2000

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Recommended Citation
Clarisa Long, *Proprietary Rights and Why Initial Allocations Matter*, 49 Emory L. J. 823 (2000).
Available at: https://scholarship.law.columbia.edu/faculty_scholarship/3492

PROPRIETARY RIGHTS AND WHY INITIAL ALLOCATIONS MATTER

*Clarisa Long**

Initial allocations of proprietary rights matter because who starts out holding the rights helps determine who ends up holding the rights. In patent law, proprietary rights are granted to those who are first to invent.[1] But entities who win the race to patent an invention are not necessarily the final, or best, or most efficient users of the technology. If proprietary rights, particularly patents on basic research results, could be traded efficiently so that downstream innovators could obtain them from initial rights holders easily, then initial allocations of proprietary rights would not matter so much. Transferring proprietary rights is costly, however, which often makes it difficult to achieve the highest and best use of such rights. In addition to transaction costs, uncertainty over whether patented basic research results can be turned into commercially viable products can cause bargaining breakdown. Faced with uncertainty, parties to a licensing transaction may rely on proxies to establish a value for the patented basic research results. Such proxies may be driven by the reputation of the initial rights holder rather than by the qualities of the technology being licensed. The characteristics of the initial rights holder and the strength of its bargaining position thus become important elements in determining whether proprietary rights get transferred and if so, under what terms. Because initial allocations drive final allocations, initial allocations matter in achieving the best and most efficient use of proprietary rights.

I.

Proprietary rights to the products of biomedical research have been controversial for quite some time. At first, the debate centered around whether the products of life were patentable and whether proprietary rights were desirable and consistent with the norms of science.[2] The United States

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[1] 35 U.S.C. § 102 (1994).

[2] Robert K. Merton, *The Puritan Spur to Science*, *in* THE SOCIOLOGY OF SCIENCE: THEORETICAL & EMPIRICAL INVESTIGATION 228 (Robert K. Merton ed., 1973).

Supreme Court answered the former question definitively in 1980.[3] As for the latter question, what used to be unthinkable is now routine. Over the past few decades, norms have evolved to the point where patenting scientific innovations is practically *de rigeur*. For example, when DNA-sequencing techniques were invented in the late 1970s, neither Frederick Sanger[4] nor Allan Maxam and Walter Gilbert[5]—to name a few of the leading lights in the field at the time—patented the techniques they created for sequencing DNA itself. When Stanley Cohen and Herbert Boyer received their patent on recombinant DNA technology in 1980, this was considered a notable departure from scientific norms in the academic/research community.[6] The Cohen-Boyer patent, assigned to Stanford University, was so broad that it had the potential to slow the development of commercial biotechnology dramatically, had Stanford University chosen to attempt to extract every last drop of potential revenue from it.[7] The patent was licensed for relatively low fees, but scientists—particularly basic researchers—nonetheless breathed a sigh of relief in 1997 when the patent expired.

Today, academic patenting, either in conjunction with, or in competition with, the private sector, is routine.[8] Many of these patents have been granted in the biomedical fields and many patents, whether held by private-sector entities or research institutions, cover inventions upon which further path-breaking research and inventions can be built.[9] Such patents frequently cover research results so basic that no commercial end-product is currently available.[10] Alternatively, a patented invention may be both a commercial end-product and the subject of basic research. For example, a chemical compound

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[3] *See* Diamond v. Chakrabarty, 447 U.S. 303 (1980).

[4] Frederick Sanger et al., *DNA Sequencing with Chain-Terminating Inhibitors*, 74 PROC. NAT'L ACAD. SCI. 5463 (1977).

[5] Allan M. Maxam & Walter Gilbert, *A New Method for Sequencing DNA*, 74 PROC. NAT'L ACAD. SCI. 560 (1977).

[6] Stanley N. Cohen et al., *Process for Producing Biologically Functional Molecular Chimeras*, U.S. PATENT NO. 4,237,224 (Dec. 2, 1980).

[7] *See* Philippe Ducor, *Are Patents and Research Compatible?*, 387 NATURE 13 (1997).

[8] Rebecca Henderson et al., *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting 1965-1988* (National Bureau of Economic Research Working Paper No. 5068) (1995) (documenting how, between 1965 and 1988, the rate of increase of university patenting outpaced the rate of non-university patenting by a factor of approximately 30 to 1).

