

**BIOMEDICAL UPSTREAM PATENTING AND SCIENTIFIC
RESEARCH: THE CASE FOR COMPULSORY LICENSES BEARING
REACH-THROUGH ROYALTIES***

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ABSTRACT

In the wake of breakthroughs in biotechnology and prosperous development in the biotechnology industry, the field of biomedical upstream research has experienced a large increase in the number of patents granted. This Article concerns mainly the threat that the proliferation of upstream patents pose to biomedical research and commercialization, especially the danger posed by research tool patents. The propagation of research tool patents may impede access to those research routes that are most promising to scientists. These patents also create substantial burdens, including research delays and financial costs, for independent researchers seeking authorization for the use of research tools. There are two contending camps—the prospect theorists and the anticommons theorists—arguing over the influence of patents on biomedical upstream research. Although the anticommons theory is more sensible and coherent, the reality of biomedical science does not unfold as predicted by this theory. Empirical studies suggest that the reason for this disparity lies in the nature of biomedical research, as well as in the informal research exception that the scientific community has developed. However, even such empirical findings cannot convincingly negate all of the problems created by upstream patents, including blockages in downstream development and increasing delays and costs for follow-on research on the patented upstream inventions. In this article, I review proposals now put forward by scholars for eradicating these problems. Finding fault with most of the resolutions proffered thus far, I argue for a compulsory license system that charges reach-through royalties, which are measured by the contribution that patented research inputs make to the individual research. This is a method that can calibrate royalties to the actual value of these research inputs. With this proposal, I hope to bridge the gap between patentees and independent researchers so as to alleviate the problems that biomedical science suffers now.

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I. INTRODUCTION

In the wake of breakthroughs in biotechnology and prosperous development in the biotechnology industry, the field of biomedical upstream research has experienced a large increase in the number of patents granted. The relaxation of patent laws, particularly with regard to the requisite conditions for patentability, has also contributed to the proliferation of upstream patents, which is having a negative impact in a number of realms.¹ The first threat of this proliferation is to the ideals of open science and the free exchange of creative ideas. The prospect of having to apply for patents is causing an increasing number of researchers to keep their excellent ideas secret at least until the patent application is filed. Their industrial partners or sponsors may also require them to do so. The second threat of the patent proliferation is to follow-on research and commercialization of patented inventions, especially the danger posed by research tools. Research tools are those research inputs that are not embodied in the final outcome of the research, yet are useful in performing the research. The propagation of research tool patents may cut off the routes of research that scientists find most promising. It also generates substantial burdens, including research delays and financial costs, for independent researchers when they seek authorization from the patentees.

At the theoretical level, there are two contending camps arguing over the influence of patents on biomedical upstream research. The prospect theory camp emphasizes the incentives that early patenting may provide for upstream innovation and downstream research and development. The anticommons theory camp, however, stresses that patent proliferation gives rise to the anticommons. The anticommons is a set of situations where too many rights exist for excluding the use of an object, and no privilege exists for anyone to overcome those rights and make use of the object.² The core problem with the anticommons is underuse. It generates high transaction costs, triggering heterogeneous strategies and agendas among various stakeholders, thus obstructing the licensing of upstream patents and constraining follow-on research and development in the field of biomedical research.³

After examining the literature on both sides, I conclude that the anticommons theory is more sensible and coherent than the prospect theory. The reality of biomedical science, however, does not unfold as predicted by the anticommons theory. There is another camp of literature that does not deny the theoretical possibility of the anticommons, but rather concentrates on exploring the actual landscape of biomedical

¹ See *infra* Section II.B.

² Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698 (1998).

³ *Id.*

upstream innovation.⁴ Scholars in this circle assert that the anticommons has not occurred in biomedical science because of the nature of biomedical research and because the scientific community has developed “working resolutions,” such as the informal research exception. As a consequence, these scholars suggest that though possible in theory, the negative impacts of upstream patents might not occur in reality. The empirical studies of this camp are helpful to recognizing the true conditions present in today’s biomedical research. But they cannot completely rule out the problems created by upstream patents, including blockages in downstream development and increasing delays and costs for research and innovation ensuing dependent on the patented upstream inventions.

Using these existing studies as a foundation, this Article goes on to identify the real problems that are occurring in the biomedical sector and the need for coping with them. The author then reviews resolutions already put forward by scholars for settling these problems. Finding fault with most resolutions proffered thus far, this Article argues for a compulsory license system, a solution that originates with Janice Mueller.⁵ I further refine this proposal and add new facets to it, such as *ex post* notification and interpleader. The compulsory license system is in essence a time-shifting mechanism, requiring independent researchers to pay reach-through royalties at the end of their research for the patented inputs they used therein. This system retains the chief virtues of the informal research exception now operating in academia, empowering researchers to use whatever input they need for their research, except for those inputs that require assistance from the patentees. Reach-through royalties are measured by the inputs’ contribution to the research at issue, which calibrates the royalties to their true value in individual research. By doing so, this resolution can hopefully bridge the gap between patentees and independent researchers that is now permeating at the license negotiation stage, hence alleviating the delays and costs thus incurred.

This Article will embark on the above issues step-by-step. The next Part analyzes the proliferation of upstream patents, including its causes and resulting dangers. Part III summarizes and assesses the debate between the prospect theory and anticommons theory camps. Part IV further explains why the prediction of the anticommons theory has not generally come true in biomedical science and points out where the real problems lie. Part V reviews important resolutions proffered thus far on this topic and discusses their respective deficiencies. Part VI argues for a compulsory license system bearing reach-through royalty fees and examines its compatibility with the World Trade Organization’s (WTO) Agreement of Trade-Related Aspects of Intellectual Property Rights

⁴ See *infra* Section IV.B.

⁵ Janice M. Mueller, *No “Dilettante Affair”*: Rethinking the Experimental Use Exception to Patent Infringement for Biomedical Research Tools, 76 WASH. L. REV. 1 (2001).

(“TRIPS Agreement”), a primary international patent agreement with prevalent membership. Finally, in Part VII, this Article concludes that the inflexibility of the current patent system may sabotage the fulfillment of the compulsory license system. Regaining latitude for reform is thus the first step on the path to improving our patent system.

II. BIOMEDICAL UPSTREAM PATENTING AND ITS PROBLEM

There has been a tendency towards patenting research outcomes in the biomedical sector since the landmark case *Diamond v. Chakrabarty*,⁶ in which the U.S. Supreme Court confirmed the patentability of living organisms for the first time. Though biomedical and other kinds of biotechnology patents are not necessarily granted for living creatures, this decision trumpeted a surge of application and issuance in biotechnology patents.⁷ The number of biotechnology patents issued by the U.S. Patent and Trademark Office (PTO) increased rapidly in the 1990s, starting at fewer than 1000 in 1990 and rocketing to its high watermark of 5977 patents granted in 1998. In the following years, the number of patents issued fluctuated and then declined after 2001. In 2004, the PTO granted 4324 biotechnology patents, about the same level as that in 1997.⁸

Biomedical patents have expanded not only quantitatively, but also towards the research upstream. A growing number of patents on gene sequences illustrates this trend. According to the statistics from the Biotechnology Industry Organization (BIO), by the end of 2001, the PTO had granted at least 6500 patents covering gene and open reading frame sequences.⁹ Of these patents, at least 1300 are on human genetic materials. Thus far more than 20,000 patent applications for gene sequences have been submitted to the PTO.¹⁰ This means that more upstream patents may be still on the way.

⁶ 447 U.S. 303 (1980).

⁷ Biotechnology patents conventionally include two major divisions: biomedical patents and bio-agricultural patents.

⁸ David E. Adelman & Kathryn L. DeAngelis, *Patent Metrics: The Mismeasure of Innovation in the Biotech Patent Debate*, 85 TEX. L. REV. 1677, 1687, 1731 fig.1 (2007). For the reason behind the high tide of biotechnology patents in 1998, see *infra* text accompanying notes 16–25; for the reason behind their decline thereafter, see *infra* Section IV.A.

⁹ Open reading frame sequences are DNA sequences that may bear genetic codes for proteins and are usually located in a gene initiation codons and termination codons. *Open Reading Frame*, in Online Medical Dictionary, available at <http://cancerweb.ncl.ac.uk/cgi-bin/omd?query=open+reading+frame&action=Search+OMD>; Wikipedia, *Open Reading Frame*, http://en.wikipedia.org/wiki/Open_reading_frame (last visited Apr. 24, 2008).

¹⁰ Biotechnology Industry Org., Primer: How Many Patents has the PTO Issued Covering Gene Sequences?, <http://www.bio.org/ip/primer/genesequences.asp> (last visited Apr. 28, 2008).

A. THE REASON FOR EXPANSION IN UPSTREAM PATENTING

The prosperity of the biomedical industry in recent decades and its science-based nature are the primary reasons for the upstream patenting in the biomedical sector. In academia, there used to be a disinclination to secure patents for scientific discoveries. This was derived from the notion that scientific findings should be open to humanity for employment, evaluation, and extension.¹¹ The Bayh-Dole Act of 1980 materially altered this academic ethos. The Act enabled public-funded researchers to file and own patents for their specific findings.¹² This change of law spread the practice of patenting and licensing scientific discoveries, which had previously existed in only a few universities, such as Stanford University and University of California, to academic institutions across the nation.¹³ Changes in patent law are another reason for the increase in biomedical upstream patenting. In addition to the expansion of subject matter that the Supreme Court articulated in *Chakrabarty*, courts have also relaxed the requirement of utility. The Supreme Court in *Brenner v. Manson*¹⁴—a 1966 case about an allegedly novel process to produce certain known steroid—set aside the traditional standard that simply required the patented invention to be more than frivolous and insignificant and laid down the modern rule for the utility requirement:

The basic quid pro quo contemplated by the Constitution and the Congress for granting a patent monopoly is the benefit derived by the public from an invention with *substantial utility*. Unless and until [an invention] is refined and developed to this point—where *specific benefit exists in currently available form*—there is insufficient justification for permitting an applicant to engross what may prove to be a broad field.¹⁵

¹¹ Rebecca S. Eisenberg, *Proprietary Rights and the Norms of Science in Biotechnology Research*, 97 YALE L.J. 177, 182 (1987).

¹² 35 U.S.C. §§ 200-211, §§ 301-307 (2000 & Supp. 2004). For an analysis of this Act, see, for example, Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663 (1996).

¹³ Cf. DAVID C. MOWERY ET AL., *IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT* 5-8 (2004) (asserting that even if the Bayh-Dole Act did not exist, technology transfer between universities and industries would still grow).

¹⁴ 383 U.S. 519 (1966).

¹⁵ *Id.* at 532-35 (emphasis added). For the traditional view, see *Lowell v. Lewis*, 15 F. Cas. 1018, 1019 (C.C.D. Mass. 1817) (No. 8568); *Bedford v. Hunt*, 3 F. Cas. 37 (C.C.D. Mass. 1817) (No. 1217).

Thirty years later in *In re Brana*,¹⁶ the Court of Appeals for the Federal Circuit (“Federal Circuit”), which was established in 1982 and vested with exclusive appellate jurisdiction over patent cases, held that it was unnecessary for pharmaceutical applicants to prove the ultimate utility of the claimed invention in human bodies. Rather, an intermediate value for further research and development was upheld as sufficiently useful.¹⁷ In this specific case, an indirect allegation was made in the patent specification that a chemical compound was effective against specified, commonly used animal tumor models, and the court ruled that the patent fulfilled the requirement of practical utility. That means pharmaceutical inventors, when applying for patents, do not need to show the invention’s efficacy in human bodies. In other words, they can submit their applications to the PTO as early in the invention process as completion of the preclinical testing, either *in vitro* or on animals. Before this decision, drug inventors had to wait until the therapeutic effectiveness of pharmaceutical compounds was substantiated in clinical trials on actual human bodies before they could patent their inventions.¹⁸

This is not the first time that the Federal Circuit has retreated from the *Manson* test. For example, the Federal Circuit took the same stance in *Cross v. Iizuka*¹⁹ as it did in the later *Brana* case. In *Cross*, the court found that *in vitro* testing of an alleged invention plus *in vivo* testing of structurally similar compounds should be regarded as useful. The court embraced *Manson* in that case, acknowledging that the “starting point for a practical utility analysis is [*Manson*].”²⁰ As a matter of fact, this line of cases greatly undermined the position of the *Manson* decision that insists currently available benefit to the public is a threshold for patentability.

Given the contribution of intermediate discoveries to the biomedical sector, which involves layers of subsectors and long development processes,²¹ direct usage in human bodies may not be necessary. But granting patents on inventions for which the asserted utility is susceptible is quite another thing. When inventors generate new compounds, they are usually unclear about the compounds’ usage. Patents on this kind of invention will authorize the inventor to reserve a class of potential candidates for valuable products available only for his or her own use.

Furthermore, the Federal Circuit set up a utility presumption in the *Brana* decision for patent applicants.²² The utility assertion in the patent

¹⁶ 51 F.3d 1560 (Fed. Cir. 1995).

¹⁷ *Id.* at 1566.

¹⁸ *Id.* at 1568.

¹⁹ 753 F.2d 1040 (Fed. Cir. 1985).

²⁰ *Id.* at 1046.

²¹ See *infra* text accompanying notes 31 & 79-87.

²² *In re Brana*, 51 F.3d at 1566.

specification is deemed presumptively correct as long as the disclosed enablement covers all terms used in the patent claims. The PTO bears the initial burden of challenging that assertion. Only when the Patent Office demonstrates reasonable doubt of the patent's utility, analyzed in light of those having ordinary skill in the art, will the burden shift to the applicant to proffer evidence showing the utility truly exists.

The PTO has also moved in the same direction. In 1995, the PTO released new utility guidelines.²³ The guidelines omitted the requirement of a substantial utility showing as mandated by the *Manson* court, only requiring that claimed inventions be "for any particular purpose" and that their usage be "considered credible" to a person of ordinary skill in the art.²⁴ Consequently, scores of patent applications claiming genes or gene fragments were filed with the PTO, which led, in 1998, to the height of patent issuance in this field.²⁵

Biotechnology is a cash-starved industry. Even if a laboratory successfully makes an upstream discovery, it still has a long way to go before achieving true commercial success. One of the primary resulting factors is a long course of research and commercialization following the upstream discovery. As a result, the industry relies to a great extent on financial support from the capital market, particularly venture capital. On the one hand, upstream patenting visualizes the technological achievements of biotech companies, providing critical assets for them to solicit investment and other financial commitments. On the other hand, upstream patenting casts obstacles in the way of independent research and commercialization, posing possible threats to the open dissemination of scientific information, and thus endangering the progress of biomedicine and biomedical science.²⁶

B. THE DANGER POSED BY UPSTREAM PATENTS

The organization of scientific communities, in the words of Michael Polanyi, fulfills the principle of "spontaneous coordination of independent initiatives."²⁷ On one level, every scientist pursues his or her own research initiatives by individually identifying his or her research goals and agendas. But through the unbounded dissemination of scientific ideas and breakthroughs, scientists keep abreast of the newest

²³ In the *Brana* decision, the Federal Circuit took note of the proposed content of the guidelines. *See id.* at 1564.

²⁴ Utility Examination Guidelines, 60 Fed. Reg. 36,263, 36,264 (July 14, 1995).

²⁵ *See infra* Section IV.A for details.

²⁶ *See generally* MOWERY ET AL., *supra* note 13, at 185-92; Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. L. REV. 77 (1999).

²⁷ *See* Michael Polanyi, *The Republic of Science: Its Political and Economic Theory*, 1 MINERVA 54, 55 (1962), reprinted in 38 MINERVA 1, 2 (2000).

developments in their areas of research, and they accordingly adjust their agendas to concentrate on the most promising, yet unachieved part of the subject. Scientists may modify their research approach to accommodate new targets, as well.²⁸ In this way, scientists cooperate perfectly without any centralized coordination.²⁹

The reason underlying this intangible cooperation is the uncertainty and unpredictability of scientific research. Issues for academic investigation often exceed the horizon of current science and knowledge. Few persons, if any, can predict accurately where the real problem lies and what approach will be the most promising and effective in its exploration.³⁰ As framed in models of innovation by economists like Suzanne Scotchmer, the lack of stability results from the scarcity of creative ideas and the features of investment in developing such ideas.³¹ Investment in those ideas has three unique features. First, the investment is often made before the pros and cons of the individual research route become clear. Second, when expert opinions diverge because of the technical complexity, there is no good standard for determining the efficiency of research paths. Third, investments might lock in specific routes for the research. After substantial investment and development, the lesser performing research path that was chosen earlier might end up being superior to excellent, later-developed alternatives. The possibility of new research paths and their unpredictable timing thus add an unstable factor to the investment decision.³² Such factors are particularly manifest in the biomedical sector. The Pharmaceutical Research and Manufacturers of America (PhRMA), a trade association of pharmaceutical research and biotechnology companies in the United States, asserted vocally that in every 10,000 potential medicines investigated by U.S. research-based pharmaceutical firms, only one medicine is likely to succeed through the research and development process and garner approval from the U.S. Food and Drug Administration (FDA).³³

Under the coordination of an “invisible hand” operating in the scientific community, however, scientists’ pursuit of personal achievement weaves a closely knit web, as they tackle their common subject of research from every potential angle. Dissemination of scientific findings carries the

²⁸ *Id.* at 2-3.

²⁹ *Id.* at 3.

³⁰ *Id.* at 3; *see also* STEVEN GOLDBERG, *CULTURE CLASH: LAW AND SCIENCE IN AMERICA* 53 (1994).

³¹ Jerry R. Green & Suzanne Scotchmer, *On the Division of Profit in Sequential Innovation*, 26 *RAND J. ECON.* 20, 22 (1995); *see also* SUZANNE SCHOTCHMER, *INNOVATION AND INCENTIVES* 39-41 (2004); Ted O’Donoghue et al., *Patent Breadth, Patent Life and the Pace of Technological Progress*, 7 *J. ECON. MGMT. STRATEGY* 1, 5 (1998).

³² *See* GREEN & SCHOTCHMER, *supra* note 31, at 55–58.

³³ PhRMA: Innovation, <http://www.phrma.org/innovation> (last visited Mar. 5, 2007).

same function as the price mechanism does in the marketplace.³⁴ It works as a guiding compass, leading scientists working on the same topic to adjust their course of research to accommodate discoveries by their colleagues around the globe. As a result, the dissemination of research findings facilitates the division of scientific endeavors and better allocation of research resources.

The first threat of biomedical upstream patenting is to open discussion and the sharing of ideas in the scientific community. As explained above, the self-guided coordination of individual research is based on instant disclosure and the distribution of novel discoveries. By virtue of upstream patenting, however, secrecy in the scientific universe is on the rise and is posing a danger to the fundamental mechanisms relied on by the scientific community. The origin of the secrecy is twofold. First, because of the possibility of gaining a patent, scientists are less willing to exchange their intuitions and thoughts with their colleagues than they were in the past. By keeping creative ideas to themselves, scientists can prevent their audience from conceiving patentable inventions based on the same ideas in advance of them, thus securing priority of inventorship. They may also delay publishing their research findings in order to first assess whether to claim them in patents.

The second source of secrecy originates from patent licensing in scientific research. Since patents are extending upstream, it is now a more frequent occurrence for scientists to encounter patents and to garner patent licenses in the course of their research. Driven by commercial instincts, patent owners from the corporate world try to preserve every valuable proceed derived from their technology. They usually require prior review of publications generated in the research process as a condition of license in order to appraise whether a patent application is adequate for the research result. When patents are desired, corporate patentees will withhold publication of the scientist's research for a longer time to ensure that the necessary patent applications are filed.³⁵ When patents are not a feasible option, corporate patentees may still object to publication as an attempt to preserve the discovery as a trade secret. They may also prohibit sharing of their claimed technology and of any proceed derived therefrom with anyone not covered in the license. The restrictions will be even harsher if the patentee also provides financial sponsorship. As a result, some university professors' laboratories are off-limits even for their colleagues and students in the same department.³⁶ Imposing license

³⁴ See Polanyi, *supra* note 27, at 4.

