD6C LICENSING GROUP, http://www.dvd6cla.com/faq.html#faq01 (last visited Feb. 8, 2015) (listing products that incorporate the patented technology involved in the standard and available for licensing).

en care of by standards, companies can focus on their specialty, presumably resulting in better end products from each company.[162]

Patent pools are similarly used by technology companies to facilitate collaboration. Patent pools are created when several companies agree to cross-license their patents to one another.[163] Patent pools alleviate barriers caused by patent thickets[164] and blocking patents by allowing a licensee to obtain all necessary licenses through one transaction.[165] Like SSOs, patent pools allow firms to specialize in one area and license the component parts that fall outside their area of expertise. In this way, each company produces products that are theoretically superior to the products they would create if they were forced to develop every component on their own.[166] This also speeds the pace of development. Though it may seem contradictory to argue that a mechanism developed to alleviate the problems associated with patents demonstrates the value of patents, one must remember that such collaboration would not happen in the absence of patents. Without patents, firms would rely on secrecy to protect their competitive advantage, making it prohibitively expensive and complicated for one firm to benefit from another's technology.[167]

As established, patents enable rights holders to engage in licensing. This increases efficiency and access to inventions by encouraging rights holders to allow more people to use the technology. Even though the rights holder loses some of his exclusive use, he can still control who has access to the technology and how it is used. "When the patent environment is less dispersed," it can be advantageous for a few patent holders to cooperate

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162 Graham et al., *supra* note 22, at 1316.

163 Early examples of patent pools include the pool established by sewing machine manufacturers in 1856 and one for aircraft patents established by the Manufacturer's Aircraft Association in 1914. Contemporary examples include the DVD6C pool discussed, *supra* note 161; *see, e.g.*, Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1 (2005) (emphasizing the significant benefits of patent portfolios).

164 A patent thicket is formed when multiple, overlapping patents have been granted in an area. As a result, "[a] single product may need to traverse so many overlapping rights that it requires hundreds, if not thousands, of licenses for production." Cahoy & Glenna, *supra* note 95, at 432.

165 *See id.* at 443 ("The strategy of pooling is explicitly a response to patent holdups.").

166 However, some have argued that patent pools overall hinder innovation. For example, Petra Moser & Ryan Lampe reviewed historical data on the development of sewing machine technology. Ryan L. Lampe & Petra Moser, *Patent Pools and the Direction of Innovation—Evidence From the 19th-Century Sewing Machine Industry* (Nat'l Bureau Econ. Research, Working Paper 17573, 2011). While a patent pool was in place, the industry saw no significant improvement in technology. *Id.* at 2. Once the pool was disbanded, the technology rapidly improved. *Id.* at 2-3.

167 This benefit has been recognized by regulators in finding that patent pools do not per se conflict with antitrust law. *Id.* at 1.

through cross licensing or a joint venture.[168] Such arrangements allow "each entity to retain ownership and a stake in the technology it developed."[169]

Because patent holders are not obligated to allow others to use their technology, they can limit the individuals or companies to whom they license, and how the licensed technology will be used—behavior that may be anticompetitive otherwise. A patent holder might agree to license to a university or nonprofit organization on far more favorable terms than it would to another for-profit corporation—or it may refuse to license to the for-profit corporation entirely. For example, in the early 1970s, researchers at the University of California and Stanford University developed a technique for cloning or splitting genes, which had massive implications for the entire biotechnology industry.[170] The universities patented and licensed this technology.[171] During the course of the patent period, licensing this patent (known as the Cohen/Boyer Patent) alone provided the universities with $255 million in revenue.[172] Contrary to what might be expected from private institutions, the universities sought to balance their desire for income with their public service mission.[173] They charged graded royalties and offered the technology royalty-free to other nonprofit research institutions.[174]

A patent holder might also agree to license his technology on favorable terms to those working in a specific industry or working on a given technology in order to foster the development of that industry or technology. This is frequently seen in the medical and pharmaceutical industries. For example, the Global Access Licensing Framework (the "Framework") seeks to make medical treatments more available to patients.[175] The Framework requires that "[e]very university-developed technology with potential for further development into a drug, vaccine, or medical diagnostic should be licensed with a concrete and transparent strategy to make affordable versions available in resource-limited countries for medical care."[176] Noting the unique quality of each licensing negotiation, the Framework sets forth a number of principles to be considered in licensing such technologies, in-

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168 Cahoy & Glenna, *supra* note 95, at 441.