[9] *See, e.g.*, Kary B. Mullis et al., *System for Automated Performance of the Polymerase Chain Reaction*, U.S. PATENT NO. 5,656,493 (Aug. 12, 1997) (currently held by Hoffman-La-Roche) (polymerase chain reaction technology ("PCR") allows DNA to be replicated rapidly).

[10] Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property and the Norms of Science*, 94 NW. U. L. REV. 77, 123 (1999) ("[S]ome of the inventions on which patents are being sought are so removed from commercial application that further *basic* research will be necessary to identify fully their potential uses.") (emphasis in original).

might simultaneously be a highly successful drug and the subject of academic research. A gene that has been associated with a specific disease might be used in a commercially lucrative genetic test and at the same time studied in the laboratory for its possible role in treatment of that disease.

The shift of scientific norms toward acceptance of patenting has occurred simultaneously with an expansion in the subject matter legally eligible for patent protection. In the past several decades, the boundaries of patentability have crept inexorably closer to the basic end of the research spectrum. A number of developments have contributed to the expansion and strength of patent law: the creation in 1982 of the United States Court of Appeals for the Federal Circuit ("CAFC"),[11] which has helped bring jurisprudential consistency and predictability to patent law;[12] the CAFC's willingness to enforce patents;[13] the expansion of proprietary rights to include life forms[14] and indeed "everything under the sun that is made by man"[15] (except humans);[16] the increasing commercial potential of patented basic biomedical research results;[17] the existence of a wide array of players in the biomedical research field, each with its own set of incentives;[18] and the passage of statutes

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[11] *See* Federal Courts Improvement Act of 1982, Pub. L. No. 97-164, 96 Stat. 25 (1982) (relevant provisions codified as amended in scattered sections of 28 U.S.C.).

[12] Rochelle C. Dreyfuss, *The Federal Circuit: A Case Study in Specialized Courts*, 64 N.Y.U. L. REV. 1, 24 (1989) ("In sum, the CAFC's jurisprudence reveals that the court has begun to make patent law more accurate, precise, and coherent.").

[13] Lawrence G. Kastriner, *The Revival of Confidence in the Patent System*, 73 J. PAT. [& TRADEMARK] OFF. SOC'Y 5, 10-11 (1991) (observing that CAFC enforcement of the presumption of validity was one of the first steps taken to materially strengthen the patent grant); Harry F. Manbeck, Jr., *The Federal Circuit—First Ten Years of Patentability Decisions*, 14 GEO. MASON L. REV. 499, 504 (1992) (stating that the statutory presumption of validity "has acquired meaning in Federal Circuit jurisprudence").

[14] Patents on living subject matter were long considered to violate the principle that products of nature were not patentable. *See, e.g.*, Funk Bros. Seed Co. v. Kalo Inoculant Co., 333 U.S. 127 (1948). But, in 1980, the Supreme Court held that genetically-altered organisms could qualify as patentable subject matter under 35 U.S.C. § 101. Diamond v. Chakrabarty, 447 U.S. 303 (1980).

[15] *Chakrabarty*, 447 U.S. at 309 (citing S. REP. NO. 1979, at 5 (1952); H.R. REP. NO. 1923, at 6 (1952)) (footnote omitted).

[16] In 1998, Jeremy Rifkin and Stuart Newman filed a patent application containing claims to animal-human chimeras. In June 1999, the PTO rejected the application on the grounds that the invention "embraces a human being." *See* Rick Weiss, *U.S. Ruling Aids Opponents of Patents for Life Forms*, WASH. POST, June 17, 1999, at A2.

[17] Kastriner, *supra* note 13, at 8 (stating that the CAFC has "significantly enhanced the economic power of patents").