³⁵ In the United States, there is a one-year grace period allowed between publishing the inventive finding and filing for a patent. 35 U.S.C. § 102(b) (2000 & Supp. 2004). But in Europe and Japan, two major jurisdictions for patent application, there is no such grace period. See PAUL GOLDSTEIN, INTERNATIONAL INTELLECTUAL PROPERTY LAW 324 (2001).

³⁶ DEREK BOK, UNIVERSITIES IN THE MARKETPLACE: THE COMMERCIALIZATION OF HIGHER EDUCATION 64 (2003).

conditions, however, is not just a privilege for corporate patentees; academic patentees sometimes demand the same limitations.³⁷

C. THE THREAT FROM PATENTS FOR RESEARCH INPUTS

The second threat posed by upstream patenting is patent proliferation in the research process, especially with regard to research tools. Because of upstream patenting and the rise of the biotechnology industry, nowadays a substantial number of biomedical patents are not for end products or the processes leading to them, but rather for research tools. These tools are inventions that cannot develop into an end product in their own right, at least in certain respects, but that are capable of assisting follow-on research and commercialization in developing valuable products for the marketplace. A large portion of these tools are intermediate products. They are useful in the biotechnology industry as research inputs for mid- or downstream development of end products. Though deployed in the research process, those tools do not appear in the final output of the research.³⁸ In the wake of the transformation of biomedical patent composition, scientists have to deal with patents more often than ever during their research course, which creates a series of burdens in securing a patent license, including lingering negotiations and an elevated level of royalty expenses.

For purely academic research, scientists could rely on the common law experimental use defense (the so-called *Bolar* exemption) in the past. Courts customarily used the “commercial purpose” test to determine whether the experimental use defense could be raised in individual cases. As Justice Story articulated in *Sawin v. Guild*,³⁹ for alleged infringement to qualify as experimental use, there must be no intention on the side of the user to employ the patent for profit. The modern jurisprudence of the Federal Circuit embraced this rule as well. For instance in *Roche Products, Inc. v. Bolar Pharmaceutical Co.*, the Federal Circuit explained

³⁷ REPORT OF THE NATIONAL INSTITUTE OF HEALTH (NIH) WORKING GROUP ON RESEARCH TOOLS (1998), available at <http://www.nih.gov/news/researchtools/index.htm> (referring to the discussion entitled “Importing research tools from universities”).

³⁸ According to the broad definition adopted by the NIH working group, all research inputs constitute research tools. *See id.* To the contrary, this Article divides them into two categories: research targets and pure research tools. Research targets are not just tools. They are the central objects that the whole research is working on. This category contains therapeutic targets, including drug targets, which are research tools because the embodiment of them may not reside in the final product, as well as drug candidates, which are not research tools because the final product may be a species out of a generic candidate. The research input for exploring alternatives to the patented invention, namely for inventing or designing around, falls into this category as well. For more explanations and examples of research targets and pure research tools, see *infra* Subsections IV.C.1 and IV.C.2.

³⁹ 21 F. Cas. 554, 555 (C.C.D. Mass. 1813) (No. 12391) (citing *Whittemore v. Cutter*, 29 F. Cas. 1120 (C.C.D. Mass. 1813) (No. 17600)).

that courts should not “allow a violation of the patent laws in the guise of ‘scientific inquiry,’ when that inquiry has definite, cognizable, and not insubstantial commercial purposes.”⁴⁰ Later, in *Embrex, Inc. v. Service Engineering Corp.*, the last case that the Federal Circuit heard on this issue before *Madey*, the court still applied the commercial purpose rule, affirming the district court’s rejection of experimental use because the defendant performed the tests at issue “expressly for commercial purposes.”⁴¹

In *Madey v. Duke University*,⁴² however, the Federal Circuit largely diminished the applicable realm of this exemption. Plaintiff John Madey is a former professor in the Physics Department of Duke University. After he took the position in 1988, he moved the free electron laser (FEL) laboratory from Stanford University to Duke. Dr. Madey obtained sole ownership of two patents covering certain equipment in the laboratory. Owing to a dispute over the management of the FEL lab, Madey was removed as its director and consequently resigned in 1998. The university continued to use some of the equipment in the laboratory. Dr. Madey subsequently filed a lawsuit against Duke for infringement of his two patents.⁴³

Duke University asserted, inter alia, the experimental use defense. The court not only rejected its assertion, but also narrowed the scope of experimental use. The court stated that:

[R]egardless of whether a particular institution or entity is engaged in an endeavor for commercial gain, so long as the act is in furtherance of the alleged infringer’s legitimate business and is not solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry, the act does not qualify for the very narrow and strictly limited experimental use defense. Moreover, the profit or non-profit status of the user is not determinative.⁴⁴

In this case, the court recognized that the defendant’s use of the patented devices had no commercial implications. The devices simply advanced business goals of the university, including educating and enlightening faculty and students, escalating its academic reputation, and attracting research grants, outstanding students, and faculty members. Nevertheless, under the rule as set forth above, the Federal Circuit held that this case still fell outside the experimental use defense. The court essentially treated

⁴⁰ 733 F.2d 858, 863 (Fed. Cir. 1984).

⁴¹ 216 F.3d 1343, 1349 (Fed. Cir. 2000) (citing *Roche Prod., Inc. v. Bolar Pharm. Co.*, 733 F.2d 858, 863 (Fed. Cir. 1984)).

⁴² 307 F.3d 1351 (Fed. Cir. 2002).

⁴³ *Id.* at 1352-53.

⁴⁴ *Id.* at 1362.

nonprofit institutions such as universities in the same way as it originally treated commercial enterprises. One business objective of universities is luring research grants, and the court noted that aggressive patent licensing programs at major research universities generated financial revenue that was not insubstantial.⁴⁵ The court seemed to suggest that academic institutions simply pursued a particular line of “business” that was not fundamentally different from any line of normal commerce.

Under the new rule of “business furtherance” as formulated in the *Madey* decision, scientists working in any institute that embraces a purpose of advancing the progress of basic science will be expelled from the realm of experimental use.⁴⁶ As Duke University pointed out in its petition for certiorari to the Supreme Court, the *Madey* decision virtually “seal[ed] the coffin on the experimental use exception for private universities.”⁴⁷ Against the backdrop of increased upstream patenting, the *Madey* decision cuts off the legal resort that researchers may invoke and will likely have profound repercussions on the progress of science. The decision makes it possible for the initial discoverer of a certain line of research to dominate all future development and innovation down the line with his or her exclusive patent rights.⁴⁸

This Article focuses on the second threat that upstream patenting brings about: the congestion of patent rights along the roads of research

⁴⁵ *Id.* at 1363 n.7.

⁴⁶ Tom Saunders, Comment, *Renting Space on the Shoulders of Giants: Madey and the Future of the Experimental Use Doctrine*, 113 YALE L.J. 261, 264 (2003).

⁴⁷ Petition for a Writ of Certiorari at 14, *Duke Univ. v. Madey*, 539 U.S. 958 (2003) (No. 02-1007) (cited in Jenniffer Miller, Case Brief, *Sealing the Coffin on the Experimental Use Exception*, 2003 DUKE L. & TECH. REV. 12, 12). Public universities can still assert sovereign immunity against patent infringement suits. *See Florida Prepaid Postsecondary Educ. Expense Bd. v. College Sav. Bank*, 527 U.S. 627 (1999).

In its amicus brief, the United States argued against this interpretation of the opinion in *Madey*, stating that “if engaging in the ‘legitimate business’ of research itself were enough to divest an institution of any experimental use defense, then there would have been no reason for the court of appeals to have instructed the district court to undertake the second half of the inquiry,” namely “whether or not the use solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry.” Brief for the United States as Amicus Curiae, at 10–11, *Duke Univ. v. Madey*, 539 U.S. 958 (2003) (No. 02-1007), available at <http://www.usdoj.gov/osg/briefs/2002/2pet/6invit/2002-1007.pet.ami.inv.pdf>.

⁴⁸ WILLIAM CORNISH, *INTELLECTUAL PROPERTY: OMNIPRESENT, DISTRACTING, IRRELEVANT?* 30 (2004) [hereinafter CORNISH, *INTELLECTUAL PROPERTY*]. There is also a statutory research exemption in the patent code, but this exemption was provided principally for the commercialization of drug candidates identified in early-on upstream research, not for upstream research itself. *See* 35 U.S.C. § 271(e) (2000 & Supp. 2004). In *Merck KGaA v. Integra Lifesciences I, Ltd.*, 545 U.S. 193 (2005), the Supreme Court extended the reach of this statutory research exemption upstream, yet only to the stage of preclinical animal or *in vitro* testing whereby pharmaceutical companies gather necessary data to file investigational new drug (IND) applications with the FDA to start clinical trials. *See id.* at 206–07.

and commercialization. On a theoretical level, there are two principal camps—the prospect theory and the anticommons theory—currently debating the impact of upstream patents on biomedical research. The next part of this Article will delve into the literature on both sides of the debate, in search of insights for determining the true faces of the issues hidden behind these convoluted phenomena.

III. THEORIES ON BIOMEDICAL UPSTREAM PATENTING: PROSPECT OR ANTICOMMONS?

Having explained the development of upstream patenting in the biomedical sector, a theoretical inquiry is now necessary. It is essential for exploring the causes and consequences of this transformation and its relationship with patent laws. Naturally, current theories on this issue are built upon more general thoughts about the patent system as a whole. Before getting to specific theories, a short review of the general thoughts will provide a context and reference point for a better theoretical understanding.

A. INCENTIVE TO INVENT AND OTHER JUSTIFICATIONS FOR THE PATENT SYSTEM

Generating sufficient incentive to invent is the primary justification for the patent system in the United States. The Constitution supports this justification by granting to Congress the power “[t]o promote the Progress of Science and useful Arts, . . . securing for limited Times to Authors and Inventors the exclusive Rights to their respective Writings and Discoveries.”⁴⁹ In order to stimulate the emergence of inventions, Congress established the patent system so that inventors could avoid the disadvantage of public goods—a feature of innovations as an intangible asset—and thus they could recoup the cost incurred in the inventing process and reap the profits of resulting innovations.⁵⁰ Even though there is evidence indicating that inventions would eventually be completed even

⁴⁹ U.S. CONST. art. I, § 8, cl. 8. This is one of the few clauses on intellectual property that has ever appeared in a national constitution. In countries without such a clause, incentives to invent may still have primary status in justifying the patent system. In Britain, for example, incentive to invent and incentive to disclose, see *infra* text accompanying note 52, are as well primary justifications of patent laws. See LIONEL BENTLY & BRAD SHERMAN, *INTELLECTUAL PROPERTY LAW* 327–29 (2d ed. 2004); CATHERINE COLSTON, *PRINCIPLES OF INTELLECTUAL PROPERTY LAW* 21–27 (1999); WILLIAM CORNISH & DAVID LLEWELYN, *INTELLECTUAL PROPERTY: PATENTS, COPYRIGHT, TRADE MARKS AND ALLIED RIGHTS* 133–42 (6th ed. 2007).

⁵⁰ WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 13–14 (2003); Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1024–28 (1989); Giles S. Rich, *The Relation Between Patent Practices and the Anti-Monopoly Laws*, 24 J. PAT. OFF. SOC’Y 159, 175–77 (1942).

without a patent regime, it is without doubt that the existence of patents accelerates their appearance.⁵¹

In addition to providing incentive to invent, there are auxiliary justifications that also vindicate the existence of the patent system. First and foremost is the incentive to disclose the invention. The patent system requires inventors to describe explicitly in the patent specification the claimed invention, as well as how to make and use it. The disclosure requirement is considered a quid pro quo for the exclusive rights that patentees are entitled to, with an aim of letting the public benefit from learning the technological progress made by the invention.⁵² The patent system also provides an incentive to commercialize patented inventions⁵³ and incentive to invent or to design around earlier inventions.⁵⁴ Though patents provide substantial incentives to invent and to disclose the innovation, a question remains in the biomedical sector, where upstream patents have increased dramatically, as to whether too many patents actually deter innovation and delay disclosure.

B. PROSPECT THEORY

The prospect theory supports the upstream proliferation of patents. It contends that the patent system should award inventions a broad scope of claims early on in the innovation pipeline. Upstream patents themselves tend to be broad in their scope of rights since prior art is much sparser in nascent fields of technology. The upstream invention sometimes even initiates a whole new line of research inquiries. Added to this natural tendency, however, the prospect theory argues for a greater breadth in the scope of claims.

Scholars in the prospect theory camp compare the patent system to a system of prospects which assigns the right to explore minerals or other natural resources within a specified area to the one who discovers the resource at that location first.⁵⁵ These scholars allege that patent rights

⁵¹ *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 490–91 (1974) (citing JONATHAN R. COLE & STEPHEN COLE, *SOCIAL STRATIFICATION IN SCIENCE* 12-13, 229-30 (1973); JAMES D. WATSON, *THE DOUBLE HELIX* (1968); Robert K. Merton, *Singleton and Multiples in Science*, in *THE SOCIOLOGY OF SCIENCE* 343 (1973); Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 *J.L. & ECON.* 265, 284-85 (1977); William F. Ogburn & Dorothy Thomas, *Are Inventions Inevitable? A Note on Social Evolution*, 37 *POL. SCI. Q.* 83 (1922)).

⁵² LANDES & POSNER, *supra* note 50, at 294-95; Eisenberg, *supra* note 50, at 1028-30; Rich, *supra* note 50, at 177.

⁵³ F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 *MINN. L. REV.* 697, 736-46 (2001); Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 *HIGH TECH. L.J.* 1, 10-12 (1992); Rich, *supra* note 50, at 177-80.

⁵⁴ See generally DONALD S. CHISUM ET AL., *PRINCIPLES OF PATENT LAW* 67-71 (3d ed. 2004).

⁵⁵ Kitch, *supra* note 51, at 267-75.

could and should operate like mineral claims by enclosing the neighboring area for the initial inventor to explore. Broad upstream patents assign inventors property rights at the outset of technological development and keep these enclosed areas at the patentees' disposal; thus, they are ideal patents in the view of prospect theorists. In their opinion, broad upstream patents assure the initial inventor of any proceeds derived from the area marked by vast patent claims, and therefore could encourage incentive to an invention race, similar to the gold rush that occurred at the turn of the twentieth century in the American West. Such patents could also mobilize patentees to invest significantly in commercializing the claimed inventions, so as to bring the benefit and convenience created by the invention to the marketplace for the public to enjoy and utilize.⁵⁶

1. The Argument for Broad Upstream Patents

The reasons for the prospect theorists' position can be summarized as follows. As stated in Section III.B, the significant incentives provided by broad upstream patents could attract substantial investment in initial inventive endeavors.⁵⁷ Moreover, they could protect investments in proceeds generated by follow-on research and commercialization of the invention. Follow-on research is a category of basic research that looks further into the properties or potentials of the invention; it also refers to applied research for the purpose of investigating possible ways to commercialize the invention. An example of the latter is the struggle to locate a drug candidate acting on a patented drug target, such as cell receptors or disease pathways in the human body.

Commercialization then develops the results of the follow-on research into a commercial product. Manufacturing or other kinds of know-how would be generated at this stage. The establishment of manufacturing facilities, distribution channels, and promotional campaigns are also part of the commercialization process.⁵⁸ In addition to these initial costs, the first mover to the market bears another layer of costs, including expenditure to introduce new types of products to the market, to set up a viable business model, and to educate consumers about the new merchandise, to name a few. The investment and its proceeds are vulnerable to appropriation by latecomers prepared to cut into the same line of products; however, an upstream patent with breadth would prevent this free riding.⁵⁹ In the biomedical sector, where follow-on research and commercialization together could take more than ten years and consume

⁵⁶ See Kieff, *supra* note 53, at 707-12.

⁵⁷ Kitch, *supra* note 51, at 275.

⁵⁸ *Id.* at 276-77.

⁵⁹ Kieff, *supra* note 53, at 707-09.

several hundred million dollars, the need for greater incentives for the development of patented inventions is even more intense.⁶⁰

Another ground for supporting broad upstream patents comes from the capacity of enabling patentees to coordinate follow-on development or inventing-around endeavors. The more expansive the patent scope is, the more downstream developments and potential substitutes the patent could cover and dominate.⁶¹ In the view of prospect theorists, this coordination could create benefits such as superior development of the patented invention, avoidance of duplicative investments from competing researchers, the arrangement of productive license transactions, and the facilitation of information sharing among researchers.⁶² In the biomedical sector, because of the uncertainty and heightened risk of follow-on research and commercialization, patentees may have more incentives to coordinate license and follow-on development efficiently so as to control and manage this risk.⁶³

2. The Extra Incentive is Unnecessary

The aforementioned rationales cannot soundly support the proposition of the prospect theorists. There is no need to expand the scope of patents to provide extra incentives for innovation. Similar to other lines of business, if patentees have the chance to recoup the sunk costs expended during the innovation process (including reasonable returns for entrepreneurship or inventorship), this should be enough to sustain sufficient innovation in society. No extra incentive beyond the recoupment of sunk costs is required for the patent system to inspire innovation.⁶⁴ Conversely, expanding the scope of patents would reward patentees excessively and would fail to keep their property rights commensurate with their real contribution to the society. Given that each patent represents a piece of the public's sacrifice of its freedom to imitate to the dominion of the patentee—that is, each patent represent a subordination of the public to the inventor's exclusive rights to make, use, or sell the patented product—broad patent scope could hardly be justifiable if the patentee did not make commensurate contributions in return for the public's sacrifice.⁶⁵

⁶⁰ *Id.* at 724-26.

⁶¹ For a patent to coordinate its substitutions, it essentially has to incorporate the latter into its scope of claims. This condition is not true in follow-on development, since the claimed invention may be required as research tools in the development process.

⁶² Kitch, *supra* note 51, at 276, 278-79.

⁶³ Kieff, *supra* note 53, at 726.

⁶⁴ See Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1050 (2005); Lawrence Lessig, *Intellectual Property and Code*, 11 ST. JOHN'S J. LEGAL COMMENT. 635, 638 (1996).

⁶⁵ See Lawrence C. Becker, *Deserving to Own Intellectual Property*, 68 CHI.-KENT L. REV. 609, 623-26 (1993).

Prospect theorists allege that most patents do not generate significant market power. As long as the market remains competitive, inventors do not garner excessive profits from patent rights. The patent system also enables price discrimination, which decreases the deadweight loss of social welfare that patent rights bring about.⁶⁶ Even though each of these is admittedly true, upstream patents would still fortify the market status of patentees. No matter what extra market power patentees gain through upstream patents, the patents will nevertheless drive the market further away from a competitive one. Output restraint and deadweight loss are more likely in the less competitive market.⁶⁷

Furthermore, price discrimination is not an easy task. First, it entails substantial amounts of data on customer preferences. But the more difficult problem is how to segregate consumers with a high willingness to pay from those with a low willingness and how to avoid arbitrage between them.⁶⁸ The patent system only makes innovation excludable, eliminating its feature of public goods and turning it into a status vaguely similar to normal commodities. No extra assistance in price discrimination is provided from the patent side. Moreover, even if price discrimination is implemented, it enriches patentees at the expense of consumer surplus, which enlarges the sacrifice of the public and thus is not necessarily desirable.

3. Follow-On Research and Commercialization Are Already Protected by Various Mechanisms

The current patent system is equally available for protecting the proceeds of follow-on research and commercialization. Prospect theorist Edmund Kitch praised the patent system for its uniform incentive structure across various subject matters.⁶⁹ If patentees make any progress against the state of the art during the follow-on research or commercialization stages, they can always count on the patent system to provide legal protection. Trade secrets are another feasible way of protecting know-how arising during commercialization, especially with regard to manufacturing processes and business strategies.

As groundbreakers in the marketplace, first movers enjoy particular benefits as well as heavier burdens. They may grasp a period of lead time over competitors, which is still one of the primary ways to appropriate the value of corporate innovations.⁷⁰ They usually secure other

⁶⁶ See, e.g., Kieff, *supra* note 53, at 735-36.