169 *Id.* Joint ventures and cross licensing provide many of the same benefits, but a joint venture is preferable when a relationship with the technology owner is advantageous, e.g., when the owner's know-how is important to development or use of the technology. *Id.* at 442.

170 KATHARINE KU, LICENSING DNA CLONING TECHNOLOGY (LES USA/Canada Central/Western Regional Meeting Paper, Feb. 1983), *available at* http://otl.stanford.edu/documents/KKLicensingDNACloningTechnology_000.pdf.

171 *Id.*

172 *Id.*

173 *Id.*

174 *Id.*

175 *Global Access Licensing Framework*, U. ALLIED FOR ESSENTIAL MEDICINES, http://uaem.org/global-access-licensing-framework/ (last visited Jan. 25, 2015).

176 *Id.* (follow link for full PDF version of the framework, http://uaem.org/cms/assets/uploads/2013/04/GlobalAccessLicensingFramework.pdf).

cluding: removal of legal barriers to generic drugs in resource-limited countries, proactive licensing provisions to ensure that follow-on patents and data exclusivity cannot be used to block generic production, non-exclusive licensing from university technology transfer programs, and systematic and transparent licensing policies.[177]

Similarly, some firms have pledged not to assert their patents against infringers in certain circumstances. This may be motivated by the positive press and tax benefits that can result from "philanthropic" behavior or may be more strategic. Even though he is not using the patent to exclude infringers, the rights holder is empowered by the patent to control disclosure of the technology. The patent still also serves a strong signaling function, and can be used to attract commercialization partners and investors. For example, inventor and engineer Elon Musk has famously pledged not to enforce patents held by Tesla that have been used in developing the electric vehicle.[178] The pledge is likely targeted at encouraging others to join the electric car industry.[179] Operating in a novel industry, largely on its own, gives Tesla the advantages associated with market dominance, but also requires that Tesla develop each and every component technology on its own. Additionally, Tesla is likely seeking more competitors within this market to create a greater demand for complementary assets.

CONCLUSION

Understanding why inventors patent and how rights holders use patents is important in developing patent policy. Without a comprehensive understanding of these uses and rationales, patent policy might be drawn too narrowly. Traditionally, scholars and policymakers have justified the patent system as a "necessary evil" used to encourage inventors to create.[180] Today, there exists a more nuanced understanding of the interplay between competition and innovation. Patents offer substantial economic benefits after they are granted, not just before. Patents, much like vehicle titles, serve as definable, tangible assets that can be readily monetized and transferred, creating a market for inventions. As such, patents facilitate more efficient cooperation and collaboration between technology developers, commercializers, and adopters.

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177 *Id.*

178 Brian Solomon, *Tesla Goes Open Source: Elon Musk Releases Patents to "Good Faith" Use*, FORBES (June 12, 2014), http://www.forbes.com/sites/briansolomon/2014/06/12/tesla-goes-open-source-elon-musk-releases-patents-to-good-faith-use/. Google has also made a number of its patents available for good faith use without charge. *Open Patent Non-Assertion Pledge*, GOOGLE, http://www.google.com/patents/opnpledge/pledge/ (last visited Feb. 9, 2015).

179 Solomon, *supra* note 178. The announcement also created bountiful public attention for the company.

180 *See, e.g.*, Kieff, *supra* note 2, at 710.

Patents also serve an important signaling function. Once a patent claim is filed, the patent holder can more easily be identified by potential collaborators and complementary asset holders. The information contained in a patent document as well as the act of filing such a claim signal important information to investors about the technology and the firm. Patents also help with financing by serving as leverageable assets.

Finally, patents facilitate private ordering. Armed with a patent as a definable asset, patent holders are able to cooperate with other entities in SSOs, patent pools, and other licensing arrangements with minimal risk of misappropriation. Such mechanisms allow technology developers to specialize and to create interoperable technology, which provides substantial benefits to consumers. Therefore, even if patents do not entirely motivate inventors to create, they remain vital to maintaining an innovative economy and ought to be considered as such by policymakers.

While some economic rationales for the patent system are more or less persuasive than others, patents remain an important part of the innovation ecosystem, and the patent system will continue to be an arena of robust scholarly debate and analysis. In addition, the fundamental institutional challenges of granting patent rights commensurate with the underlying innovation, increasing the efficiency and reducing the costs of patent enforcement, and minimizing opportunistic behavior within the legal system for both acquiring and enforcing patent rights, will engage scholars and policymakers for a long time to come.