[18] *See* NAT'L RESEARCH COUNCIL, INTELLECTUAL PROPERTY RIGHTS AND RESEARCH TOOLS IN MOLECULAR BIOLOGY 57 (1997); *Report of the National Institutes of Health (NIH) Working Group on Research Tools, Presented to the Advisory Committee to the Director*, June 4, 1998 (visited May 28, 2000) <http://www.nih.gov./news/researchtools/index.htm> ("Report").

to encourage patenting of innovations produced by government-sponsored research.[19]

Not all patentees who obtain patents on basic research results will have the capacity or interest in conducting further research to turn their patented inventions into commercial end-products. Because applying for (prosecuting) a patent in the United States Patent and Trademark Office ("PTO") is an expensive and time-consuming process, and because enforcing and defending a patent can cost patentees millions of dollars in litigation fees, patenting is a strategic decision.[20] Under the "first to invent" system used in the United States, the PTO grants patent rights to the applicant who can prove prior invention, even if that applicant is not the first to file an application to patent the invention.[21] Independent discovery by a rival does not deprive a prior inventor of property rights, but may raise the cost of defending the patent.[22]

In order to realize a return on their investment, holders of patents on basic research results must either develop the product further themselves or license their patents to downstream innovators who conduct further research to turn it into a commercial end-product. For example, Human Genome Sciences, Inc. ("HGS") owns a patent on the gene coding for the CCR5 receptor.[23] Scientists believe the AIDS virus enters into human cells through the CCR5 receptor.[24] HGS has licensed several other companies the rights to the CCR5 receptor patent; with this gene, these companies will conduct downstream research on possible therapies for AIDS.[25]

Central to much of the race to obtain patents on basic research results is the assumption that such patents will be licensed to downstream researchers.

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[19] *See* Bayh-Dole Act, 35 U.S.C. §§ 200-11 (1994); Stevenson-Wydler Technology Innovation Act, 15 U.S.C. §§ 3701-14 (1998).

[20] The American Intellectual Property Law Association has estimated that the "cradle to grave" costs of prosecuting a relatively straightforward patent in the United States range from $14,420 to $23,540. AMERICAN INTELLECTUAL PROPERTY ASS'N, AIPLA BULLETIN 446 (1996).

[21] 35 U.S.C. § 102 (1994).

[22] A priority contest before the PTO to determine which of two applicants was the first to invent is called an interference. 35 U.S.C. § 135 (1994). Interferences are costly. *See* Donald S. Chisum, *The Harmonization of International Patent Law*, 26 J. MARSHALL L. REV. 437, 449 (1993).

[23] Yi Li et al., *Polynucleotides Encoding Human G-Protein Chemokine Receptor HDGNR10*, U.S. PATENT NO. 6,025,154 (Feb. 15, 2000).

[24] *See* Nelson L. Michael et al., *The Role of CCR5 and CCR2 Polymorphisms in HIV-1 Transmission and Disease Progression*, 3 NATURE MED. 1160 (1997); Michael U. Smith et al., *Contrasting Genetic Influence of CCR2 and CCR5 Variants on HIV-1 Infection and Disease Progression*, 277 SCIENCE 959 (1997).

[25] Human Genome Sciences, Inc,. Press Release, Human Genome Sciences Receives Patent on AIDS Virus Entry Point, February 16, 2000 (visited May 29, 2000) <http://www.hgsi.com/news/press/00-12-16_CCR5.html>.

These users, it is assumed, will conduct further research and create finished commercial products. If transferring patent rights is easy, then we can expect patents on basic research to flow seamlessly to downstream innovators. But if transferring patent rights is not easy, then we can expect hangups and holdouts to leave patents in the hands of their initial holders when bargaining breaks down. Patents are licensed all the time, but many transfers, particularly over basic research results, are not smooth. If bargaining over socially beneficial transfers of proprietary rights sometimes fails, even when both sides would like the transfer to occur, it would be useful to figure out why such failures occur. Understanding how transaction costs affect transfers of transferring patent rights sheds some light on this problem.

II.

One of the most influential theories regarding initial rights or entitlements and their transfer is the Coase Theorem.[26] The Coase Theorem posits that absent transaction costs, entitlements will be transferred, through private bargaining, to the users who value them most.[27] Thus, how legal entitlements are initially distributed in a transaction-cost-free world would be irrelevant for efficiency purposes.[28] But when transaction costs exist, as they most certainly do in reality, then this result does not hold.[29] As Guido Calabresi and A. Douglas Melamed point out, the Coase Theorem's heroic assumption of no transaction costs "must be understood extremely broadly as involving both perfect knowledge and the absence of any impediments or costs of negotiating."[30] The Coase Theorem, therefore, underscores the important role transaction costs play in driving the exchange of property rights.[31]

Transaction costs are composed of many elements. In the context of licensing a patent they include: the costs of searching for licensees by the

[26] What later came to be called the Coase Theorem originally appeared in R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960); *see generally* Robert D. Cooter, *Coase Theorem*, *in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 457, 458 (John Eatwell et al. eds., 1987).