⁶⁷ See, e.g., MASSIMO MOTTA, COMPETITION POLICY: THEORY AND PRACTICE 40-44 (2004); SCOTCHMER, *supra* note 31, at 36-37; Lemley, *supra* note 64, at 1059-60.

⁶⁸ SCOTCHMER, *supra* note 31, at 37-38.

⁶⁹ Professor Kitch believes patents are preferable to trade secrets in this regard, as trade secrets are much more effective in process rather than product protection. Kitch, *supra* note 51, at 279.

⁷⁰ According to a survey conducted in the 1980s by Levin, Klevorick, Nelson, and Winter,

competitive edges that are excellent for capitalizing on the innovations. First movers confront the learning curve sooner, thus improving product quality and decreasing costs more effectively through learning by doing. They also have the opportunity to get a head start on promotion and marketing. Valuable brand images and goodwill can be established during the lead time carved out by innovation. Furthermore, trademark law effectively protects these values.⁷¹ These benefits, which owe their origins to innovation, combine to create a useful arsenal for marketplace battles.

Certain investments made at the commercialization stage, such as those in constructing distribution channels, are common expenditures for all related lines of products. They have tremendous value beyond the roaring sales of an individual item. These commercial assets can also serve as a foundation for companies to extend their lines of business. And, if well utilized, these assets may generate a fortune. Protecting such assets with the patent system, where the primary purpose is to prevent misappropriation of useful inventions, is neither necessary nor appropriate. Moreover, when the scale of the market for relevant products is limited, there is no space left for competitors to copy the products or business strategies of the first mover. In this situation, latecomers have to invent new products or identify market strategies of their own.

It is true that in the biomedical sector the process of follow-on research and commercialization is protracted, intricate, and costly. On the other hand, among all major industries, the patent system's protection against misappropriation has the greatest effect in the pharmaceutical industry.⁷² Considering simultaneously the fact that any invention conceived during the development process still qualifies for patenting, a particular emphasis on the length of the process does not make the argument for broad upstream patents more plausible or persuasive.

4. Coordination Goes Against the Very Nature of Scientific Research and the Patent System: *Searle*, *Integra*, and CCR5

Turning to the argument based on coordination of follow-on development and inventing-around, there is no indication that centralized coordination by a single entity would be truly operational in the scientific field. On the contrary, scientific research is one of the areas that are in dire need of freelancers and mavericks.⁷³ As a matter of fact, the follow-on

lead time is generally more effective in protecting the competitive advantages of new processes and products than the patent system. See Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 1987 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 793-96.

⁷¹ See *id.* According to the survey, "moving quickly down the learning curve" and "sales or service efforts" have approximately the same effectiveness in appropriating innovation value as does lead time. *Id.* at 793-96.

⁷² *Id.* at 796-98.

⁷³ Eisenberg, *supra* note 50, at 1059-65; Katherine J. Strandburg, *What Does the Public*

development of an upstream patent may still fall within the realm of scientific research, which needs unbounded investigation of all avenues of inquiry. More often than not, a researcher will not know in advance what the best way to approach a problem is.⁷⁴ Most of the time, the approach comes to light only after trial and error. Coordination on ways and means of performing follow-on research and inventing-around may collide with this aspect of scientific research. Coordination obstructs the implicit cooperation embedded in the scientific community, which allows independent scientists working on the same topic to explore it collaboratively using their respective viewpoints, methodologies and special talents.⁷⁵

There are actual cases demonstrating that coordination may not be necessary in follow-on development. The lawsuit between the University of Rochester and G.D. Searle is a telling example.⁷⁶ Scientists at the University invented an assay to screen compounds that inhibit only enzyme COX-2 and not enzyme COX-1. These enzymes are distinct types of cyclooxygenases that traditional non-steroidal medicine blocks simultaneously to heal inflammation. In the early 1990s, however, scientists found that inhibiting COX-1 did not contribute to anti-inflammatory treatment and that it instead caused undesirable side effects such as upset stomachs, irritation, ulcers, and bleeding.⁷⁷

The University received a patent for the screening method in 1998 and obtained another patent for the method to treat inflammation in 2000. The claimed treatment method involved compounds selectively inhibiting COX-2 rather than COX-1. Nonetheless, the patent specification did not indicate any compound with such a characteristic. On the day the treatment patent was issued, the University sued G.D. Searle and three other companies for the sale of Celebrex and Bextra, two COX-2 inhibiting medicines allegedly infringing the patent. Without any coordination from the patentee, G.D. Searle successfully invented and commercialized these drugs, passed all necessary clinical testing, and secured marketing approval from the FDA.⁷⁸

In a number of cases, independent researchers proceed even better than patentees or licensees that are coordinated in follow-on research and commercialization. The litigation between Merck KGaA and Integra

Get? Experimental Use and the Patent Bargain, 2004 WIS. L. REV. 81, 130.

⁷⁴ Rai, *supra* note 26, at 124. For a discussion of the general features of scientific research, see GOLDBERG, *supra* note 30, at 6-13.

⁷⁵ This is the notion of “spontaneous coordination of independent initiatives” proffered by Michael Polanyi; see *supra* text accompanying notes 27-29.

⁷⁶ Univ. of Rochester v. G.D. Searle Co., 358 F.3d 916 (Fed. Cir. 2004).

⁷⁷ *Id.* at 917-18.

⁷⁸ See *id.* at 918-19. After a series of mergers and acquisitions which began in 1985, G.D. Searle became a part of Pfizer in 2003. See *id.* at 919 n.2.

Lifesciences illustrates precisely this possibility.⁷⁹ Integra Lifesciences discovered the short tripeptide sequence Arg-Gly-Asp—also referred to as the “RGD peptide”—and acquired five patents for it. The RGD peptide induced cell adhesion and growth in human bodies and was anticipated to perform medical functions such as promoting the healing of wounds, prosthesis adhesion, and the growth of new blood vessel branches.⁸⁰ But for years, the inventors could not effectively develop commercial applications of the invention, and they eventually sold the patents to Integra Lifesciences.⁸¹ Again without the patentee’s coordination, Dr. David Cheresh of the Scripps Research Institute discovered that cyclic RGD peptides could resolve certain problems occurring with the linear RGD peptides found by the inventors. Dr. Cheresh also discovered that the new peptides possessed the potential to suppress tumor growth by starving cancerous tumor cells.⁸²

With the funding of Merck KGaA, Dr. Cheresh directed *in vitro* and *in vivo* experiments on three types of cyclic RGD peptides, checking their efficacy, specificity, and toxicity. In 1997, the Scripps research team chose EMD 121874 as the best candidate for clinical testing. In 1998, the National Cancer Institute agreed to sponsor the clinical trials and filed an Investigational New Drug (IND) application with the FDA to start the regulatory approval process.⁸³ When learning of the collaboration between Merck KGaA and the Scripps Institute, Integra Lifesciences offered Merck KGaA a license agreement. Merck KGaA declined the offer after lengthy negotiations and Integra Lifesciences brought an infringement lawsuit against them, alleging that the cyclic RGD peptides fell within the scope of the patent claims.⁸⁴

Sometimes upstream patents are so expansive that their scope extends to cover follow-on or parallel inventions that are within an arm’s length of the patentees’ findings. In those cases, the patented technology make only limited contribution to the ensuing discovery. The most notable example is reach-through claims. In this type of claim, inventors extend their upstream patents to contain potential downstream inventions that are facilitated by, but independent of the original inventions. In *Searle*, the University of Rochester was granted reach-through claims and asserted them against G.D. Searle. What the University found was a method to

⁷⁹ *Integra Lifesciences I, Ltd. v. Merck KGaA*, 331 F.3d 860 (Fed. Cir. 2003), *rev’d*, 545 U.S. 193 (2005).

⁸⁰ *Integra*, 331 F.3d at 863; *id.* at 873 (Newman, J., dissenting).

⁸¹ *Id.* at 873 (Newman, J., dissenting); Janice M. Mueller, *The Evanescent Experimental Use Exemption from United States Patent Infringement Liability: Implications for University and Nonprofit Research and Development*, 56 BAYLOR L. REV. 917, 948 (2004).

⁸² *Integra*, 331 F.3d at 873-74 (Newman, J., dissenting); 545 U.S. at 197-98.

⁸³ *Integra*, 545 U.S. at 198-99; *Integra*, 331 F.3d at 874 (Newman, J., dissenting).

⁸⁴ *Integra*, 331 F.3d at 863.

screen possible medicinal compounds that selectively inhibit the COX-2 enzyme, a drug target. But in addition to that, the University got another patent on the method for blocking the function of COX-2 by the inhibiting compound, a drug candidate that was unknown to the University and the very object that the invention was meant to find out.⁸⁵ The gap between screening drug candidates through intended targets and actually identifying qualified candidates was not so easy to overcome. New technologies such as combinatorial chemistry and high-throughput screening (HTS) had already been adopted in pharmaceutical investigations by the late 1990s. These fancy tools generated a substantial number of “hits,” i.e., signals of possible drug candidates. However, hardly any “leads,” i.e., qualified candidates for clinical trials, were found and optimized through following these hits.⁸⁶ The facts illuminate why reach-through claims for separate downstream inventions are baseless and off-limits. It thus was no surprise that the Federal Circuit held in *Searle* that this type of claim was invalid for failing the written description requirement as stipulated in 35 U.S.C. § 112.⁸⁷

Besides reach-through claims, there are still other types of upstream patents possessing considerable breadth. Upstream inventions are likely to be pioneers in their technological field because of their position in the course of scientific progress.⁸⁸ But still, an upstream patent that claims exclusive rights in excess of technological findings that the inventor actually discover may over-compensate the patentee while at the same time suppressing the incentives and rewards for other inventors to explore neighboring technologies. Even assuming, *arguendo*, that coordination is beneficial for follow-on innovation, the patentee may not be acquainted with methods for developing the invention. The problem

⁸⁵ Claim One of the patent is representative: “A method for selectively inhibiting PGHS-2 [i.e., COX-2,] activity in a human host, comprising administering a non-steroidal compound that selectively inhibits activity of the PGHS-2 gene product to a human host in need of such treatment.” U.S. Patent No. 6,048,850 col.71 l.36–39 (filed June 7, 1995).

⁸⁶ Roger Lahana, *How Many Leads from HTS?*, 4 DRUG DISCOVERY TODAY 447, 447 (1999). The situation was better around 2003 when scientists started paying more attention to absorption, distribution, metabolism, and excretion (ADME) parameters of potential drug candidates. Even so, there may still be challenges ahead, such as how to improve virtual screening techniques and how to synthesize desirable molecules in a dose-dependent and specific way. See Hugo Kubinyi, *Drug Research: Myths, Hype and Reality*, 2 NATURE REV. DRUG DISCOVERY 665, 666–67 (2003); Jürgen Drews, *Strategic Trends in the Drug Industry*, 8 DRUG DISCOVERY TODAY 411, 414, 416 (2003).

⁸⁷ *Univ. of Rochester v. G.D. Searle Co.*, 358 F.3d 916 (Fed. Cir. 2004).

⁸⁸ As the Federal Circuit once explained, without extensive prior art to confine their claims, pioneering inventors usually obtain patents of a broader scope than nonpioneers who have to adopt narrow claims to make their way through congested technical fields. *Augustine Med., Inc. v. Gaymar Indus., Inc.*, 181 F.3d 1291, 1301 (Fed. Cir. 1999).

becomes acute when it comes to research tools, where the patented invention and its applications may well belong to different research circles.⁸⁹

This situation arose when Human Genome Science (HGS) acquired a patent on the gene sequence encoding the CCR5 receptor. When the sequence was first found, the company gauged it as a gene coding for a cell receptor by comparing it with known homologues in its database.⁹⁰ HGS filed for a patent in June 1995, expecting the gene to be a research tool of use chiefly in the development of anti-inflammatory therapies, a utility that had not been fully established as of the filing.⁹¹ Six months later, however, French scientist Dr. Parmentier and researchers from other institutes, including the Aaron Diamond AIDS Research Center and the NIH, confirmed that the CCR5 receptor was the route that the HIV virus used to break into an immune cell, a function that was never known to HGS.⁹²

This instance corroborates the *Integra* case, illustrating that independent researchers can do a much better job than those who are coordinated by patentees. It also indicates how the follow-on innovation may shift to areas that are unfamiliar to the upstream inventor. Given the uncertainty and unpredictability of scientific research,⁹³ even experts may not be able to adequately coordinate the follow-on development in their own fields—not to mention the difficulties that a newcomer to a research field would have with such development. Sadly, the patent was granted to HGS in February 2000, covering all potential medical applications of the gene sequence.⁹⁴ Such a broad upstream patent subordinates true experts in fields of development, such as HIV research, to the coordination of the patentees, who are not specialized in the new fields of application. Fortunately, HGS appears thus far uninterested in coordinating the follow-on research for CCR5, as it is tolerating unlicensed academic research and has already committed to several license agreements.⁹⁵

In addition to going against the nature of scientific research, coordination also goes against fundamental features of the patent system, one of which is a system of decentralization.⁹⁶ Inventors do not need permission from a central research authority before going on to create

⁸⁹ Strandburg, *supra* note 73, at 127.

⁹⁰ COMMISSION ON INTELLECTUAL PROPERTY RIGHTS (CIPR), INTEGRATING INTELLECTUAL PROPERTY RIGHTS AND DEVELOPMENT POLICY 128 (2002).

⁹¹ CORNISH, *supra* note 48, at 16-17; NUFFIELD COUNCIL ON BIOETHICS, THE ETHICS OF PATENTING DNA: A DISCUSSION PAPER 41 (2002).

⁹² CIPR, *supra* note 90, at 128; NUFFIELD COUNCIL ON BIOETHICS, *supra* note 91, at 41.

⁹³ See *supra* text accompanying notes 30-33.

⁹⁴ CIPR, *supra* note 90, at 128.

⁹⁵ NUFFIELD COUNCIL ON BIOETHICS, *supra* note 91, at 41.

⁹⁶ SCOTCHMER, *supra* note 31, at 38.

something. The technological prospects, potential value of the project, and its probable cost will determine which inventions are pursued and what resources are dispensed. If these estimates are wrong, inventors will bear the risks and costs. A decentralized system like this could prevent creativity from strangulation by anyone other than the inventors themselves. Patentees' coordination of follow-on development, however, functions just like a central research authority for individual lines of innovation, which defeats the virtues of decentralization in the patent system.

5. Coordination is Anticompetitive

Conferring a broad patent on the inventor for the purposes of coordinating follow-on development and inventing-around activities is equivalent to providing leverage to him or her for extending the patent rights in a way that restrains competition in downstream markets that are beyond the reach of the original invention. On the other hand, leveraging patent rights to affect competition beyond the scope of the patent may constitute patent misuse or an antitrust violation.⁹⁷ As a result, an excessive patent claim that includes downstream terrains may provide a safe means for the inventor to circumvent these checks on illegal patent right extensions. The Patent Misuse Reform Act of 1988⁹⁸ explicitly recognized that an inventor conditioning a patent license on another product or license solely from him- or herself could constitute patent misuse, so far as the inventor possesses market power over the embodiments of the patent on which the conditioning is based.⁹⁹ The same situation could also be considered an illegal tying arrangement under antitrust law.¹⁰⁰ A broad patent claim, however, may totally release the inventor from the extensive legal scrutiny of downstream coordination. In addition, courts consider other types of patent leveraging in violation of antitrust law. For example, collecting royalties beyond the patent scope, such as on unpatented products or after the patent's expiration date, has

⁹⁷ See CHISUM ET AL., *supra* note 54, at 1103-04, 1130-31; LANDES & POSNER, *supra* note 50, at 372-73 (opposing the existing laws).

⁹⁸ Pub. L. No. 100-703, 102 Stat. 4674 (codified as amended at 35 U.S.C. § 271(d)(4)-(5) (2000)).

⁹⁹ Section 271(d) of the Patent Act now provides:

No patent owner otherwise entitled to relief for infringement . . . of a patent shall be denied relief for deemed guilty of *misuse or illegal extension of the patent right* by reason of his having done one or more of the following: . . . (5) *conditioned* the license of any rights to the patent or the sale of the patented product *on the acquisition of a license to rights in another patent or purchase of a separate product*, unless, in view of the circumstances, the patent owner has *market power* in the relevant market for the patent or patented product on which the license or sale is conditioned.

35 U.S.C. § 271(d)(5) (2000) (emphasis added).

¹⁰⁰ See, e.g., *Int'l Salt Co. v. United States*, 331 U.S. 392 (1947).

repeatedly been held illegal.¹⁰¹ In light of these inconsistencies, it appears that the very idea of downstream coordination runs afoul of the legal principle against anticompetitive leveraging of market power to adjacent markets.

There is no basis to believe that a research field dominated by a single entity will operate more efficiently than a domain of competition, which we normally trust with respect to economic affairs.¹⁰² If no convincing evidence is presented, it would be paradoxical to indulge expansive upstream patents in restraining competition at the upstream level or in the follow-on development. In a study conducted in Italy, 69.2% of the surveyed patentees would have made their invention whether or not the patent system existed.¹⁰³ This propensity was stronger for inventors working in an enterprise—ranging from 68.0% to 80.4%—and was positively correlated to the size of the company.¹⁰⁴ For individual inventors, the percentage who would have invented despite the nonexistence of the patent system was only 65.1%.¹⁰⁵ A logical inference is that something must be much more attractive to inventors in their innovative activities than simply the possibility of attaining a patent. As demonstrated above, “lead time,” “moving quickly down the learning curve,” and “sales and service efforts” are all effective means of preserving and deploying the value of innovations.¹⁰⁶ They are great incentives for corporate inventions. The driving force behind the pursuit of these marketplace advantages is competition. Taking this evidence into account, it would be fair to say that competition is still essential in the patent world and that deviation from this concept is still absurd.

Patent protection is more effective and thus more important in the biomedical sector than in ordinary industries. Surveys show that 60% to 65% of pharmaceutical inventions would not have been developed without a patent system.¹⁰⁷ Nevertheless, once patent scopes become so expansive as to allow coordination to displace competition in follow-on development and inventing-around, inventors might just sit on their patents in order to reap profits, while blocking new innovations that might substitute their

¹⁰¹ *E.g.*, *Zenith Radio Corp. v. Hazeltine Research, Inc.*, 395 U.S. 100 (1969); *Brulotte v. Thys Co.*, 379 U.S. 29 (1964); *Scheiber v. Dolby Labs.*, 293 F.3d 1014 (7th Cir. 2002).

¹⁰² Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 877 (1990).

¹⁰³ Giorgio Sirilli, *Patents and Inventors: An Empirical Study*, 16 RES. POL'Y 157, 164-66 (1987).

¹⁰⁴ *Id.* at 164 tbl.10.

¹⁰⁵ *Id.*

¹⁰⁶ *See supra* text accompanying notes 70-71.

¹⁰⁷ C.T. TAYLOR & Z.A. SILBERSTON, *THE ECONOMIC IMPACT OF THE PATENT SYSTEM* 199 tbl.9.2 (1973); Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 MGMT. SCI. 173, 174-75 (1986).

own. Competition keeps inventors on their toes, but excessive protection allows them to relax and therefore could slow down the progress of technology. This is not to say that increased competition will necessarily lead to an increase in innovation. All things being equal, monopolies generate fewer incentives to invent than does perfect competition.¹⁰⁸ Consequently, while the prospect theory provides patentees with dominance in their respective technological fields, it also creates inefficiencies to the promotion of invention—the primary rationale for the patent system.

Throughout history, numerous examples have illustrated how excessive protection may foster stagnation in innovation, but that competition can transform the dire situation. Of ten technologies recently adopted in the telecommunications sector, the average time between inception and initial commercial use was shorter when the market was more competitive.¹⁰⁹ Moreover, for individual technology, commercial use often took place when contention was introduced in the relevant market. For instance, DSL was not offered for retail high-speed internet access even after the internet first became popular. It was not until the 1996 Telecommunications Act brought competition for data customers into regional markets that DSL services were provided commercially.¹¹⁰ In another example, fiber optic technology was both available and ready for the market in 1977. But commercial use of this technology did not begin to accelerate until the mid-1980s, subsequent to emerging competition in the long-distance telephone service market and Sprint's advertisement for installation of a fiber optic system.¹¹¹

In the realm of patents, Thomas Edison's famous patent for the filament of incandescent lamps demonstrated exactly the tendencies of idle innovation.¹¹² Edison received a patent for the carbon filament invention on January 27, 1880.¹¹³ After introducing the new incandescent lamp and its first modifications to the market, however, Edison's attention was redirected to other fields of experimentation. His company, Edison General Electric, did not make many substantial improvements to its products until after merging with Thomson-Houston in 1896.¹¹⁴ At first,

¹⁰⁸ MOTTA, *supra* note 67, at 56-57.

¹⁰⁹ The ten technologies are touch-tone dialing, digital switching, ISDN transmission, electronic stored-program-control, SS-7 signaling, fiber-optic transport, automatic switching, Digital Subscriber Line (DSL) service, cable modem service, and digital wireless transmission. See Howard A. Shelanski, *Competition and Deployment of New Technology in U.S. Telecommunications*, 2000 U. CHI. LEGAL F. 85, 115.

¹¹⁰ Pub. L. No. 104-104, 110 Stat. 56 (1996); see also Shelanski, *supra* note 109, at 116.

¹¹¹ Shelanski, *supra* note 109, at 116-17.

¹¹² See generally Merges & Nelson, *supra* note 102, at 885-87.

¹¹³ U.S. Patent No. 223,898 (filed Nov. 4, 1879).

¹¹⁴ ARTHUR A. BRIGHT, JR., *THE ELECTRIC-LAMP INDUSTRY: TECHNOLOGICAL CHANGE AND ECONOMIC DEVELOPMENT FROM 1800 TO 1947*, at 122 (1949).

several lamp-producing corporations competed effectively with Edison's company by providing timely improvement and better electrical efficiency.¹¹⁵ However, between 1885 and 1894, progress in lamp design was seriously hampered by protracted and expensive patent struggles between Edison's company and its competitors.¹¹⁶ The filament patent was finally validated in court in 1891.¹¹⁷ After the ruling, Edison's company swiftly acquired injunctions that closed down a number of competitors. The company had no intention of accepting licensees; rather, it prepared to regain a monopoly for the remainder of the patent life that ended in 1894.¹¹⁸ Relying on the basic filament patent, Edison's company suppressed follow-on innovations for incandescent lamps, yet generated no important improvements of its own.¹¹⁹

One of the alleged reasons for artificial coordination is to avoid duplicate innovation efforts. As a matter of fact, duplication is essential for competition in the marketplace. Assuming no competitors exist, competition will not take place. Even if competitors do exist, if no surplus capacity is available, why will they dash for potential customers? Inventors might just sit back and wait for business to come to them. Customers not accommodated by competitors will sooner or later turn to suppliers who still have ample capacities. In addition, duplication is not equal to pure waste. Conversely, duplicative endeavors might make possible certain benign results, such as the rapid unveiling of new inventions, early validation by the scientific community, and the appearance of more alternative technologies.¹²⁰

6. Coordination in Self-Interest

Patentees may coordinate follow-on development of the patented invention, but only for their own interest.¹²¹ For the sake of fully grasping

¹¹⁵ *Id.* at 122-23.

¹¹⁶ *Id.* at 138-39.

¹¹⁷ Edison Elec. Light Co. v. U.S. Elec. Lighting Co., 47 F. 454 (C.C.S.D.N.Y. 1891), *aff'd*, 52 F. 300 (2d Cir. 1892).

¹¹⁸ BRIGHT, *supra* note 114. For an explanation why the duration of the filament patent was cut short from the normal seventeen-year span, see *id.* at 91 n.28.

¹¹⁹ Rochelle Dreyfuss once suggested that the same idleness might have arisen in *Rite-Hite Corp. v. Kelley Co.*, 56 F.3d 1538 (Fed. Cir. 1995) (en banc). In this case, the infringing product was in direct competition with the plaintiff's product, which was not covered by the patent at suit. The plaintiff only deployed the patent at suit in a noncompeting product. By doing so, the plaintiff failed to provide customers with the option of choosing between a fully or a partially automated machine. See Rochelle Dreyfuss, *Protecting the Public Domain of Science: Has the Time for an Experimental Use Defense Arrived?*, 46 ARIZ. L. REV. 457, 467 n.43 (2004).

¹²⁰ CHISUM ET AL., *supra* note 54, at 66-67; Lemley, *Free Riding*, *supra* note 64, at 1062-63; Rai, *Scientific Research*, *supra* note 26, at 124 n.247.

¹²¹ See generally Strandburg, *supra* note 73, at 127-29.

profits flowing from the exclusive coverage of the patent claims, patentees will act rationally to keep opportunities to themselves if there is any chance for them to conceive the follow-on innovations. If the chance of doing so is too slim, they will then consider licensing the invention. For the sake of avoiding competition between licensees that may decrease the prospect profits of the patentees, nonexclusive license is not so frequent here. Given the uncertainty and unpredictability of follow-on research,¹²² patentees incline to license their invention to whoever is willing to pay the highest amount in royalties, rather than to the group or individual who has the greatest capacity for exploring its full potential. In other words, the amount of royalties may not be a proper measure of the talents and abilities of follow-on developers. Developers with inferior technological competence depend more on patent rights to protect latent profits flowing from the downstream innovation, while developers with superior capacity may attribute these profits, to a larger extent, to their own talents and endeavors. Due to this disparity in attribution, the former may accept an amount well beyond the limit that the latter is willing to pay for a license, an inclination that could drive the claimed invention away from capable hands that can fully optimize its technical prospects.

In the biomedical sector, patent protection is more effective than in other industries,¹²³ and the premiums flowing from patent exclusivity is thus even higher. As a result, companies in this industry have a history of pursuing “blockbuster” products that generate at least \$1 billion in annual revenue, in order to support their high percentage of growth.¹²⁴ This feature makes patentees increasingly concerned with the profits or royalties they may receive from their inventions, lest a “blockbuster” among them might slip away unnoticed. Consequently, coordination in self-interest may be even more drastic in the biomedical sector than it is for ordinary patents.

7. Incompatibility with Developments in the Judiciary

Jurisprudential developments run counter to the basic propositions of prospect theory. In *Searle*, the Federal Circuit invalidated reach-through claims, which were purported for upstream patentees to seize lucrative downstream inventions by expanding patent scopes.¹²⁵ In *In re Fisher*, the Federal Circuit made another important decision, holding that patents for

¹²² See *supra* text accompanying notes 30-33.

¹²³ See *supra* text accompanying note 72.

¹²⁴ See CLARK GILBERT & RATNA G. SARKAR, *MERCK: CONFLICT AND CHANGE* 1-8 (2005); JEFFREY ROBINSON, *PRESCRIPTION GAMES: MONEY, EGO AND POWER INSIDE THE GLOBAL PHARMACEUTICAL INDUSTRY* 25-27 (2001); Robert F. Service, *Surviving the Blockbuster Syndrome*, 303 *SCIENCE* 1796, 1796-97 (2004).

¹²⁵ See *supra* text accompanying notes 87-89. For a discussion of ESTs and EST patents, see *infra* Subsection III.C.1 and Section IV.A.

expressed sequence tags (ESTs) are invalid.¹²⁶ This was a bio-agriculture case. The plaintiff discovered five ESTs in the maize genome and applied for a patent, which was later rejected by the patent examiner and by the Board of Patent Appeals and Interferences of the PTO. The Federal Circuit affirmed the decision below, holding that the patent statute's requirements of utility and enablement were not fulfilled. While the plaintiff disclosed in the application seven ways to use the ESTs, the court rejected all of them for not being specific and substantial.¹²⁷

For utility to be substantial, the court reasoned, it needed to have real-world benefits for the public in a currently available form. Added to that, the required utility had to be specific as well—that is, not vague or generic.¹²⁸ In this case, each of the claimed ESTs distinctively corresponded to a single gene, yet the functions of those genes were still unknown. The court found the use to be insubstantial, indicating that the *Fisher* scenario was similar to what the Supreme Court encountered in *Brenner*, where the Court held that a process to prepare chemicals of unknown functions was void of substantial use.¹²⁹ The Federal Circuit in turn rejected the utility as non-specific and general, noting that: “[n]othing about [the patentee’s] seven alleged uses set the five claimed ESTs apart from the more than 32,000 ESTs disclosed in the . . . application or indeed from any EST derived from any organism.”¹³⁰ The EST with no learned functions is the most upstream outcome of a whole series of research and development in the biomedical sector. By denying its patentability, the Federal Circuit once again departed from the proposition of the prospect theory.

Taking *Searle* and *Fisher* together, the Federal Circuit really demonstrates its intention to control the scope of upstream patents within a reasonable limit. Whether the court is just cutting off some type of overbroad upstream claims, or it will proceed to tighten up the standards of patentability and to reduce the coverage of upstream patents still remains to be seen.

¹²⁶ 421 F.3d 1365 (Fed. Cir. 2005).

¹²⁷ *Id.* at 1365-68. The seven proffered uses were: “(1) serving as a molecular marker for mapping the entire maize genome . . . (2) measuring the level of mRNA in a tissue sample via microarray . . . (3) providing a source for primers for use in the polymerase chain reaction (PCR) . . . (4) identifying . . . polymorphism; (5) isolating promoters . . . (6) controlling protein expression; and (7) locating genetic molecules of other plants and organisms.” *Id.* at 1368.

¹²⁸ *Id.* at 1370-72.

¹²⁹ *Id.* at 1372-74.

¹³⁰ *Id.* at 1374. Because the enablement requirement commands disclosure of the way to use the invention, it incorporates the utility requirement implicitly. When the Federal Circuit concluded that the required utility was missing in this case, it correspondingly found the application failing to satisfy the enablement requirement. *Id.* at 1378-79.

C. ANTICOMMONS THEORY

In contrast, the anticommons theory contends that, at present, the field of biomedical research is congested with too many patents. Patents are now everywhere, covering everything from DNA, proteins, cell receptors, cell lines, animal models, and other biological materials, to reagents, testing kits and procedures, and more. In every line of research and commercialization, a host of patentees is given the right to exclude others, without providing anyone a privilege to skip those barriers and conduct experiments along the line of research.¹³¹

1. The Anticommons Phenomena

Patents are an abstraction, meaning that one can claim the same object in a number of different ways. As a result, patents may overlap with one another. When there is no overlapping, multiple patents may be granted on the same basic unit of practical use, such as a gene. The most salient example is expressed sequence tags (ESTs). ESTs are cDNA fragments that represent expressed portions of genes.¹³² In 1991, the National Institutes of Health (NIH) led the way to seeking patents on ESTs while the specific function of the fragment or the gene is still unknown.¹³³ Though the NIH later became antagonistic to EST patents, private genome companies had already garnered a substantial number of EST patents in advance of cautions from the PTO and the Federal Circuit about such applications.¹³⁴

There is another group of patents that are issued not on the same object, but which spread along the lines of biomedical research and commercialization. Patents on receptors illustrate this situation. When

¹³¹ Heller & Eisenberg, *supra* note 2, at 698. “Patent thickets” are a similar but somewhat distinctive concept. This concept focuses on patent proliferation in end products and manufacturing processes. By contrast, the anticommons theory stresses the mass of patents in the research and development process. For a discussion of patent thickets, see Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, in 1 INNOVATION POLICY AND THE ECONOMY 119 (Adam B. Jaffe et al. eds., 2001).

¹³² See, e.g., Wikipedia, Expressed Sequence Tag, http://en.wikipedia.org/wiki/Expressed_Sequence_Tag (last visited Apr. 29, 2008); see also Molly A. Holman & Stephen R. Munzer, *Intellectual Property Rights in Genes and Gene Fragments: A Registration Solution for Expressed Sequence Tags*, 85 IOWA L. REV. 735, 748-50 (2000).

¹³³ See Rebecca S. Eisenberg & Robert P. Merges, *Opinion Letter As to the Patentability of Certain Inventions Associated with the Identification of Partial cDNA Sequences*, 23 AIPLA Q.J. 1, 2, 13-20 (1995).

¹³⁴ The PTO tightened the utility requirement in 2001, requiring that utility to be “substantial,” “specific,” and “credible.” In 2005, the Federal Circuit finally held EST patents invalid for lack of utility. See *In re Fisher*, 421 F.3d 1365 (Fed. Cir. 2005); and *supra* Part III.B.7. An accurate figure for the number of EST patents is hard to estimate because the specific term rarely appears in patent applications. See *infra* Part IV.A.

researchers find a chemical candidate for pharmaceuticals, it is advisable to test against all cell receptors in the human body that might interact with the candidate, so as to learn as much as possible about the therapeutic functioning and side effects before clinical trials on volunteers commence. This screening not only saves clinical trial expenses, but is also better for the safety and health of those who volunteer for the trials. When those cell receptors are patented and controlled by various patentees, however, it is difficult to secure all of the licenses necessary for the screening.¹³⁵

Another problem arises with reach-through rights.¹³⁶ This is a licensing mode commonly used for research tools. A research tool cannot turn into a commercial product itself, at least in some respects, but it can provide valuable assistance for the research or commercialization of other suitable candidates. Inventors of research tools nonetheless strive to maximize their return from patent license, particularly because a substantial portion of them are cash-starved biotechnology firms and universities. On the other hand, the supposed licensees—researchers and developers—do not have the financial resources to satisfy inventors on the instant. Reach-through rights are one of the compromises that emerged. In this way, research-tool inventors receive some rights to the results of the research or development, in exchange for the license. The common types of arrangements in this category include sharing revenues of the research results (reach-through royalties), exclusive or nonexclusive licenses (grantback license), prepublication review, and prior approval on licensing the result.¹³⁷ If the approval right is accepted, the research tool patentee will have a veto power against the contemplated license.

When confronting the anticommons as described above, a biomedical scientist may have to secure patent licenses from various owners in order to continue his or her own research. This task could be burdensome and time-consuming. Furthermore, denial of any indispensable license will cancel out all other licenses the scientist has already obtained, meaning that a single patentee may have the power to determine the fate of the research.¹³⁸ Even if all patentees agree on the licensing, the aggregate amount of royalties may well exceed the

¹³⁵ See Heller & Eisenberg, *supra* note 2, at 699.

¹³⁶ See generally *id.* at 699–700.

¹³⁷ Rebecca S. Eisenberg, *Reaching Through the Genome*, in PERSPECTIVES ON PROPERTIES OF THE HUMAN GENOME PROJECT 209, 214–17 (F. Scott Kieff ed., 2003).

¹³⁸ Based on the dynamics of the computer and semiconductor industries, Carl Shapiro indicated that the patent thicket, which refers to too many fragmented patents on the same product or its manufacturing process, might give rise to strategic holdouts. Patentees would refrain from enforcing their patent rights until the infringing product is already on the market, so as to charge a disproportionate amount for royalties by virtue of the manufacturer's reluctance to rip off the product and throw away all investments already made. See Shapiro, *supra* note 131, at 121, 124–26. This kind of holdout is also possible in the biomedical sector, although there is no sign that it has already occurred.

affordable range for an academic scientist, who usually has only a limited budget for research expenditures. This situation is comparable to having too many tollbooths on one parcel of land. Various reach-through requests may also give rise to conflicts and deadlocks in licensing negotiations. Any of these events may lead to abandoning the research project altogether or shifting to an alternative approach that might not be as promising as the original.

2. High Transaction Costs

The reason why patent proliferation would generate such a dire outcome is embedded in a number of factors.¹³⁹ One of them is high transaction costs. The sheer number of relevant patents and patentees in a research or commercialization project spawns the burden of reviewing patent claims and negotiating necessary licenses.¹⁴⁰ A large portion of owners and users for upstream patents are public universities and research institutes, which have limited capacities for patent negotiations. Yet patentees have no interest in standardizing the terms of their licenses, as manufacturers do on contracts for most commodities. Here, the inventors seek to extract all of the possible value of their patents from future downstream applications. This preference gives rise to highly engaged and forward-looking negotiations between the parties, which compounds the difficulty of negotiation, insufficient resources thus leading to huge delays.¹⁴¹

Furthermore, research tools comprise a wide variety of technologies, ranging from research targets like cell receptors and drug candidates, to ordinary research tools such as reagents, to other equipment and inputs like research instruments and bioinformatics. No single distribution scheme or terms of contract can accommodate all of these tools at the same time. Finally, heterogeneous interests between different types of inventors and licensees, and the divergent time frames thus arising for innovation returns, which will be elaborated on next, generate disparate expectations between parties, hampering consensus and contributing to possible breakdowns in negotiation.

3. Heterogeneous Interests.

The diversified nature of patentees and licensees in the area of upstream biomedical patents fosters divergent interests, which lead to

¹³⁹ See generally Heller & Eisenberg, *supra* note 2, at 700-01.

¹⁴⁰ For a description of the quantity of biotechnology patents, see *supra* text accompanying notes 7-8; for a discussion of the extent of the impact it generates on research and commercialization, see *infra* Section IV.C.

¹⁴¹ See, e.g., John P. Walsh et al., *Effects of Research Tool Patents and Licensing on Biomedical Innovation*, in PATENTS IN THE KNOWLEDGE-BASED ECONOMY 285, 314-17 (Wesley M. Cohen & Stephen A. Merrill eds., 2003).

different strategies and agendas in follow-on development. A review of the contrasting interests implicated in the realm of biomedical patents can help explain the disparities between actors in this field.

(A) Public/Private

Some patentees or licensees, such as the NIH or the National Science Foundation (NSF), are public agencies which shoulder the mission of promoting the national progress of science. They would like to see an open exchange of scientific discoveries and information, including patent licenses at fair prices, in order to foster the dynamic accumulation of human knowledge. Private companies, on the other hand, set profit maximization as their primary goal. They have no interest in an open licensing scheme that could hurt the prospective financial benefit of their patents. In the same vein, they are also more aware of potential patent infringement internally than are public agencies and institutions.¹⁴²

(B) Upstream/Downstream

Patentees or licensees from academia and the biotechnology industry are largely located upstream and work predominantly on the research end of the biomedical sector. They are cash-starved and in favor of exclusive licenses so as to maximize their revenue from royalties. If licensees are positioned upstream and are short of cash, upstream patentees will seek reach-through royalties or grantback licenses.¹⁴³ On the other hand, licensees tend to spurn the idea of grantback licenses for their future research results, as these interfere with potential lucrative transactions with their own exclusive licensees. Universities are reluctant to offer the option for patentees to take an exclusive license in exchange for an incoming license for research tools. They generally reserve this degree of exclusivity to full research sponsorship. Owing to this disparity across the table, the negotiations between upstream entities are particularly protracted and it is difficult to reach an agreement desirable to both sides.¹⁴⁴

Pharmaceutical companies, in contrast, are primarily located downstream, favoring widely available licenses to and from other biomedical institutions. This enables them to reduce royalty expenses and vest more resources in their major work on follow-on research and commercialization. For incoming research tools, they prefer to pay fixed,

¹⁴² An informal research exception exists for universities and research institutes. *See infra* Section IV.D. In addition, state-owned institutes are entitled to sovereign immunity in patent infringement suits. *See Florida Prepaid Postsecondary Educ. Expense Bd. v. College Sav. Bank*, 527 U.S. 627 (1999).

¹⁴³ Rebecca S. Eisenberg, *Bargaining over the Transfer of Proprietary Research Tools: Is This Market Failing or Emerging?*, in *EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY* 223, 246 (Rochelle Dreyfuss et al. eds., 2001).