[27] Coase, *supra* note 26, at 15 ("Such a rearrangement of rights will always take place if it would lead to an increase in the value of production.").

[28] *Id.*

[29] *Id.* ("The argument has proceeded up to this point on the assumption ... that there were no costs involved in carrying out market transactions. This is, of course, a very unrealistic assumption."); Richard A. Epstein, *A Clear View of The Cathedral: The Dominance of Property Rules*, 106 YALE L.J. 2091, 2092 (1997) ("[O]ur world is not one in which transaction costs are zero. Rather, they are positive and large . . . .").

[30] Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1094-95 (1972).

[31] *See* THRÁINN EGGERTSSON, ECONOMIC BEHAVIOR AND INSTITUTIONS 105 (1990) ("Coase's main contribution ... was to arouse our awareness of the implications of positive transaction costs.").

patent holder or licensors by the would-be licensee; the costs of negotiating a license, sometimes with multiple licensees or patent holders; and the costs of enforcing the terms of the license and protecting against infringement by nonlicensees.

The search costs of patent licensing should not be underestimated. Downstream innovators must determine what licensing rights they need to obtain, from whom they must obtain them, and how to contact the patent holders. The secrecy procedures surrounding patent applications do not lower these search costs. The PTO keeps patent applications secret until they are issued, or for eighteen months under some circumstances.[32] Thus, unless an applicant chooses to make public the fact that it has applied for a patent, potential licensees will not know that an application is pending. This makes it difficult for downstream innovators to know, *ex ante*, that a patent will be issuing for which they will desire—or need, if they are competitors who lose the race to the patent office—a license.

The transaction costs of negotiating a license are not insignificant, either. Innumerable variables must be addressed. How many, and which, of the licensee's employees may use the licensed product? If the licensee is a non-profit organization, may it use the licensed material for commercial purposes? May it use the licensed material in research sponsored by another organization? Patentees may insist upon licensing the patent only for use in a particular experiment or study specifically described in the licensing agreement.[33] When the patent covers an invention from which many further inventions can be derived, patentees frequently want to reserve rights, known as "reach-through" rights, in future discoveries made by the licensee. Whether the patentee will have outright property rights to future discoveries, or whether it will merely have use rights (a license), or whether it will have no rights at all can be a hotly-contested issue. Downstream innovators negotiating with multiple patentees may find themselves faced with a multiplicity of such "reach-through" demands. Reach-through provisions in a single license are burdensome enough; but multiple reach-through provisions can conflict with each other or may be virtually impossible for the licensee to satisfy. In the

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[32] *See* 35 U.S.C. § 122 (1994), *amended by* 35 U.S.C.A. § 122(a) (West Supp. 2000). The PTO publishes a pending patent application 18 months after it is filed in the United States if the patentee has sought to patent the same invention in another country that requires publication of pending patent applications 18 months after filing. 35 U.S.C. § 122 (1994), *amended by* 35 U.S.C.A. § 122(b) (West Supp. 2000). The term of patent protection begins on the issue date and ends 20 years from the date the inventor filed the application. 35 U.S.C. § 154(a)(2) (1994).

[33] Report, *supra* note 18.

context of licensing research tools, the same provisions tend to give rise to conflict again and again.[34] Because transaction costs reduce the surplus that would be gained from a license, their very existence can deter patent holders and would-be licensees from negotiating.

Sometimes the transaction costs associated with licensing patents on basic research results can be so high that what was expected to be a straightforward licensing negotiation either drags on for an extended length of time or fails altogether.[35] Another cause of licensing failure can be the impatience of downstream researchers with the licensing process and their unfamiliarity with the intricacies of legal language. As the National Institutes of Health (NIH) Working Group on Research Tools has concluded, "[m]ost scientists are not skilled at reading license agreements and distilling the legal implications of their language, even in consultation with their own institutional representatives."[36] One thing is clear: there are no hard-and-fast rules.

When a downstream innovator needs to collect more than one license in order to conduct further research, its transaction costs increase dramatically.[37] For example, a pharmaceutical company interested in developing a commercial treatment for a genetic disease may have to take out licenses on multiple gene fragments, known as expressed sequence tags ("ESTs"), each of which may be owned by a different entity. As Michael Heller and Rebecca Eisenberg argue in the context of biomedical research, a thicket of patent rights on upstream discoveries may magnify transaction costs to the point of stifling downstream development and commercialization.[38] When proprietary rights to a resource are carved up into pieces too small to be aggregated easily, they argue, this creates an "anticommons" that results in underuse of the resource.[39] Drafting multiples licenses may or may not lead to economies of scale. When institutions holding patents on basic research results want to license their patents to multiple licensees, they are faced with the choice either of constructing a single licensing agreement that fits all comers like a Procrustean bed (which may reduce licensing revenues and increase negotiation costs) or of

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34 *See* Rebecca S. Eisenberg, *Streamlining the Transfer of Research Tools*, 74(6) ACAD. MED. 683 (June 1999) (describing some of the provisions that lead to bargaining breakdown).

35 Report, *supra* note 18.

36 *Id.*

37 *See* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698, 699 (1998).

38 *See id.*

39 *Id.* at 698-99. *See also* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 677 (1998) (arguing that a tragedy of the anticommons can occur when too many individuals have rights of exclusion in a scarce resource).

crafting licensing agreements tailored to each negotiation (which will be more costly to draft).[40] Either way, the result is the same: negotiation is costly.

Just because there is a large number of licenses to be negotiated or multiple players involved in the transaction does not mean that bargaining failure will occur, of course. Some commentators have argued that the presence of high transaction costs encourages both patent holders and would-be licensees to invest in institutions that lower the cost of certain types of exchanges.[41] Various industries have developed institutional responses over time, such as the ASCAP copyright collective and the MPEG-2 compression technology patent pool, to mitigate some of the obstacles to successful licensing transactions.[42]

And let us not forget that most flagrant aspect of patent costs—enforcement. The direct costs of enforcing patents and licenses are well documented.[43] The perception of potential litigation creates significant costs as well. One study has shown that the cost of intellectual property litigation plays a major role in driving the research plans of more than half of the corporations with less than 500 employees, and is a significant concern for one-third of larger businesses.[44] Enforcement of proprietary rights has indirect costs as well. Discovery imposes significant opportunity costs on managers, executives, and researchers. The mere announcement of an infringement suit has costs for patent holders and alleged infringers alike. News reports of the filing of a patent infringement suit have been shown to cause both the patent holder's and the alleged infringer's firm values to drop.[45] Finally, avoidance costs are positive. Entities have an "affirmative duty to exercise due care to

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40 *See* Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 1053 (1997).

41 *See* Robert P. Merges, *Contracting Into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CALIF. L. REV. 1293, 1294 (1996).

42 *See id.* at 1329-43.

43 Jean Olson Lanjouw, *Economic Consequences of a Changing Litigation Environment: The Case of Patents* (National Bureau of Economic Research Working Paper No. 4835) (1994).

44 *Id.*

45 *See* Josh Lerner, *Patenting in the Shadow of Competitors*, 38 J.L. & ECON. 463, 470 (1995) (showing that the market-adjusted combined capitalization of plaintiff and defendant in the sample presented fell an average of 2.0% in the two-day window ending on the day that news of the infringement filing appeared in the *Wall Street Journal*). *See also* Sanjai Bhagat et al., *The Costs of Inefficient Bargaining and Financial Distress: Evidence from Corporate Lawsuits*, 35 J. FIN. ECON. 221 (1994) (showing that the market-adjusted combined capitalization of plaintiff and defendant in the sample presented fell an average of 3.1% in the same two-day window).

determine whether or not [they are] infringing" other firms' patents.[46] Willful infringement can lead to enhanced damages[47] and attorney's fees.[48]

To date, legal scholars have discussed extensively the relevance of transaction costs to allocations of proprietary rights generally.[49] Some scholars have applied this analysis to intellectual property specifically, discussing the presence of search costs,[50] bargaining costs,[51] and enforcement costs[52] surrounding intellectual property rights.