¹⁴⁴ *Id.* at 244-46.

up-front royalties instead of giving up a share of revenue from the end product, which could be worth billions of dollars.¹⁴⁵

As for their own upstream patents, they also prefer licensing them out so as to increase their chances of identifying lucrative end products. The main concern of pharmaceutical companies is preserving the opportunity to deploy the full potential of their patents. First of all, the outcome of the licensee's research might end up being a competing product. The licensed research might also discover a new therapeutic use for the claimed invention in treating another indication, or conversely, it might find something that constrains or undermines the strength of the company's patents. Second, without prior prohibitions, the licensee might use the claimed invention in a project sponsored by competitors of the firm. Third, the licensed research might generate information destructive to the company's products, such as suggesting health risks or undesirable side effects. Correspondingly, pharmaceutical firms usually confine their license to particular projects conducted in certain laboratories and disallow other uses without prior authorization. Pre-publication review and limitations on the use of the research data are also frequently seen in their license agreements. When they have reason to believe the research will lead to something valuable down the road, drug companies will seek to preserve an option to obtain a patent or grantback license.¹⁴⁶

(C) Scientist/Institution

For scientists in academia, the primary goal is to win the race against other fellow scientists for priority in scientific findings. Their main concern about patent licensing is obtaining state-of-the-art technology as soon as possible whenever they need it in their research. As for the obligations that come with patent licenses, they are averse to accepting prepublication review because the requirement would delay their pursuit of scientific priority. Beyond this, academic scientists do not care as much about other types of obligations, such as reach-through royalties or grantback licenses on prospect research results.¹⁴⁷ Though academic scientists may also be concerned about commercializing the inventions derived from their research, they generally will not go that far until they have accomplished their end results.

The interests of academic institutions, however, are not always aligned with those of research scientists. Besides academic superiority, institutions are also in pursuit of increased funding and improving their overall reputations. Patent licensing has been seen as a way of bringing monetary resources into academia, though considerable doubts have been raised in this regard.¹⁴⁸ Nowadays, academic institutions usually have a

¹⁴⁵ See Eisenberg, *supra* note 137, at 215.

¹⁴⁶ See Eisenberg, *supra* note 143, at 244.

¹⁴⁷ *Id.* at 239-40.

¹⁴⁸ See, e.g., Eisenberg, *supra* note 12, at 1712-14; Arti K. Rai & Rebecca S. Eisenberg,

technology transfer office that is engaged in patent licensing for the purpose of fundraising in the form of royalty revenues, private research grants, and industrial partnerships. Charged with this goal, the office usually has different priorities than those of the research scientists.¹⁴⁹ Like its counterparts in industry, the office seeks to maximize licensing revenue by crafting reach-through requirements and other obligations, which demand highly involved, case-by-case negotiations. This practice causes considerable delay for research scientists in securing necessary licenses for their research.

In contrast, technology transfer offices usually consult against scientists at their institutions accepting reach-through obligations, as this will hopefully preserve the commercial value of prospective research achievements for more lucrative transactions in the future.¹⁵⁰ These opposing attitudes towards incoming and outgoing patents may halt license negotiations for an indeterminate amount of time. With much deeper pockets than individual scientists, the institution is also more concerned about patent infringement litigation. This inclination may lead to the regulation of scientific research, particularly when there is fear of a lawsuit developing. Needless to say, scientists do not favor such regulations, which may considerably confine their research latitude.

4. Cognitive Bias and Evaluation Difficulty

It is commonplace for human beings to have a self-serving bias, namely to overestimate themselves or their contributions to joint work in comparison to their colleagues. This bias flows from selective, role-dependent information processing.¹⁵¹ People with this bias tend to mistake what is in their interest with what is fair. This feature may compound the disagreement between negotiating parties, giving rise to suspicions that one party is taking advantage of the other. Cognitive bias thus is a frequent reason for bargaining impasse or breakdowns.¹⁵² Downstream pharmaceutical companies are used to considering that upstream entities will fail to realize the risks and uncertainties in follow-on research and commercialization and thus ask for too much during license negotiations.

Bayh-Dole Reform and the Progress of Biomedicine, 66 LAW & CONTEMP. PROBS 289, 300 (2003).

¹⁴⁹ Nonetheless the technology transfer office in certain institutes, such as MIT, Harvard and Stanford, does share the scientist's view and refrain from patenting certain discoveries like ESTs, cell receptors or SNPs, which are remote from specific commercial development or of use to many developers. See Rai, *supra* note 26, at 112-13.

¹⁵⁰ See Eisenberg, *supra* note 143, at 240-41.

¹⁵¹ See Linda Babcock & George Loewenstein, *Explaining Bargaining Impasse: The Role of Self-Serving Biases*, in BEHAVIORAL LAW AND ECONOMICS 355, 360-61 (Cass R. Sunstein ed., 2000).

¹⁵² *Id.* at 355-62.

On the other hand, biotechnology firms and academic scientists usually devote themselves to a small circle of research and are optimistic about their chances of succeeding in the downstream market. The difficulty of evaluation compounds this discrepancy. Given the high uncertainty inherent in biomedical innovation, there are hardly any appreciable rules for objective evaluation before pharmaceutical development is concluded. Parties may therefore stick to their respective biases, diverging significantly on the commercial value of the pharmaceutical research and on how to apportion the value to the license.¹⁵³

Moreover, information asymmetry exists between upstream and downstream agents. Each possesses only part of the information that is necessary for the evaluation. Upstream entities know more about the patented invention and cutting-edge biotechnological research, while pharmaceutical companies are well informed in chemistry, drug candidate screening, clinical testing, distribution and promotion. Partial information aggravates the self-serving bias and generates overreaction to incidents of high salience but low probability.¹⁵⁴ Consequently, patentees and licensees might be too cautious to forge a mutually acceptable license agreement.

5. Counter-Argument and Rebuttal

The argument above may be countered by the fact that the proliferation of patents is not a condition that has occurred only in the biomedical sector. Today, almost every industry employs a large number of patented inputs, especially those that manufacture composite products, such as automobiles. To date, there has been no indication in these industries that the proliferation of patents results in an anticommons problem that may hinder progress.¹⁵⁵ This counterargument, however, misses the point. A large number of patents is not a sufficient condition for the anticommons. Fragmented ownership by scores of patentees is another indispensable condition. If a manufacturer and its allies own many patents on a specific product, it might not be necessary for them to spend a lot of time and energy negotiating the license. Patent portfolios, if crafted well, could deter aggressive enforcement strategies and assure the manufacturer of its ability to produce and sell the product without undue interference.¹⁵⁶

In addition, the competition dynamics are quite different in the biomedical sector than in other industries. For example, in the automobile industry, there are many competitors in every submarket. This competition suppresses the price that the manufacturers could feasibly charge. As a result, the primary approach for augmenting profits is to sell more units at

¹⁵³ See Eisenberg, *supra* note 143, at 247.

¹⁵⁴ See Heller & Eisenberg, *supra* note 2, at 701.

¹⁵⁵ Kieff, *supra* note 53, at 720.

¹⁵⁶ Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 34-35 (2005).

a fixed price. In the pharmaceutical industry, a downstream market of the biomedical sector, competition is much more confined. During the life of a major pharmaceutical patent, viable competition is reduced to limited cases where non-infringing imitative drugs (“me-too” drugs) are successfully developed.¹⁵⁷ The lack of competition gives the patentee an opportunity to charge a high price for an innovative drug, especially a blockbuster—the most noted source of profits in the industry.¹⁵⁸ Consequently, upstream patentees are not willing to set a fixed price for their inventions to enlarge the number of licenses. They will search every possible candidate for the next blockbuster and try to squeeze as many benefits as they can from the astonishing rent that arises due to the dominant position that a pharmaceutical patent may hold in the downstream market. As a result, this causes fragmented upstream patent owners to act similar to toll collectors, as they are eager for harsh terms of license.

Dan Burk and Mark Lemley imply that the prospect theory and the anticommons theory can coexist.¹⁵⁹ This, in fact, is an illusion. In the case of mineral claims—the model for the patent system according to the prospect theorists, there are no overlapping claims. Neither party can claim the same parcel of land over another. But patents are different. As long as they are new and not obvious, given the state of the art, patents can be granted within the literal scope of another patent. If patent law remains unchanged, upstream patents with a broad scope will only create more stacking in patent ownership, rather than diminishing stacking. Made by either independent inventors or the original patentees, improvement patents will still spring up on the top of upstream patents. Enlarged patent scopes may, in fact, create more overlaps. What Burk and Lemley actually recommended was to tighten up the non-obviousness standard and to simultaneously loosen the disclosure requirement in biotechnology, so as to combine inventions with different but interchangeable structure variations into a single patent. This proposal, however, is more like an anticommons reform than a prospect one.

D. CONCLUDING REMARKS: THE PROSPECT THEORY GETS OUT OF THE PICTURE

There are still some expressed objections to the anticommons theory, asserting that even if this theory may hold true in the biomedical sector, viable solutions already exist for scientists to overcome its inherent difficulties. Informal norms, collective rights groups, patent pools, and

¹⁵⁷ See Fabio Pammolli & Massimo Riccaboni, *Market Structure and Drug Innovation*, 23 HEALTH AFF. 48, 49-50 (2004).

¹⁵⁸ See, e.g., Service, *supra* note 124, at 1796-97.

¹⁵⁹ Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1683 (2003).

cross licensing are the possibilities that are frequently mentioned.¹⁶⁰ This issue involves the real-world licensing practices that will be discussed in Part IV, and this Article will return to the same issue later in Section IV.D and Section V.A. On balance, after a thorough review of the application of the two primary theories in the biomedical arena, the anticommons theory is obviously more persuasive than the prospect theory. The prospect theory suffers from a number of serious flaws, such as providing excessive incentives and protection of innovation, while ignoring the nature of scientific research and the importance of competition in both innovation and the marketplace. Accepting the anticommons theory as a starting point, this Article will proceed in the next Part to the world of patent practice, exploring the reasons for why the anticommons problem has not, thus far, been a major concern in the biomedical field.

IV. THE REALITY OF FOLLOW-ON RESEARCH AND COMMERCIALIZATION

Theories often provide us the sharp insights that are necessary for penetrating a convoluted factual complex. Yet no matter how solid the foundation of these theories may be, at the end of the day we must return to the empirical world to verify their teachings. In this Part, I will delve into the empirical studies that exist in the realm of biomedical patents, examining when precisely the anticommons arises and the contour of the scientific landscape in which it appears.

A. THE STACKING OF EST AND SNP PATENTS IS NOT A DRASTIC PROBLEM

EST patents are one of the main concerns for many anticommons theorists,¹⁶¹ although to a large extent, these concerns have been curbed. It is difficult to quantify how many EST patents have actually been granted. Because ESTs are defined by the way in which the materials were obtained, not by their substance or structure, patent applications rarely use the term “EST” or “expressed sequence tag” to describe the invention.¹⁶²

¹⁶⁰ See, e.g., Kieff, *supra* note 53, at 724–27.

¹⁶¹ See, e.g., John H. Barton, *Patents, Genomics, Research, and Diagnostics*, 77 ACAD. MED. 1339, 1339-42 (2002); Rebecca S. Eisenberg, *Technology Transfer and the Genome Project: Problems with Patenting Research Tools*, 5 RISK 163, 163-66 (1994); Heller & Eisenberg, *supra* note 2, at 699; Arti K. Rai, *Genome Patents: A Case Study in Patenting Research Tools*, 77 ACAD. MED. 1368, 1370-71 (2002) [hereinafter Rai, *Genome Patents*]; Arti Kaur Rai, *Evolving Scientific Norms and Intellectual Property Rights: A Reply to Kieff*, 95 NW. U. L. REV. 707, 708, 710-11 (2001) [hereinafter Rai, *Reply*]; Rai, *supra* note 26, at 112-25, 125-26, 134, 140-43. Burk and Lemley also noted that: “Anticommons theory was designed with DNA in mind, and seems to work most effectively there.” Burk & Lemley, *supra* note 159, at 1627.

¹⁶² NUFFIELD COUNCIL ON BIOETHICS, *supra* note 91, at 33; Holman & Munzer, *supra* note 132, at 754 n.46.

This practice makes it difficult for even the PTO to keep track of the accurate number of EST patents. Some commentators believe that very few EST patents have actually been granted.¹⁶³ It is certain, however, that over one million applications claiming one or more ESTs have been filed,¹⁶⁴ and many of them are as long as 2000 pages.¹⁶⁵ In 1996, Incyte Pharmaceuticals alone filed 400,000 ESTs with the PTO.¹⁶⁶ For a period of time, the PTO looked favorably on EST patents. In 1998, John Doll, then the Director of Biotechnology Examination at the PTO, indicated that ESTs might possess utility in areas such as chromosome identification and gene mapping.¹⁶⁷ This opinion suggests that the PTO accepted the patentability of ESTs.

That said, patent grants for ESTs have been reined in lately. First, the 2001 Utility Guidelines emphasize that for a patent to be granted, it must possess at least one practical utility. The Guidelines require that the alleged use be “substantial”, in addition to being “specific” and “credible,” as stipulated in the 1995 Utility Guidelines.¹⁶⁸ To constitute a substantial use, the asserted utility cannot be analogous to deploying “a complex invention as landfill.”¹⁶⁹ More recently in *In re Fisher*, the Federal Circuit further invalidated EST patents for lacking specific and substantial utility.¹⁷⁰

Second, prior to these visible changes, the PTO was already becoming less lenient towards biotechnology applications. In 1999, the Office published a proposal of the new utility guidelines for public comments,¹⁷¹ which was much tighter than the liberal 1995 Guidelines. This proposal was ultimately finalized in the 2001 Guidelines. From the same year, the number of biotechnology patents issued per year began to decrease from its high point of 5977 such patents granted in 1998.¹⁷² In the six years that followed, the number of patents granted in this area dropped 29%, while during the period of 2000 to 2004, the applications for biotechnology patents increased by 46%.¹⁷³ Yet the PTO’s limited

¹⁶³ NUFFIELD COUNCIL ON BIOETHICS, *supra* note 91, at 33.

¹⁶⁴ Martin Enserink, *Patent Office May Raise the Bar on Gene Claims*, 287 SCIENCE 1196, 1196 (2000); Tom Hollon, *Gene Patent Revisions to Remove Some Controversies*, 6 NATURE MED. 362, 362 (2000).

¹⁶⁵ Holman & Munzer, *supra* note 132, at 753-54.

¹⁶⁶ See Eliot Marshall, *Patent Office Faces 90-Year Backlog*, 272 SCIENCE 643 (1996).

¹⁶⁷ John J. Doll, *The Patenting of DNA*, 280 SCIENCE 689, 689-90 (1998).

¹⁶⁸ Utility Examination Guidelines, 66 Fed. Reg. 1092, 1098 (Jan. 5, 2001).

¹⁶⁹ *Id.*

¹⁷⁰ 421 F.3d 1365 (Fed. Cir. 2005). For a discussion of this case, see *supra* Part III.B.7.

¹⁷¹ Revised Interim Utility Examination Guidelines; Request for Comments, 64 Fed. Reg. 71440 (Dec. 21, 1999).

¹⁷² Adelman & DeAngelis, *supra* note 8, at 1687.

¹⁷³ *Id.*; *The Patent System: Today and Tomorrow: Hearing Before the Subcomm. on Intellectual Property of the S. Com. on the Judiciary*, 109th Cong. 3 (2005) [hereinafter

resources do not provide an adequate explanation for this trend. The examination of patent applications runs on a first-come, first-served basis. The increase in applications would normally produce more backlogs and a long prosecution time due to the prolonged period of waiting for the next available examiner.¹⁷⁴ However, this might not impact the number of patents granted annually. A logical explanation is that the PTO changed its generous attitude in 1999, adopting a more stringent stance on biotechnology patents, hence increasing the rejection rate in the years since.¹⁷⁵

Finally, the DNA sequences and other genomic information discovered in the Human Genome Project are placed in GenBank, a free public database open to anyone with internet access, so as to facilitate the pervasive use of genomic data while decreasing transaction costs.¹⁷⁶ There are still private companies that provide genomic databases loaded with additional patented genes and information on the properties of assorted DNA sequences. Although scientists find these expensive commercial databases quite productive in their research,¹⁷⁷ GenBank and other public databases ensure access to critical human genome information, such as ESTs. This is especially important for small start-up companies and university laboratories that have very tight budgets.¹⁷⁸

Single nucleotide polymorphisms (SNPs) are another primary concern of the anticommmons camp.¹⁷⁹ They are variations of DNA sequences where a single nucleotide (A, T, C, or G) in the genome is altered.¹⁸⁰ SNPs may be the genetic sources of personal disposition to

Hearing] (statement of Jon Dudas, Under Secretary for Intellectual Property, Department of Commerce).

¹⁷⁴ Adelman & DeAngelis, *supra* note 8, at 1691.

¹⁷⁵ Another possible explanation might be the increase in “super-sized” applications. Currently, a small portion of applications contains a large number of claims. Approximately 25% of the claims now reviewed by the PTO come from only 7% of the patent applications received. *Hearing, supra* note 173, at 9. There is, however, no evidence indicating an increase in this group of applications.

¹⁷⁶ Human Genome Project, Genetics and Patenting, *available at* http://www.ornl.gov/sci/techresources/Human_Genome/elsi/patents.shtml (last visited Apr. 24, 2008). The Human Genome Project, a public consortium funded chiefly by the NIH for the task of human genome sequencing, was established partially in order to inhibit genomic firms from claiming copyrights for the DNA sequences they discovered. *See* J. Andrew Maniko, Note, *Who Should Know?—The Disclosure Debate over Genetic Information*, 26 SETON HALL LEGIS. J. 151, 157 n.42 (2001).

¹⁷⁷ Commercial genomic databases often cost tens of millions dollars and sometimes even more than \$100 million. *See Genomic’s Wheelers and Dealers*, 275 SCIENCE 774, 774-75 (1997).

¹⁷⁸ *See* Walsh et al., *supra* note 141, at 301-02.

¹⁷⁹ *See* sources cited in *supra* note 161.

¹⁸⁰ NUFFIELD COUNCIL ON BIOETHICS, *supra* note 91, at 92.

certain diseases and thus could be useful in treating a variety of illnesses. These genetic variations have a demonstrated ability as gene markers to greatly accelerate the identification of the targeted DNA sequence.¹⁸¹ They may also play a substantial role in the formation of complex diseases that involve a plurality of factors, such as multiple genes, lifestyle choices, and living environments. Additionally, SNPs could influence patients' reactions to specific medicines, which would give these minor variations in the human genome great potential for designing personalized medicine.¹⁸²

Given these unique features, SNPs became an important subject of upstream investigation after the conclusion of the Human Genome Project. Following the steps of the Project and GenBank, ten of the largest pharmaceutical companies and the Wellcome Trust founded the SNP Consortium in 1999, which aims to release to the public domain the SNP discoveries made under their sponsorship, in order to forestall the genomic companies' attempts to win patents on SNPs.¹⁸³ This release provides instant, free, and equal access to all drug companies, biotech firms, and academics. The Consortium also seeks patents for these released SNPs, so that biotech firms can no longer patent and sell these DNA snippets.¹⁸⁴ A large-scale collaboration like this greatly alleviates the danger that SNP patents will impede the progress of biomedical research.

B. THE RESEARCH GROUND IS WIDE OPEN

In addition, the research ground of biomedicine is wide open and contains many different potential ways of confronting the various illnesses that affect mankind. There are a variety of disease pathways and therapeutic targets to be explored, which outnumber the amount that current researchers could possibly process.¹⁸⁵ Though the advance of

¹⁸¹ A research team at Glaxo Wellcome tested the performance of the SNP markers. Dr. Roses and his team at Duke University spent several years and finally located a specific version of a gene, APOe, which disposed people to Alzheimer's disease. The team redid the research process at Glaxo Wellcome with SNP markers and came to the same result in five months. See Robert Langreth et al., *DNA Dreams: Big Drug Firms Discuss Linking Up to Pursue Disease-Causing Genes*, WALL ST. J., Mar. 4, 1999, at A1.

¹⁸² Human Genome Project, *supra* note 176.

¹⁸³ Justin Gillis, *Drug Companies, Gene Labs to Join Forces; Collaboration Aims to Probe Genetic Difference—Without Proprietary Interests*, WASH. POST, Apr. 15, 1999, at E01; Nicholas Wade, *10 Drug Makers Join in Drive to Find Diseases' Genetic Roots*, N.Y. TIMES, Apr. 15, 1999, at A27. These genomic companies include Genset SA, Incyte Corp., and Millennium Pharmaceuticals, Inc. Langreth et al., *supra* note 181, at A1. For an analysis of the formation of the SNP Consortium, see *infra* text accompanying notes 183-184.

¹⁸⁴ Langreth et al., *supra* note 181; Genetics and Patenting, *supra* note 176; Wade, *supra* note 183.

¹⁸⁵ See generally David E. Adelman, *A Fallacy of the Commons in Biotech Patent Policy*,

molecular biology has furthered our understanding of the genetic origins of human diseases, genetic makeup is not the only key necessary to unlocking the secrets of human ailments. Rather, genes do not sustain fixed relations with human health. As a matter of fact, only a weak causal link exists between a person's genetic composition and his or her susceptibility to disease.¹⁸⁶

The primary reason that genes are not as predominant in the development of diseases as was initially thought lies in a class of intervening factors that stand in the way of correlations between specific phenotypes and particular genotypes.¹⁸⁷ Many critical processes that control the expression of genes or manipulate the activities of proteins are out of the hands of DNA sequences.¹⁸⁸ The existence of other genes in a person's genome also affects the function of his or her genes. For instance, the natural redundancy of human genes has made most mutations, which contain genetic diseases to a large extent, recessive.¹⁸⁹ The human biological systems are not just reflections of gene makeup. Rather, the human body operates more like a complex network, comprised of multiple layers of sub-networks that interact intensively with one another. The structures of the biological systems and the dynamics between various biological pathways again have a significant influence on the function of the genes.¹⁹⁰ There are even inheritable biological traits that are not encoded in DNA sequences. These epigenetic phenomena transform the expression of genes and are transmitted across generations.¹⁹¹

Besides these internal factors, the environment also plays an important role in the cause of disease.¹⁹² Nowadays, two-thirds of the deaths in the United States are attributable to heart disease or cancer. Scientists have found only weak and incoherent genetic signals for the underlying conditions, such as hypertension and diabetes.¹⁹³ Non-genetic

20 BERKELEY TECH. L.J. 985 (2005).

¹⁸⁶ *Id.* at 1009.

¹⁸⁷ See, e.g., Kenneth M. Weiss & Joseph D. Terwilliger, *How Many Diseases Does It Take to Map a Gene with SNPs?*, 26 NATURE GENETICS 151, 151 fig.1 (2000).

¹⁸⁸ Adelman, *supra* note 185, at 1007 n.115; Alan E. Guttmacher & Francis S. Collins, *Genomic Medicine—A Primer*, 347 N. ENG. J. MED. 1512, 1514 (2002).

¹⁸⁹ See, e.g., John L. Hartman IV et al., *Principles for the Buffering of Genetic Variation*, 291 SCIENCE 1001, 1004 (2001).

¹⁹⁰ Adelman, *supra* note 185, at 1008 n.116; U. Alon, *Biological Networks: The Tinkerer As an Engineer*, 301 SCIENCE 1866, 1866 (2003); Hiroaki Kitano, *Systems Biology: A Brief Overview*, 295 SCIENCE 1662, 1662 (2002).

¹⁹¹ Alan P. Wolffe & Marjori A. Matzke, *Epigenetics: Regulation Through Repression*, 286 SCIENCE 481 (1999); Guttmacher & Collins, *supra* note 188, at 1513-14.

¹⁹² See Kenneth M. Weiss & Anne V. Buchanan, *Evolution by Phenotype: A Biomedical Perspective*, 46 PERSP. BIO. MED. 159, 174-75 (2003).

¹⁹³ Richard S. Cooper & Bruce M. Psaty, *Genomics and Medicine: Distraction, Incremental Progress, or the Dawn of a New Age?*, 138 ANNALS INTERNAL MED. 576,

factors, however, might account for 80–90% of the risks of these serious diseases. This conclusion is drawn from the observation that the affection rates differed from five-fold to one-hundred-fold among different populations, yet when people moved from low-risk countries to high-risk ones, their affection rates routinely aligned with those in the new environment.¹⁹⁴

As a result, there exist numerous targets for biomedical researchers to explore, even in the confines of the same disease. When confronted with blockages in possible targets, scientists can usually turn to alternative targets on the disease pathway. Consequently, patents normally do not pose a serious constraint on competition for new innovations. As one research manager in a pharmaceutical firm stated in an interview, “We have more targets than we have chemists to work on them.”¹⁹⁵

Indeed, defects in single genes may give rise to over 10,000 illnesses in humans. These single-gene disorders, which are caused by just one flaw in a gene, are nevertheless very rare and affect only 1% of the population.¹⁹⁶ Taking relatively few examples like this into consideration, it is fair to say that for biomedical research, the problem of the anticommons and other types of blockages may still exist, but only in some specific places.

C. BLOCKAGE DOES OCCUR IN CERTAIN PLACES

In a mid-sized survey, Walsh, Arora, and Cohen found that the biomedical industry generally considers the number of patents that they face in the course of research and commercialization to be manageable, although the number is much larger than before.¹⁹⁷ The interviews they conducted with ten industry respondents show that at the onset of a research project, a considerable number of patents—sometimes in the hundreds—may come to the researchers’ attention. After examination and culling, five to twenty pieces of patents may stand out as requiring intensive investigation. Finally, up to approximately six patents may prove to be relevant and in need of a license agreement and sometimes even full-fledged negotiations.¹⁹⁸ On the other hand, academia does not have the same level of resources as does the private industry to cope with patent investigation and negotiation on this scale. Academic researchers instead

577 (2003).

¹⁹⁴ Walter C. Willett, *Balancing Life-Style and Genomics Research for Disease Prevention*, 296 *SCIENCE* 695, 695–96 (2002).

¹⁹⁵ Walsh et al., *supra* note 141, at 304.

¹⁹⁶ Richard Twyman, *Single Gene Disorders*, *The Human Genome*, Apr. 16, 2003, http://genome.wellcome.ac.uk/doc_WTD_020848.html.

¹⁹⁷ Walsh et al., *Research Tool*, *supra* note 141, at 295. This may be the only comprehensive survey conducted on this topic thus far.

¹⁹⁸ *Id.* at 294–95, 316.

rely on the informal research exception to keep their work going, an issue that will be discussed in Section IV.D.

Surely there are some places where patents have piled up, such as in the case of Golden Rice. This is a genetically modified variety of rice rich in Vitamin A, which was developed for the 100 million people who live in developing countries and suffer from Vitamin A deficiency.¹⁹⁹ It was estimated that as of 2000, at least seventy patents in the world, held by thirty-two different entities, applied to this strain of rice or its formulation process. In individual countries, the numbers of patents ranged from forty-four (the United States), to the upper thirties (European Union countries), to around ten (Brazil, China, and Vietnam), while some countries have no patents on Golden Rice (Argentina, Bangladesh, and Nigeria).²⁰⁰ Because of the charitable nature of developing and growing the rice, patent assignees such as Syngenta, Monsanto, and Bayer are now providing royalty-free licenses for farmers who earn less than \$10,000 per year.²⁰¹ Naturally, the primary market for Golden Rice is poor consumers and farmers in developing countries, meaning that there is little commercial value for multinational companies. But were Golden Rice a lucrative biomedical product, the story about patent licensing would be quite different.

Moreover, most scientific discoveries and innovations build on past findings.²⁰² Biomedical research is no exception in this regard.²⁰³ Although in theory the landscape for innovation is wide open, unbounded, and dispersed with a variety of research opportunities, the breadth and depth of currently available knowledge may nevertheless confine the vision of scientists. At times biomedical researchers have to follow the approaches of their predecessors, because they might be the only strategies that are known to be promising. In order for scientists to have broad visions and reach specific discoveries, they need the shoulders of giants to stand on. And it is the accumulation of scientific findings that plays the role of these giants.²⁰⁴

¹⁹⁹ CIPR, *supra* note 90, at 129.

²⁰⁰ R. DAVID KRYDER ET AL., THE INTELLECTUAL AND TECHNICAL PROPERTY COMPONENTS OF PRO-VITAMIN A RICE (*GOLDENRICE*TM): A PRELIMINARY FREEDOM-TO-OPERATE REVIEW 8 tbl.1, 33-36 (2000), available at <http://www.isaaa.org/Resources/publications/briefs/20/download/isaaa-brief-20-2000.pdf>.

²⁰¹ CIPR, *supra* note 90, at 129.

²⁰² See, e.g., Kenneth W. Dam, *Intellectual Property in an Age of Software and Biotechnology* 4 (U. Chi. Law Sch., John M. Olin L. & Econ. Working Paper No. 35, 1995), available at http://www.law.uchicago.edu/Lawecon/WkngPprs_26-50/35.KWD.IP.pdf.

²⁰³ Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERS. 29, 29 (1991).

²⁰⁴ See *id.*

The patents for mutations on the BRCA1 and BRCA2 genes exemplify the cumulative characteristic of biomedical research. These mutations may give rise to breast cancer. In 1974, Mary Claire King started her long effort to locate and sequence the BRCA1 gene. In 1990 she identified the general location of the gene, a region on chromosome seventeen that contains approximately 1000 genes.²⁰⁵ This breakthrough induced a classic scientific race for the gene. Besides King, the European Breast Cancer Consortium and Myriad Genetics, led by Dr. Mark Skolnick, also competed for the significant discovery. Finally Myriad Genetics, backed by the state government of Utah, which has massive genealogical resources and intensive tumor records, first sequenced the gene in August 1994.²⁰⁶ The company filed for a patent, claiming the mutations of the gene and the nucleic acid probes that specifically hybridize to these mutations.²⁰⁷ In December 1995, Myriad announced that it had successfully sequenced the BRCA2 gene, for which it also claimed a patent.²⁰⁸

The BRCA1 patent embraces the compounds that may be made or used in the course of applying the invention for diagnostic or therapeutic purposes, including genetic tests for cancer or gene therapy.²⁰⁹ Although the unearthing of BRCA1 and BRCA2 was achieved thanks to the prior accomplishments of Mary Claire King, Myriad Genetics did not provide any latitude for allowing independent scientists to follow up on this issue. Myriad Genetics licenses the patent to over twelve organizations, including teaching hospitals, medical schools, and cancer clinics to do cancer screening for only a few known mutations. Myriad disallows all other genetic tests based on its inventions, including sequencing, except for those conducted in its own laboratories. In 2001, academics conducting an NIH-funded research project paid \$1200 for a Myriad test, while ordinary patients were charged \$2680 for the same test.²¹⁰

Myriad's restrictive licensing policy has stifled the investigation of sections in BRCA1 and BRCA2 that still puzzle the biomedical science community. The policy deprives scientists and their students of the opportunity to learn the screening procedure and genetics of BRCA1 and BRCA2, thus hindering the development of their expertise in this area. By

²⁰⁵ Matthew Rimmer, *Myriad Genetics: Patent Law and Genetic Testing*, 25 EUR. INTELL. PROP. REV. 20, 21 (2003); Karen Van Kampen, *Owning the Code*, NAT'L POST BUS., Sept. 1, 2005, at 56.

²⁰⁶ Rimmer, *supra* note 205, at 21-22; Van Kampen, *supra* note 205, at 56.

²⁰⁷ U.S. Patent No. 5,693,473 (filed June 7, 1995).

²⁰⁸ Van Kampen, *supra* note 205, at 56.

²⁰⁹ '473 Patent, at [57].

²¹⁰ Kimberly Blanton, *Corporate Takeover Exploiting the US Patent System, A Single Company Has Gained Control over Genetic Research and Testing for Breast Cancer. And Scientists, Doctors, and Patients Have to Play by its Rules*, BOSTON GLOBE MAG., Feb. 22, 2002, at 10.

requiring independent investigators to submit their samples to its “testing plant,” Myriad gains access to clinical information that takes these scientists decades to accumulate. Each sample enriches Myriad’s collection of DNA and patient profiles, which allows the company to take even more control over this area of research.²¹¹

Myriad’s licensing policy may have delayed the progress of studies about breast cancer. There have been cases where hereditary breast cancer was apparently passed down in families. In one such case, the Myriad test nevertheless came back negative. Because no other institute in the United States performs advanced research in this field, the family went to the Institute Curie in Paris to seek further help. The institute confirmed that the mother and the daughter both suffered from “big deletions” in BRCA1 or BRCA2. Missing sections of DNA on these two genes were just coming to scientists’ attention in the United States, and thus were not detectable by the Myriad test.²¹² In the words of Dr. Debra Leonard, the director of a molecular pathology laboratory at the University of Pennsylvania, “It took a long time for the deletion issue to come up [in America]. Maybe it would’ve come up sooner if more academic labs had been doing this research.”²¹³

1. Research Targets

The blocking effect of proliferating upstream patents arises in two ways. For research targets, it comes from the prevention of competition, which keeps independent researchers away from the follow-on development campaign. Research targets are objects of the research, which can be roughly divided into two categories: therapeutic targets, including drug targets, and drug candidates.²¹⁴ Therapeutic targets include any gene, cell receptor, enzyme, or other protein which is implicated in the disease pathway and is thus a plausible locus for medical intervention.²¹⁵ The Cox-2 enzyme in the *Searle* case,²¹⁶ the CD34 cell receptor in the *CellPro* case,²¹⁷ and the CCR5 cell receptor involved in AIDS treatment²¹⁸

²¹¹ *Id.*; Rimmer, *supra* note 205, at 27; Van Kampen, *supra* note 205, at 56.

²¹² Blanton, *supra* note 210, at 56.

²¹³ *Id.*

²¹⁴ Since certain research targets, such as therapeutic targets, will not be represented in the final products, those research inputs can be research tools as well. When first discovered, drug candidates and therapeutic targets might fail to show the specific and substantial utility that is required to secure a patent. In such case, the problems posed by patent proliferation will not occur. For the current utility requirement standard, see *In re Brana*, 51 F.3d 1560, 1567 (Fed. Cir. 1995); and *In re Fisher*, 421 F.3d 1365, 1371 (Fed. Cir. 2005).

²¹⁵ *Cf.* Walsh et al., *Research Tool*, *supra* note 141, at 310 (referring to drug targets).

²¹⁶ *Univ. of Rochester v. G.D. Searle Co.*, 358 F.3d 916 (Fed. Cir. 2004). See *supra* text accompanying notes 76-78 for more detailed discussion.

²¹⁷ *Johns Hopkins Univ. v. CellPro, Inc.*, 931 F. Supp. 303 (D. Del. 1996), *aff’d in part*,

are all examples of therapeutic targets. The BRCA1 and BRCA2 genes could also be targets of breast cancer therapy, and thus they are contained in the same category. Drug candidates, which comprise the second category, are compounds or molecules that have the potential to turn into commercial medicines. The RGD peptide at issue in the *Integra* case is part of this category.²¹⁹

No matter which category they belong to, research targets are key building blocks for biomedical products and important milestones in the development process. This explains why patent owners are used to restraining access to these inputs. There is a prevalent exclusivity inflicted on research targets in the biomedical sector, a phenomenon that researchers repeatedly complain about.²²⁰ Approximately one-third of the scientists, lawyers and business managers interviewed in a study expressed concerns about patenting gene targets.²²¹ Individuals in academia and private industry are similarly concerned about such patents.²²²

The blockage that patentees impose on follow-on development may appear in several forms. Patentees may eschew licensing entirely, keeping research and commercialization of the claimed inventions all to themselves. Or, they may merely allow exclusive licensees, as Baxter Healthcare did in the *CellPro* case,²²³ or very limited licensees with restricted authorization, as demonstrated in Myriad's BRCA1 and BRCA2 licensing strategies. These restrictive measures may dislocate the patented invention from capable hands that can fully explore its technological possibilities.

As noted earlier, given the uncertainty and unpredictability of scientific research, patent owners may rationally license their invention to those who pay generous royalties, rather than to those who are most capable of downstream innovation and development.²²⁴ In addition, each entity performing research has limits on its capacities, and also its own specialized approaches to utilizing the invention. Every pharmaceutical

rev'd on other grounds, 152 F.3d 1342 (Fed. Cir. 1998). For a more detailed discussion, see Avital Bar-Shalom & Rober Cook-Deegan, *Patents and Innovation in Cancer Therapeutics: Lessons from CellPro*, 80 MILBANK Q. 637 (2002).

²¹⁸ See *supra* text accompanying notes 90-95 for details regarding the CCR5 cell receptor.

²¹⁹ *Merck KGaA v. Integra Lifesciences I, Ltd.*, 545 U.S. 193 (2005). See *supra* text accompanying notes 79-85 for more detailed discussion.

²²⁰ In the survey by Walsh, Arora, and Cohen, respondents repeatedly referred to this blockage in their interviews. Walsh et al., *supra* note 141, at 310.

²²¹ *Id.*

²²² *Id.*

²²³ Baxter was the exclusive sub-licensee of Johns Hopkins University on the My-10 patents and a plaintiff in the *CellPro* infringement lawsuit. For a discussion of the *CellPro* case, see generally Bar-Shalom & Cook-Deegan, *supra* note 217.

²²⁴ See *supra* Subsections III.B.4 and III.B.6.

company has its own library of compounds, usually kept secret, and each library varies considerably from the next.²²⁵ Small biotechnology firms have more restricted capabilities and expertise. For example, the genomic firm Geron has been thwarted in its pursuit of telomerase as a potential target for cancer drugs. The company already owns an extensive patent portfolio for telomerase. But stuck with the biological complexity surrounding telomerase, the company has deferred considerably its schedule for having the product ready for clinical trials.²²⁶ Additionally, the “coordination” or suppression of competition that the blockage creates could further delay and delimit the progress of science and useful art.²²⁷

At face value, exclusive licensing would be better than abstaining from licensing. Nevertheless, exclusive licensing has its own problem: double marginalization. This concept denotes a series of vertical monopolies, a situation that is more pernicious than a single integrated one. Each monopoly in this series is able to secure a monopolistic rent, which, in aggregate would be much greater than a single integrated rent.²²⁸ This problem could arise in the biomedical sector.²²⁹ According to a survey on the licensing of DNA patents owned by U.S. academic institutions, nearly 46% of the patents were exclusively licensed either for all fields or for individual fields of use.²³⁰ When researchers contact an exclusive licensee for a sublicense, they face several monopolists, including the one they are negotiating with, other exclusive licensees that came before, and the patent owners—each of which is charging a premium. This phenomenon could substantially increase license expenditures, compounding the problem of royalty stacking caused by patent proliferation and consuming the limited research budgets of academic institutions and biotechnology start-ups.

²²⁵ Walsh et al., *supra* note 141, at 310-12.

²²⁶ Geron rescheduled the date for clinical trials to begin from 1998 to 2003. *Id.* at 312-13; Jean Marx, *Tackling Cancer at the Telomeres*, 295 *SCIENCE* 2350 (2002). Arti Rai called the ingenuity foregone because of blockage and the coordination created by patentees as “creativity cost.” Rai, *supra* note 26, at 136-41.

²²⁷ See *supra* Subsections III.B.4-6.

²²⁸ Shapiro, *supra* note 131, at 123; cf. Richard A. Epstein, *Steady the Course: Property Rights in Genetic Material*, in *PERSPECTIVES ON PROPERTIES OF THE HUMAN GENOME PROJECT*, *supra* note 137, at 153, 162-68 (arguing that double marginalization does not apply to patents because the vertical relationships cannot be clearly established between them).

²²⁹ See Iain M. Cockburn, *The Changing Structure of the Pharmaceutical Industry*, 23 *HEALTH AFF.* 10, 19 (2004).

²³⁰ Lori Pressman et al., *The Licensing of DNA Patents by US Academic Institutions: An Empirical Survey*, 24 *NATURE BIOTECH.* 31, 36, 37 fig.4 (2006).