But bargaining between patent holders and would-be licensees can break down for a host of reasons, not all of which have to do with transaction costs. Empirical studies of different industries—including electric lighting, automobiles, airplanes, and radio—reveal many cases in which the holder of a patent that was the key to downstream products was unable to negotiate licenses with downstream innovators to coordinate further development of the basic invention.[53] The characteristics of patents on basic research indicate that they, too, may be another area in which we can expect frequent bargaining breakdown. To understand why, I want to focus on another factor, often overlooked in the literature, that is particularly important when patent rights on basic research are changing hands: uncertainty.

III.

Risk involves predictable probabilities of a future event occurring, whereas uncertainty involves unpredictable probabilities.[54] Licensees can assess the risk associated with further research and development of a basic invention and negotiate licensing fees accordingly. But when the patented invention is so basic that the downstream uses are unknown and unknowable—i.e., when they

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46 Underwater Devices, Inc. v. Morrison-Knudsen Co., 717 F.2d 1380, 1389 (Fed. Cir. 1983).

47 *See* 35 U.S.C. § 284 (1994).

48 *See id.* § 285.

49 *See, e.g.,* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral,* 85 HARV. L. REV. 1089 (1972); Louis Kaplow and Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis,* 109 HARV. L. REV. 713 (1996).

50 *See* Lemley, *supra* note 40.

51 *See* Heller & Eisenberg, *supra* note 37.

52 *See* Lerner, *supra* note 45 (examining the patenting behavior of firms with various levels of litigation costs).

53 *See* RICHARD R. NELSON & SIDNEY G. WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE 255-62 (1982); Robert P. Merges & Richard R. Nelson, *On the Complex Economies of Patent Scope,* 90 COLUM. L. REV. 839, 885-91 (1990).

54 *See* FRANK KNIGHT, RISK, UNCERTAINTY AND PROFIT 197-263 (1921).

are uncertain—then would-be licensees and patentees will have difficulty bargaining over the transfer of proprietary rights.

The closer an invention gets to the basic end of the research spectrum, the greater the uncertainty about the future value and commercial uses of that invention.[55] For example, a patent may exist on a fragment of a gene although the function of that gene fragment is unknown; the sequence and function of the entire gene of which that fragment is a part is unknown; the ways in which that gene can malfunction are unknown; the diseases that arise when the gene malfunctions are unknown; and the pharmaceutical compound that can combat the disease that arises when the gene (of which the gene fragment is but a part) malfunctions is unknown. In this string of unknowns, it is discovering and patenting the last that is commercially lucrative. When all that is known is the sequence data surrounding the gene fragment, the future value of a patent on the gene fragment is difficult for the patent holder and the would-be licensee to predict and even more difficult for both to agree upon.

Let me make clear what the problem is *not*. I am not referring to bargaining breakdown that occurs under full or near-full information because the parties place different subjective values on the patent.

Nor is the problem to which I refer one of inequitable conduct in which patentees deliberately withhold information regarding how to make or reproduce the invention. Patentees know, *ex ante*, that a valuable patent will be carefully pored over by competitors. The patent laws require that patentees reveal as part of the patent "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 others to recreate the invention.[56] Patent applicants who attempt to withhold vital information about the invention from their applications, in the hopes of de facto extending protection after the statutory period, run the risk of having their patents invalidated.[57] If competitors believe the invention is not fully disclosed in the patent, they can challenge the validity of the patent. If the PTO or the CAFC concludes that the patent holder misled the PTO when filing the application, such as by hiding relevant information, then the PTO or the court will invalidate the entire patent. The punishment is sufficiently disproportionate to the value of the information withheld that

[55] Innovation is often not a linear process. *See* Clarisa Long, *Patents and Cumulative Innovation*, 2 WASH. U. J. L. & POL'Y 229 (2000). Nonetheless, conceptualizing research as ranging along a spectrum from basic research at one end to applied research at the other is a useful construct.

[56] 35 U.S.C. § 112 (1994).

[57] *See* 37 C.F.R. § 1.56 (1999).

successful inequitable conduct actions are rare. The anticipated value of the patent, therefore, is directly correlated to the incentive to act honestly when submitting the patent application. The greater the anticipated stream of future revenue, the greater the incentive for the patentee to be scrupulously honest and reveal all relevant information.

The problem is not one of informational asymmetry either, in which one party to a transaction knows valuable information that it withholds from other parties to a transaction. For example, if a downstream innovator believes the benefits from entering into a particular licensing transaction will be very high, it has no incentive to reveal the full extent of the benefit, lest the patent holder increase its demanded share of revenue. While informational asymmetry raises transaction costs and may contribute to bargaining breakdown, it is a phenomenon different from the one I have in mind.

Rather, I am referring to a severe and intractable lack of knowledge by *all* parties to the transaction regarding the fundamental value of the resource changing hands. In this situation, even if each side reveals all the relevant information available to it, the uncertainty surrounding the future value of the invention is still high. Some licenses will prove to be worth a large licensing fee; most will not.

Innovation is cumulative, and upstream patent holders have greater bargaining power than downstream would-be licensees. In the event of licensing breakdown, a holder of a patent on basic research results can, if it has sufficient resources and inclination, attempt to develop the basic research results into a commercial product. A would-be licensee, however, does not have this option if bargaining fails. It must either look for a substitute product to license or attempt to work around the patent. Imagine the scenario in which downstream innovators will contribute most of the value of a consumer end-product such as a pharmaceutical compound. In order to turn basic research results patented by upstream innovators into the consumer product, the downstream innovators would have to take out licenses on all the underlying patented basic research results, often from more than one patentee. But because patents are subject to property rules rather than liability rules, even under circumstances (such as bilateral monopoly) where liability rules would be more efficient, the first patent holder in line has the power to hold up the entire downstream chain of research.[58]

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[58] A compulsory licensing regime, by imposing a liability rule, can alleviate the holdout problem. But commentators have argued that compulsory licensing, and indeed imposition of liability rules in intellectual

The greater the uncertainty surrounding the future value of the patent, the greater the likelihood that various biases will influence the outcome of the negotiation. A patent holder may overvalue the patent, believing that it represents the linchpin of the next great blockbuster invention.[59] When the contribution of multiple parties to a joint endeavor are cumulative, each may overestimate its own contribution and underestimate the contribution of the others.[60]

Despite such uncertainty and the concomitant biases that creep into the negotiating process, patents are licensed all the time—even patents on basic research results. How do the underlying patents get valued? In this highly subjective process, proxies are frequently used to determine the patent's anticipated value, importance, and strength. Such proxies include the size of the patent holder's portfolio, the licensing fees the patentee has received from licensing other patents, the amount of venture capital financing the patentee has been able to attract, and the litigiousness (or expected litigiousness) of the patent holder, to name a few.

Like all proxies, these are helpful if imperfect. Patentees with large portfolios are more likely to be repeat players and thus have a better bargaining position than patentees who possess only one or a few patents. The stronger its bargaining position, the greater the rents the patentee can expect to extract from licensees. Among other things, the size of the patent holder's portfolio signals the degree to which the patent holder is willing to devote scarce resources to obtaining proprietary rights, which in turn can signal the patent holder's confidence in its research results and its beliefs about the development potential of its inventions. Because a firm tends to receive multiple patents clustering around the same technology, the licensing fees a patentee receives from licensing other patents can be interpreted as a signal of the assessment of competitors of the would-be licensee of the value of the patentee's technology. The same analysis holds true when the amount of venture capital financing the patentee has been able to attract is used as a proxy: if investors are willing to

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property cases generally, would be inefficient to the extent that parties would contract into liability rules themselves. *See* Merges, *supra* note 41, at 1296.

59 *See* Heller & Eisenberg, *supra* note 37, at 701.