2. Pure Research Tools

For pure research tools,²³¹ the impact of upstream patent proliferation comes from prolonged and complicated negotiations and related burdens on downstream development. This is the realm in which the anticommons wields its power and where transaction costs and negotiation difficulties become reality. Normally, patent owners are, in fact, willing to license their pure research tools. The problem results from protracted, case-by-case license negotiations, which cause delay and impose high costs for bringing in technologies or materials that scientists require for their research. Over one-third of the respondents surveyed by Walsh, Arora, and Cohen positively confirmed this situation.²³² Sometimes the delay or breakdown in negotiations even requires altering the approach for tackling the research problem or changing the entire research design. While researchers may try getting around the patents or moving the project overseas, these solutions may come at the expense of research efficiency, as they entail additional time, cost, and labor. Reviewing the patents involved in the research and negotiating the license agreement are also time consuming, complex, and costly. One attorney affiliated with a large pharmaceutical company estimated that such work cost the business \$2 million per year.²³³

The problem of pure research tools is nevertheless much more dramatic in certain cases. Commentators are used to asserting that platform technology, which is instrumental in a variety of nonrivalous lines of research, will be publicly authorized to interested scientists for a moderate fee. This strategy seeks to maximize monetary returns, just as Stanford University and the University of California did with the Cohen-Boyer patent for basic DNA cloning techniques.²³⁴ Though this argument is sensible in economics, some cases have gone precisely against this prediction. A salient example comes from DuPont, which required onerous reach-through rights for its Cre-lox technology. This invention enables scientists to mark a targeted gene in a DNA sequence by the loxP DNA, and then to cut off the gene from the sequence by using the Cre enzyme. Currently, the technology is used primarily to raise knock-out mice that lack specific genes. The more powerful application of the

²³¹ For the distinction between research targets and pure research tools, see *supra* note 38.

²³² Walsh et al., *supra* note 141, at 314.

²³³ *Id.* at 314-16. Walsh and his co-authors, however, did not consider that transaction costs had already risen dramatically, because the growth rate of attorney input in the biotechnology industry did not exceed the growth rate of research expenditures in the same industry during the second half of 1990s.

²³⁴ See, e.g., Adelman, *supra* note 185, at 1023-29. For a brief introduction to the Cohen-Boyer invention, see Sally Smith Hughes, *Making Dollars Out of DNA: The First Major Patent in Biotechnology and the Commercialization of Molecular Biology, 1974-1980*, 92 *Isis* 541, 542 n.2 (2001); *Biotechnology at 25: The Founders*, <http://bancroft.berkeley.edu/Exhibits/Biotech/25.html> (last visited Apr. 22, 2008).

technology in creating “conditional mutants,” which drop specific genes from specific cells in particular organs.²³⁵ Both of the usages are invaluable in designing animal models that fit the respective needs of *in vitro* testing in individual projects.

Instead of generally licensing this technology, however, DuPont asked the licensees for full-fledged reach-through rights on the scientific findings reached through experimentation with test animals that were genetically modified using the Cre-lox technique. Specifically, the company required reach-through royalties, prepublication review, and prior approval of the license or other transfers of the findings to third parties.²³⁶ Given the purely facilitative role of the technology in individual research, some university licensing groups referred to this approach as the “Steinway Piano model,” comparing it to the demand for legal rights in songs that are written on brand-name pianos. This unreasonableness prompted dissent from research institutes such as Massachusetts Institute of Technology (MIT), University of California, the NIH, and the Jackson Laboratory (the largest repository in the nation for test mice).²³⁷ Finally, the NIH solved the problem by striking a deal with DuPont to allow nonprofit institutions to receive the technology from the NIH without any charges or reach-through rights.²³⁸

Polymerase chain reaction (PCR), an openly licensed platform technology broadly used in amplifying DNA, also induced controversy over its license policy. Researchers may obtain the license through buying authorized thermal cyclers, *Taq* polymerase, and other authorized enzymes.²³⁹ The controversy, however, centered on the amount of royalty fees, particularly the price of *Taq* polymerase. Some academics asserted that the relatively high royalties made many experiments impossible for them, especially in the field of molecular biology.²⁴⁰ Small biotechnology companies also complained about the difficulties they endured in supporting the licensing costs of PCR.²⁴¹

²³⁵ Naomi Freundlich, *Cre-lox Controversy Divides Institutions, Prompts NIH Panel*, SIGNALS, June 12, 1998, <http://www.signalsmag.com> (search the website using the article name, and follow the hyperlink thus retrieved).

²³⁶ *Id.*; *NIH and DuPont Hammer Out Cre-lox Agreement*, SIGNALS, Aug. 20, 1998, <http://www.signalsmag.com> (search the website using the article name, and follow the hyperlink thus retrieved)

²³⁷ Freundlich, *supra* note 235.

²³⁸ *NIH and DuPont Hammer Out Cre-lox Agreement*, *supra* note 236.

²³⁹ Shane Beck, *Do You Have a License?: Products Licensed for PCR in Research Applications*, 12 SCIENTIST 21, 21 (1998).

²⁴⁰ Except for human genomic studies, which enjoy much more funding than other subfields of molecular biology.

²⁴¹ NAT'L RESEARCH COUNCIL, THE NAT'L ACADEMIES, INTELLECTUAL PROPERTY RIGHTS AND THE DISSEMINATION OF RESEARCH TOOLS IN MOLECULAR BIOLOGY 43-45 (1997).

Genetic tests represent another area that is rife with difficulties. In a 2001 survey of American laboratories conducting DNA-based genetic tests, 65% of respondents had been notified of possible patent infringement and 25% of respondents had therefore ceased performing the allegedly infringing tests. Additionally, 53% of respondents revealed that they had determined not to develop or perform a test since patents had already covered it.²⁴²

Although the precise magnitude of the blockage that has arisen in scientific progress remains to be seen,²⁴³ delays and additional costs have accrued in the research and clinical application of genetic tests. Unacceptable terms of license might be a reason for laboratories to discontinue the patented tests that they originally performed. Most respondents in the survey further confirmed that the effects of patents and licenses on the cost, access, and development of the genetic tests were all considered negative. They were equally divided as to whether patents had enhanced the quality of genetic tests.²⁴⁴ The drawback of patenting in this situation is so apparent that it could even cast doubt on the patents' function of facilitating commercialization, a belief that bolstered the enactment of the Bayh-Dole Act.²⁴⁵ As demonstrated by the case of haemochromatosis, laboratories can be quick to make use of published findings regarding gene-disease association, and thus are able to successfully craft new genetic tests without patent incentives.²⁴⁶

In summary, the anticommons has not occurred as widely in the biomedical sector as the theory predicts. The main reason for this discrepancy is the plurality of research targets positioned along disease pathways. Although independent researchers may be able to use alternative targets if patent owners have blocked the preferred one, sometimes this avenue is simply not plausible because of the cumulative nature of science. The blockage imposed by patentees on research targets directly constrains competition in research and commercialization following upstream patents, and thus negatively impacts the progress of downstream innovation. On the other hand, the blockage imposed on pure research tools creates substantial delays and costs to follow-on development. These obstacles to innovation vindicate the necessity of a

²⁴² Mildred K. Cho et al., *Effects of Patents and Licenses on the Provision of Clinical Genetic Testing Services*, 5 J. MOLECULAR PATHOLOGY 3, 5 (2003).

²⁴³ The cases of BRCA1/BRCA2 and PCR, which is also a widely used genetic test, substantiate the possibility of blockage created by patenting genetic tests.

²⁴⁴ Cho, *supra* note 242, at 7 tbl.3.

²⁴⁵ 35 U.S.C. §§ 200–211, 301–307 (2000 & Supp. 2004). The Bayh-Dole Act allows scientists to seek patents for discoveries that arise from federally funded research projects.

²⁴⁶ See Cho, *supra* note 242, at 6, 8; Jon F. Merz et al., *Diagnostic Testing Fails the Test: The Pitfalls of Patents Are Illustrated by the Case of Haemochromatosis*, 415 NATURE 577 (2002).

legal privilege for independent researchers to overcome the barriers of patents and thus pursue follow-on innovations.

D. THE INFORMAL RESEARCH EXCEPTION IS NOT DEPENDABLE

Faced with the problems demonstrated above, the United States' academic community now heavily relies on the informal research exception. It is informal in the sense that it is not enshrined in legal doctrine, but in reality forbearance does exist among biomedical patentees for infringement by academics. Although not recognized by black-letter law, this exception has social foundations in the biomedical sector and thus would not be easy to eliminate.

The primary basis of support for this *de facto* exemption is the desire of patent owners to maintain close relationships with the scientific community. Universities do not sue each other for patent infringement, and they also hate to be sued. Turning to the scenario between academia and industry, the biomedical business is a science-based industry and thus greatly dependent on the progress of science to spark new momentum for industrial innovation.²⁴⁷ Accordingly, enterprises in the industry tend to keep close and friendly ties with academics. As one university technology transfer officer described in an interview, “[T]hese firms are consumers of technology as well. No one will talk to you if you sue. We all scratch each others’ backs. You will become an instant pariah if you sue a university.”²⁴⁸ Another respondent from the industry made the same point:

We rely on lots of outside collaborations with academic labs. Our scientists want to feel on good terms with the academic community. If you start suing, it breaks down the good feeling. We give out our research tools for free, frequently. All we ask is, if you invent anything that is directly related to the tool, you allow us the freedom to practice.²⁴⁹

The inflow of technology from universities to industry takes various forms. Companies may sponsor industry affiliates programs, through which they can attend research group meetings and get early knowledge of research progress. They also attain closer partnerships through individualized research projects, which are aimed at developing specific commercial products.²⁵⁰ Another important connection is interpersonal relations. Technology companies or their research departments are often located close to major universities. They recruit a

²⁴⁷ See Merges & Nelson, *supra* note 102, at 883-84, 904-08, 915.

²⁴⁸ Walsh et al., *supra* note 141, at 325.

²⁴⁹ *Id.* at 326.

²⁵⁰ Cristina Weschler, Note, *The Informal Experimental Use Exception: University Research After Madey v. Duke University*, 79 N.Y.U. L. REV. 1536, 1557 (2004).

well-educated workforce and invite professors from nearby universities to be their consultants. As a matter of fact, a large number of biotechnology firms are spin-offs from universities, and leading professors may hold top management positions at these firms.²⁵¹ The universities may also own equity in such firms. All of these connections enhance personal contacts and information exchange. New scientific progress and business opportunities can circulate conveniently through personal networks and frequent interactions, particularly in the technology clusters that have emerged around universities.²⁵²

Another reason for the patent owners' forbearance is the high cost and few payoffs of infringement litigation coupled with the minimal payoffs it yields. In addition to the considerable expenses of attorneys fees, plaintiffs risk having their patents invalidated in court.²⁵³ Research tools are, by definition, not present in the final outcomes of research and commercialization. The employment of patented research tools during development processes would thus be difficult to discern, so long as the end products and publication of the scientific findings gave no indication of the unauthorized use.²⁵⁴ In other words, the information costs of detecting infringement have escalated. The infringement could remain under the radar of patentees. In the same vein, since research tools are not embodied in the end products that draw profits from the market, it may be difficult for plaintiffs to prove substantial damages in court, which may further deter infringement lawsuits.²⁵⁵

Still, the informal research exception is not robust and comprehensive enough to satisfy independent researchers. First of all, the informal exception is usually applied only to non-commercial research, whether conducted in academia or industry.²⁵⁶ There have already been cases like *Merck KGaA v. Integra Lifesciences I, Ltd.*,²⁵⁷ where businesses doing follow-on research and commercialization were brought to court by patentees. In *Integra*, the pharmaceutical company Merck commissioned the Scripps Institute to perform drug development. Merck also provided the Institute with *Integra's* patented compound as a primary drug candidate. Although the final product that was developed did not comprise embodiments of the patented invention, *Integra* nevertheless sued Merck and Scripps for infringement during the development period. This case

²⁵¹ *Id.* at 1557-58.

²⁵² *Id.* at 1558-59.

²⁵³ Walsh et al., *supra* note 141, at 328.

²⁵⁴ See Weschler, *supra* note 250, at 1562.

²⁵⁵ *Id.* at 1563.

²⁵⁶ *Id.* at 1564; see also Walsh et al., *supra* note 141, at 326-27.

²⁵⁷ 545 U.S. 193 (2005).

clearly illustrates that the high costs and low returns of litigation²⁵⁸ are not dependable insulation from infringement lawsuits.

Second, the informal exception is vulnerable. A small number of incidents may cause it to collapse. The exception is, in effect, a social norm within the biomedical sector, deriving from the old norm that underlay the ideal of open science. The traditional scientific norm is now retreating; further, it is being progressively undermined by laws that govern patents and technology transfers, such as the Bayh-Dole Act.²⁵⁹ In addition, the informal exception is not bolstered by patent law; rather, it relies, at least in part, on the benign self-restraint of patent owners in the biomedical field.

Accordingly, a “butterfly effect” may attack and substantially restrain the informal exception.²⁶⁰ In today’s litigious society, universities face an increasing number of legal disputes. Handling legal problems has become one of the main tasks for university administrators. Among the various types of disputes, litigation imposes the most pressure on universities because of its visibility and formalities. Universities and other research institutions thus remain on watch for potential legal liabilities.²⁶¹ To deal with this concern, universities frequently establish legal compliance and risk management departments.²⁶²

²⁵⁸ In the *Integra* case, the Federal Circuit reversed a \$15 million damage award for reasonable royalties. The court emphasized that when assessing damages for research tool infringement, the lower court must factor in the scientific and economic risks that Merck sustained during the development process, the prospect of the drug being released on the hypothetical license negotiation date, the point at which the patented research tool was utilized in the development process, and the number of patent licenses necessary for developing the drug. *See Integra Lifesciences I, Ltd. v. Merck KGaA*, 331 F.3d 860, 869–72 (2003).

²⁵⁹ *See Rai, supra* note 26, at 109-15.

²⁶⁰ The Butterfly effect, also called “sensitive dependence on initial conditions,” is a term central to chaos theory. It denotes the large variations that small changes in an initial condition can bring about in the long-term behavior of a nonlinear dynamical system. Wikipedia, *Butterfly Effect*, http://en.wikipedia.org/wiki/Butterfly_effect (last visited Apr. 22, 2008); *see also* Chaos & Fractals—The Butterfly Effect, <http://www.pha.jhu.edu/~ldb/seminar/butterfly.html> (last visited Apr. 22, 2008); Wolfram Mathworld—Butterfly Effect, http://mathworld.wolfram.com/Butterfly_Effect.html (last visited Apr. 22, 2008).

²⁶¹ *See* 1 WILLIAM A. KAPLIN & BARBARA A. LEE, *THE LAW OF HIGHER EDUCATION: A COMPREHENSIVE GUIDE TO LEGAL IMPLICATIONS OF ADMINISTRATIVE DECISION MAKING* 3–9, 93–95 (4th ed. 2006); RICHARD D. STRAHAN & L. CHARLES TURNER, *THE COURTS AND THE SCHOOLS: THE SCHOOL ADMINISTRATOR AND LEGAL RISK MANAGEMENT TODAY* xiii–xv (1987).

²⁶² The Risk Management Department at Stanford University begins its mission statement with the following: “For humanitarian, social, *legal*, and financial reasons, the University will make every reasonable effort to protect the health and safety of members of the community and the public. . . .” Stanford University Risk Management Department: Mission, *available at* <http://www.stanford.edu/dept/Risk-Management/about> (emphasis added).

If fortuitous but salient incidents of patent enforcement arise against academic institutions, they would likely ignite the latent fears of university management about patent litigation, thus resulting in more stringent limitations on the use of patented research tools and, as a consequence, triggering a sudden contraction in use of the informal research exception.²⁶³ Vigorous enforcement of patents could come from outsiders of the biomedical sector, who do not perform continuous research in the field and therefore have few (or no) incentives to retain close relations with academic researchers.²⁶⁴ An example of this problem comes from DuPont. The company has phased out its research in molecular biology and taken a strong position on patent licensing and implementation. In addition to its full-fledged reach-through requirements for the license of Cre-lox technology,²⁶⁵ it also aggressively enforced the OncoMouse patent that it exclusively licensed from Harvard College. Universities were accused of infringement for not vigorously abiding by the exact terms in the memorandum of understanding, which DuPont and the NIH agreed to for the purpose of affording a free license to NIH-funded research.²⁶⁶ Moreover, DuPont construed the claims of the patent so broadly so as to embrace all types of cancer-prone mice, whether they were made by inserting oncogenes or by any other means. Many scientists considered this assertion to be baseless and overpowering.²⁶⁷

In addition, there is a group of patent licensing companies, dubbed the “patent trolls,” which are already active in the electronic and internet industries. The term “patent troll” was coined by Peter Detkin, a former assistant general counsel of Intel, to denote those firms that, in his words, “tr[y] to make a lot of money of a patent that they are not practicing and have no intention of practicing and in most cases never practiced.”²⁶⁸ Most patent trolls do not manufacture any products. Quite a number of them neither engage in research nor sponsor innovative campaigns. The primary line of their business is patent licensing, which is supported by their patent

See also Finance Division, Tufts University: Policy on Regulatory Compliance, available at http://finance.tufts.edu/policies/poli_regcompliance.php; The Office of Compliance, University of Southern California: Compliance Plan—Mission Statement, available at <http://www.usc.edu/admin/compliance/whatsnew.html>; Research at Indiana University—Overview of Research Compliance on the IUB and Regional Campuses, available at <http://www.research.indiana.edu/rschcomp/over.html>.

²⁶³ See Weschler, *supra* note 250, at 1566-68.

²⁶⁴ Rai, *supra* note 26, at 85 (discussing the work of Robert Ellickson on law and social norms); Walsh et al., *supra* note 141, at 325-26.

²⁶⁵ See *supra* text accompanying notes 234-235.

²⁶⁶ Walsh et al., *supra* note 141, at 326; Gareth Cook, *Researchers Criticize Terms of Cancer-Mice Use*, BOSTON GLOBE, May 31, 2002, at A1.

²⁶⁷ Cook, *supra* note 266.

²⁶⁸ Brenda Sandburg, *Battling the Patent Trolls*, THE RECORDER, July 30, 2001 (on file with author).

willingness to file infringement lawsuits in court.²⁶⁹ Once patent trolls encroach on the biomedical sector, these licensing companies will have nothing to lose when they bring infringement litigation against academic institutions and researchers. They do not share the incentives for maintaining a cordial relationship with the scientific community.

Lastly, scientific competition is as fierce as the race in the marketplace, and thus is another potential source of assertive patent enforcement. In order to prevail in the race for scientific discoveries or to defend their own intellectual beliefs, it is possible for scientists to use patents to keep their colleagues away from their research topics, or to prevent contending theories from attacking their basic viewpoints and assumptions.²⁷⁰ From this perspective, it would not be a surprise if someday a research scientist filed infringement litigation against academic institutions that assume the scientist's tolerance for academic use of the patents and are further engaged in competing research. These instances and possibilities clearly elucidate the vulnerability of the informal research exception. Independent researchers need a reliable way to acquire research tools efficiently and lawfully. Acknowledging the necessity, this Article will focus in the following parts on the search for an adequate resolution to deal with the blockage problems caused by upstream patent proliferation.

V. POSSIBLE SOLUTIONS FOR THE PATENT PROLIFERATION DILEMMA

There are two basic approaches to dealing with the blockage problem posed by upstream patent proliferation. Modifying the patentability requirements of utility, nonobviousness, enablement, and written description in order to make them more stringent is one way to confront this problem. This approach may have a substantial and unique impact on upstream patents. On this front, the Federal Circuit has made heavy use of the written description requirement to control the scope of biomedical patents. In *Regents of the University of California v. Eli Lilly & Co.*,²⁷¹ the court confined the claim scope of molecular biological materials, such as DNAs or proteins, to those for which the chemical sequences or common structure features are already recited or represented in the patent specifications. In *Searle*,²⁷² the Federal Circuit again used the written description requirement, this time to invalidate reach-through

²⁶⁹ See *id.*; Elizabeth D. Ferrill, Comment, *Patent Investment Trusts: Let's Build a Pit to Catch the Patent Trolls*, 6 N.C. J.L. & TECH. 367, 374-78 (2005); IPrex Intellectual Property Solutions et al., *Patent Terrorism—Terror of the Intangibles*, June 27, 2006, ipFrontline.com, <http://www.ipfrontline.com/printtemplate.asp?id=11605>.

²⁷⁰ See Eisenberg, *supra* note 50, at 1057-59; Rai, *supra* note 26, at 124.

²⁷¹ 119 F.3d 1559 (Fed. Cir. 1997).