60 A similar phenomenon can be found in the domestic relations literature. For example, studies show that spouses tend to overestimate their contribution to household tasks. Erik Olin Wright et al., *The Non-Effects of Class on the Gender Division of Labor in the Home*, 6 GENDER & SOC'Y 253, 260 (1992); *see also* Julie E. Press & Eleanor Townsley, *Wives' and Husbands' Housework Reporting*, 12 GENDER & SOC'Y 188, 203, 208-09 (1998). The existence and measurement of cognitive biases, however, is subject to dispute. *See, e.g.*, Gerd Gigerenzer, *How to Make Cognitive Illusions Disappear: Beyond "Heuristics and Biases,"* 2 EUR. REV. SOC. PSYCHOL. 83 (1991).

support a company, assume the would-be licensees, then its technology must be worth something. (Interestingly, the relationship between venture capital funding and patenting seems to be a feedback loop.)[61] The litigiousness of the patent holder signals its competitive ferocity and how important it believes its proprietary rights to be. A patent holder has an incentive not to engage in litigation defending a patent when it anticipates that the costs of the defense will be greater than the expected profits and damages from the infringed patent. On the other hand, a patent holder may want to enforce a particular patent, even when enforcement is more costly than the anticipated gains, because sending a signal that the patent holder is willing to lose money defending its rights may deter would-be infringers of other patents and prove to be efficient in the long run. None of these proxies, either individually or taken together, however, provides a means of valuing the patented technology accurately.

If these proxies are so imperfect, then why don't downstream innovators negotiate licensing terms that allow them to innovate first, and pay later? In other words, wouldn't downstream innovators want to craft licensing terms that allowed them to pay only after downstream research on a patented basic invention had revealed its commercial value? In practice, such terms are rarely used. This is partly due to the fact that if licensing fees must be paid sooner or later, rational patent holders would prefer to be paid a determined amount sooner rather than an undetermined amount later. (Remember that if the parties to the transaction could determine the probability of success of the future research and discount accordingly, there would be no need to defer payment.) Rational licensees would prefer to negotiate a licensing amount sooner rather than later, so as to fix one more variable in their downstream research risk equation. Licensees must subtract the cost of the license from the profitability of the commercial end-product and thus will be willing to pay only if they anticipate that the cost of the license will allow a sufficient return on investment. No innovator wants to be in the position of having to pay licensing fees, however small, for the use of a patent that turned out to be a dud. And no patent holder wants to hear that it will not be receiving licensing revenues because its patent turned out to be one of the majority of patents that ultimately is not commercially viable.

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[61] *See* Samuel Kortum & Josh Lerner, *Does Venture Capital Spur Innovation?* (National Bureau of Economic Research Working Paper No. W6846) (1998) (demonstrating that a positive correlation exists between venture capital activity and patenting).

The expansion of patentable subject matter closer to the basic end of the research spectrum promises to exacerbate the valuation problem. If licensing attempts fail, the would-be licensee can only attempt to work around the patent or look for a substitute product on which to take out a license. But the initial rights holder, if sufficiently capitalized, has the option of conducting the downstream research and development necessary to turn the patented research results into a commercial product. Alternatively, an initial rights holder that is unable to conduct the downstream innovation necessary to turn basic research results into a commercial product may be more dependent on licensing revenues, and thus more eager to avoid bargaining breakdown, than one that is not so dependent. Different sets of incentives will apply under different circumstances; the characteristics and preferences of initial rights holders help determine whether or not attempts to transfer proprietary rights to basic research ultimately are successful. As the number of patents on basic research results increases, we can expect the frequency of bargaining breakdown over these resources likewise to increase. Whenever negotiating licensing terms to basic research results breaks down, valuable time is lost. The problem will be most acute when the entities patenting the basic research results do not have the capital to develop the patented material and have no further use for it except as a source of licensing revenue.

If both parties to a licensing transaction are equally ignorant of whether a patented basic research result can be turned into something that has a viable commercial use, then ought we to grant proprietary rights to basic research results at all? Determining whether proprietary rights ought to be granted for basic research results is well beyond the ambitions of this Article. Instead, my intent is to suggest that we need to focus more closely on the uncertainty surrounding basic research results as one of the factors that leads to bargaining breakdown. Analyzing licensing transactions of basic research through the lens of uncertainty can help us to understand better the causes behind at least some instances of licensing breakdown. If proxies are used as a substitute for analysis of the scientific merits of the patented invention, then it would be helpful to know which proxies are used and when, to what extent they are useful and why, and the circumstances under which they are useful. With uncertainty and the proxies used to value basic research as our focus, we can then explore how to create mechanisms that will allow for the smooth transfer of proprietary rights from initial rights holders to downstream innovators. At the very least, we can examine the barriers that prevent transfers from occurring and focus our attention on lowering them.