²⁷² *Univ. of Rochester v. G.D. Searle Co.*, 358 F.3d 916 (Fed. Cir. 2004). For more detailed discussion of the written description issue in this case, see *supra* text accompanying notes 85-87.

claims, so as to prevent upstream patents from preoccupying after-arising innovations downstream. In regards to the utility requirement, the Federal Circuit made clear in *In re Fisher*²⁷³ that general use which is common to the genus that the invention belongs to is not a substantial and specific use as required by patent law. Accordingly, the court invalidated EST patents.²⁷⁴ These cases exemplify the importance of the patentability standards in addressing the problems caused by proliferation.

Nevertheless, given the existence and prosperity of the biotechnology industry and its dependence on patent protection, perhaps upstream patents will not fade from the horizon of biomedicine after all. Assuming this to be true, this Article will instead concentrate on another approach to tackling the problem of upstream patent proliferation: limiting the exclusive rights of upstream patents and facilitating their license. The following sections will investigate such solutions, including the creation of license-facilitating institutions and providing exemptions for patent rights.

A. CROSS LICENSING, PATENT POOLS, AND OTHER COLLECTIVE RIGHTS ORGANIZATION

Some commentators believe that license-facilitating institutions may ease the problems caused by upstream patents. These scholars appeal to experiences in other industries and to certain public data pools that currently exist in the biomedical sector. In actuality, there are only two major data pools that exist: the Human Genome Project and the SNP Consortium.²⁷⁵ Biomedical data pools are not just few in number; they also emerge only when upstream patents pose a keen threat to the core interest of a class of businesses, thus making a collective defense desirable. In addition, public interest institutions such as the NIH and the Wellcome Trust, a charitable nonprofit organization, also played a critical role in catalyzing the aforementioned data pools. Because of these limitations, data pooling does not currently provide the comprehensive resolution necessary for tackling blockage problems.

The more profound difficulty of this approach lies in the stringent preconditions required for license-facilitating institutions to take shape. Since these conditions, as explained below, rarely exist in the biomedical sector, the chances are low that facilitative institutions would be able to ease the negative effects that blockage inflicts on biomedical research. Even if individual coordination or cross licensing were possible, these piecemeal solutions do not have the capacity to settle the problem as a whole.

²⁷³ 421 F.3d 1365 (Fed. Cir. 2005).

²⁷⁴ See *supra* Subsection III.B.7 for a more detailed discussion.

²⁷⁵ See *supra* text accompanying notes 176-184 for brief descriptions of the Human Genome Project and the SNP Consortium.

1. Precondition I: A Few Firms in a Repeated Game

Biotechnology and pharmaceutical industries are fragmented industries with a low concentration of market.²⁷⁶ Although both industries have experienced many mergers and acquisitions, the degree of market concentration remains moderate. According to a combined survey conducted across the two industries, the ten largest companies accounted for only half of the combined sales revenue in 2002.²⁷⁷ The relatively large number of key players and the diffusion of market shares make it more difficult for companies to come to terms with one another, thus aggravating the problem of collective action and increasing the chances of entire arrangements breaking down, as one or two participants retreat.²⁷⁸

The hostility bred among competitors in the marketplace is another hurdle to their cooperation. Companies engaged in the same line of business act as enemies, fighting for similar clusters of customers. Only in a repeated game with very limited players—typically an oligopolistic market where no player can defeat other contenders and where harsh fighting decrease profits and results in a zero-sum competition—will competitors learn to cooperate with each other over time, in order to reach agreements that diminish common concerns.²⁷⁹

2. Precondition II: Sharing Aligned Goals and Interests

Furthermore, the industries where license-facilitating mechanisms come forward often possess internally shared goals and aligned interests. Businesses in such industries may use interrelated manufacturing processes or produce largely homogeneous products.²⁸⁰ These similarities foster common interests between these businesses, putting them at risk for encountering mutual patent interlocking. The resemblance among competitors also brings about complementary patents in the same industries, which empowers competitors to release each other from the web of interlocking patents by cross licensing or through other types of

²⁷⁶ ALFONSO GAMBARDELLA ET AL., GLOBAL COMPETITIVENESS IN PHARMACEUTICALS: A EUROPEAN PERSPECTIVE 25-26 (2000); ROBINSON, *supra* note 124, at 26 (quoting statement of Dr. P. Roy Vagelos, former Chairman and CEO of Merck).

²⁷⁷ Patricia M. Danzon et al., Mergers and Acquisitions in the Pharmaceutical and Biotech Industries 1 (Sept. 2003) (unpublished manuscript, presented at the Organizational Economics of Health Care Conference 2003), available at <http://ssrn.com/abstract=468301>.

²⁷⁸ Rochelle K. Seide & Michelle LeCointe, *Just Say 'No' to Patent Pooling for Genomics*, GENOMEWEB DAILY NEWS, July 13, 2001, <http://www.genomeweb.com/news/117309-1.htm>.

²⁷⁹ See Robert D. Cooter, *Structural Adjudication and the New Law Merchant: A Model of Decentralized Law*, 14 INT'L REV. L. & ECON. 215, 218-20 (1994); Rai, *supra* note 26, at 85-86.

²⁸⁰ See Seide & LeCointe, *supra* note 278.

cooperation. Common interests like these have been a critical factor in encouraging patent cooperation among competitors.

In the biomedical sector, however, the market is highly dispersed and fragmented. For example, medicines for two different types of diseases cannot be considered as part of the same market. The rapid progress of science and the diverse approaches to investigation also make it difficult to determine which patents should be pooled or shared.²⁸¹ As discussed in Subsection III.B.3, members of this sector have heterogeneous interests and agendas. Upstream academics and biotechnology companies prefer exclusive licenses, seeking to share the rent that a downstream blockbuster product might bring about, while downstream pharmaceutical firms prefer to keep the rent to themselves, opting for a more open licensing scheme in order to have more opportunities to discover lucrative products.

The divergence of goals and interests between businesses, on the one hand, and academic institutions and government agencies on the other, is even greater. The primary goal of academics is scientific achievement. They desire speedy access to useful research tools, whenever such tools are needed. Government agencies such as the NIH shoulder the mission of promoting the progress of science, thus preferring an open exchange of scientific data, as illustrated by the establishment of a data pool in the Human Genome Project. Private businesses, in contrast, are focused on maximizing their profits so as to achieve the best interest of their shareholders.

3. Precondition III: The Impetus to Overcome High Costs

Patent pools and other collective rights organizations require high costs to construct. This implicates hard work in the form of negotiation, persuasion, consensus building, and agreement drafting, not to mention the more difficult tasks of patent evaluation and royalty division.²⁸² This high threshold is aggravated by the problem of collective action. The firm who puts forth the initiative for a cooperative enterprise bears most of the costs, but enjoys no more benefit than any other participant with a similarly sized business operation and patent portfolio.

Consequently, endless patent fights may not be sufficient to prompt the creation of a license-facilitating institution. They usually require something of even greater magnitude to outweigh the enormous costs. An industry-wide pool that arose in the airplane industry can best illustrate this situation. The Wright brothers' patent for the stabilizing and steering system of aircrafts is the foundation upon which airplanes are

²⁸¹ *Id.*

²⁸² Robert P. Merges, *Institutions for Intellectual Property Transactions: The Case of Patent Pools*, in EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY, *supra* note 143, at 123, 144-45.

built,²⁸³ but Glenn Curtiss developed the flap configuration that implements this system much more effectively. Even before Curtiss secured a patent for his invention, most manufacturers had been using the technology in aircraft production.²⁸⁴ One of the Wright brothers and his successor—the Wright-Martin Company—initiated and finally won an infringement litigation over the Curtiss technology. In the aftermath, Curtiss avoided the consequences of the decision by continuously making small changes to his configuration. On the other hand, the Wright-Martin Company charged as much as \$1000 per airplane for its patent, and threatened to sue those manufacturers that were unwilling to accept that term.²⁸⁵ What followed was a deadlock that jammed the entire airplane industry. When World War I erupted, this situation prompted concern from the armed forces. It was not until Congress threatened to expropriate the patent that the Wright-Martin Company conceded it to a patent pool, open to every firm in the airplane industry.²⁸⁶

Besides governmental intervention, the critical forces that have turned patent cooperation into a reality include pressure from potential licensees, enormous projects beyond the reach of a single competitor, and acute common threats to competitors. A telling example of pressure from potential licensees arose in the industry for swimming pool cleaners.²⁸⁷ Landon Inc. and Robert Pace held interlocking patents on swimming pool cleaners. No manufacturer could produce the cleaner without licenses from both of them. When Landon first sought to license, manufacturers were not interested without the co-presence of the Pace license.²⁸⁸ To cope with the resulting deadlock, Landon and Pace set up a patent pool. Pace assigned his patent to Landon, but kept a royalty-free right to use both patents. According to a fixed formula, they shared royalties from outgoing licenses.²⁸⁹

MPEG-2 and DVD patent pools are good examples of projects beyond the reach of a single competitor. These patent pools are auxiliary to the standard setting of digital storage formats.²⁹⁰ For standard setting to succeed, the acceptance of manufacturers in related product markets is key. For digital storage, this involves multiple industries, including computer and consumer electronics manufacturers and audio/video

²⁸³ Merges & Nelson, *supra* note 102, at 890.

²⁸⁴ George Bittlingmayer, *Property Rights, Progress, and the Aircraft Patent Agreement*, 31 J.L. & ECON. 227, 231 (1988).

²⁸⁵ *Id.* at 231-32.

²⁸⁶ *Id.* at 232; *see also* Merges & Nelson, *supra* note 102, at 891.

²⁸⁷ *See generally* Merges, *supra* note 282, at 143 n.79.

²⁸⁸ *International Mfg. Co., Inc. v. Landon, Inc.*, 336 F.2d 723, 729 (9th Cir. 1964).

²⁸⁹ *Id.*

²⁹⁰ Merges, *supra* note 282, at 151.

content providers.²⁹¹ The founders of the MPEG-2 and DVD patent pools thus solicited companies that have large market shares in different industries to join the project, together developing a new protocol for digital storage devices.²⁹² When the new formats were stipulated, the project participants were principal advocates for these technologies. They used their influence in the industries to promote products of the new protocols, thus expanding market shares and consumer acceptance of the novel technologies, as they strove to advance the formats to be the prevalent industrial standards. At the same time, each patent that was perceived in the development process as necessary for implementing the protocols was pooled into a package to provide one-stop licensing, which was offered publicly to every interested manufacturer.²⁹³ The royalty rate of this package was kept at a reasonable level in order to secure pervasive acceptance.²⁹⁴ Projects such as these overwhelm the capabilities of any single business and therefore are a frequent impetus to collaboration among competitors.²⁹⁵

For the third scenario, where acute common threats to competitors are present, the SNP Consortium fits in. SNPs are a perfect source for exploring the genetic bases of human disorders.²⁹⁶ Those who engage in biomedical research need SNP data in order to keep their studies at the cutting edge. In addition, SNP information is also the foundation for personalized medicine. If the connection between side effects of certain types of compounds and specific SNPs can be established, it could save a fortune for pharmaceutical companies by significantly reducing the amount of time and money required for clinical trials.²⁹⁷ To make this happen, drug companies need easy access to a SNP map that is annotated with this type of information and that is officially recognized by both the scientific community and a regulatory agency, namely the FDA.²⁹⁸

²⁹¹ For products and services that are implicated by the two technologies, see JEANNE CLARK ET AL., U.S. PATENT & TRADEMARK OFFICE, PATENT POOLS: A SOLUTION TO THE PROBLEM OF ACCESS IN BIOTECHNOLOGY PATENTS? 13-15 (2000), available at <http://www.uspto.gov/web/offices/pac/dapp/opla/patentpool.pdf>.

²⁹² For the membership of these patent pools, see *id.*

²⁹³ *Id.*

²⁹⁴ In both cases, the patent pools charged only a relatively small fraction of the total manufacturing costs for the patent package. *Merges*, *supra* note 282, at 161-62.

²⁹⁵ Despite the necessity of cooperation, disparities between the participants' strategies and agendas nevertheless led the ten-member DVD consortium—the technology-developing body—to split into two patent pools. The split created a risk of increased costs for the protocol and also affected its acceptance. See *Merges*, *supra* note 282, at 153.

²⁹⁶ Gillis, *supra* note 183; Genetics and Patenting, *supra* note 176.

²⁹⁷ Langreth et al., *supra* note 181.

²⁹⁸ *Id.*; see also Wade, *supra* note 183.

Recognizing the significance of SNP maps, genomic companies raced to secure SNP patents for the purpose of forging proprietary SNP databases.²⁹⁹ If pharmaceutical companies do not forestall the SNP patents, genomic firms may end up controlling a great portion of the SNP data in humans, which would give them an incredible leverage in the biomedical sector.³⁰⁰ In a worse scenario, the entire sector might have to rely on multiple private databases, with each database asking for monopolistic rent. This situation will not only dramatically increase the costs of biomedical research, but will also place the lifeblood of the sector in the hands of a few genomic companies. Consequently, SNP patents represent a common threat that confronts every pharmaceutical giant.

In addition, if SNP data is withheld by a number of genomic firms, it will be difficult, if not impossible, for the scientific community to complete a SNP map. Even if a SNP map is compiled, without the ability to verify the data held secret by these firms, the map will not obtain the recognition of the scientific community, which in turn will be fatal to its chances of being accepted as a benchmark in clinical trials.³⁰¹ In order to conserve the ideal of personalized medicine and to forestall the threat posed by genomic firms, ten pharmaceutical giants set up the SNP Consortium as a public domain for SNP information. With the sponsorship of the Wellcome Trust, participating drug companies support academic SNP research, publicly disclose genetic discoveries thus reached, and pool these discoveries altogether to form the Consortium.³⁰²

The SNP Consortium demonstrates the whole point made in this section. In facing a menace to their common goals and interests, competing pharmaceutical companies overcame high costs and created a public data pool to preclude SNP patents and to facilitate the exchange of scientific findings.³⁰³ However, under circumstances that lack one of the three preconditions discussed above, it will be arduous to establish or sustain such a license-facilitating institution.

B. EXEMPTIONS

After the *Integra* decision in 2005, a disparity arose between downstream commercialization, which is exempted in this case from infringement liability,³⁰⁴ and upstream research, which still depends on the

²⁹⁹ Langreth et al., *supra* note 181.

³⁰⁰ Wade, *supra* note 183.

³⁰¹ *Id.* In regard to the SNP map, this also a project that is beyond the capabilities of individual companies and thus requires collaboration.

³⁰² Gillis, *supra* note 183; Genetics and Patenting, *supra* note 176; Langreth et al., *supra* note 181.

³⁰³ What is lacking in the SNP Consortium is a repeat game. Pharmaceutical firms may have learned a lesson from the Human Genome Project, which contained a public genomic database primarily maintained by the NIH and the Wellcome Trust.

³⁰⁴ See *supra* note 48.

informal research exception for relief from patent blockages. In effect, upstream research creates more spillover effects and positive externalities than downstream commercialization. From this point of view, an exemption for upstream research is indeed compelling.

1. The European Research Exception Is Not Sufficient

Major jurisdictions around the world frequently adopt a European-style exception for research activities. This exemption originated in Articles 27 (a) and 27(b) of the Convention for the European Patent for the Common Market, more commonly referred to as the Community Patent Convention (CPC).³⁰⁵ The provisions read as follows:

The rights conferred by a Community patent shall not extend to:

- (a) acts done privately and for non-commercial purposes;
- (b) acts done for experimental purposes relating to the subject-matter of the patented invention.³⁰⁶

Although the CPC has not yet taken effect, the European Union states have widely incorporated this exception into their national laws. As Professor William Cornish surveyed in 1998, eleven countries adopted it without modification, including Germany, France, and the United Kingdom.³⁰⁷ Other countries adopted it with certain variations.³⁰⁸ Since 2000, the European Council and European Commission have been working on preparing a Council regulation to establish a community patent system. The research exception has been incorporated into the proposed regulation using the same language as appears in the CPC.³⁰⁹ On the other side of the globe, Japanese patent law provides for a similar exception. It stipulates that “[t]he effects of the patent right shall not

³⁰⁵ Dec. 15, 1975, 15 I.L.M. 5 (1976). These provisions originally appeared in Article 31, until they were renumbered in the amendment of Dec. 15, 1989.

³⁰⁶ *Id.* art. 27(a)-(b).

³⁰⁷ William R. Cornish, *Experimental Use of Patented Inventions in European Community States*, 29 INT’L. REV. INTELL. PROP. & COPYRIGHT L. 735, 735-36 (1998). The other eight countries were Belgium, Denmark, Finland, Greece, Ireland, Italy, Spain, and Sweden.

³⁰⁸ For example, Dutch patent law requires the exempted act “to be solely serving for research on the patented subject-matter.” *Id.* at 736. Portuguese patent law, meanwhile, immunizes from liability only those “acts carried out exclusively for testing or experimental purposes.” *Id.* at 736 n.3.

³⁰⁹ Council Proposal for a Council Regulation on the Community Patent, art. 9(a)-(b), Nov. 21, 2003, available at <http://register.consilium.europa.eu/pdf/en/03/st15/st15086.en03.pdf>.

extend to the working of the patent right for the purpose of experiment or research.”³¹⁰

The experimental prong as represented in CPC Article 27(b) is the core of this exception. As interpretation of this prong has developed in Europe, it has garnered considerable coverage. Every activity that is intended to attain information related to the patented subject matter qualifies as an experiment that fits into the exception.³¹¹ For example, in *Clinical Trials I*, the German Supreme Court confirmed that the sale and distribution of medicine for proving additional medical indications was a suitable candidate for the research exception.³¹² In *Clinical Trials II*, the court ruled that trials in search of unknown side effects do generate information on the patented compounds and thus also fall within the purview of the exception. The court rejected the argument that after basic effectiveness has been established extra testing on drugs is simply for marketing purposes.³¹³ Both decisions have been commended and are expected to be followed in other European Union states.³¹⁴

On the other hand, tests to establish the bioequivalence of generic drugs to their brand-name counterparts yield no new information on the drugs themselves. Most European courts have refused to invoke the exception in this scenario.³¹⁵ Courts have also distinguished qualified cases from unqualified ones, such as those aimed at collecting business information, such as consumer demand for the patented product, or the range of acceptable prices and distribution channels.³¹⁶

Another question is whether the mixed nature of an infringing activity makes it ineligible for the research exception. In *Clinical Trials I* and *II*, the German Supreme Court repeatedly held that the experimental purpose could coexist safely with other purposes, including a commercial intention, and still qualify for the research exception.³¹⁷ In other words, not only can the experiment itself be commercial in nature, but the infringing use is also allowed to fulfill other objectives. What the experiment needs in order to qualify for the exception, then, is a genuine experimental purpose. It does not matter whether the experiment is

³¹⁰ Mueller, *supra* note 5, at 39 (citing Japanese Patent Law of 1959, § 69(1) (as amended May 6, 1998)).

³¹¹ BENTLY & SHERMAN, *supra* note 49, at 543-44; CORNISH, *supra* note 48, at 29; Peter Ruess, *Accepting Exceptions?: A Comparative Approach to Experimental Use In U.S. and German Patent Law*, 10 MARQ. INTELL. PROP. L. REV. 81, 100 (2006).

³¹² Ruess, *supra* note 311, at 98-99.

³¹³ Cornish, *supra* note 307, at 750.

³¹⁴ *Id.* at 751.

³¹⁵ CORNISH, *supra* note 48, at 29 n.60.

³¹⁶ Ruess, *supra* note 311, at 101; *see also* CORNISH, *supra* note 48, at 29 n.60. (citing *Monsanto v. Stauffer* [1985] RPC 515).

³¹⁷ Cornish, *supra* note 307, at 748-50; Ruess, *supra* note 311, at 98-101.

conducted by selling samples to subjects, treating patients, or whether the real, behind-the-scene purpose is to obtain approval for marketing.³¹⁸

Surely some country-by-country differences exist between stipulations of this exception. Not every jurisdiction embraces the private, non-commercial prong as provided in CPC Article 27(a). But that part is a rather limited exemption, which applies primarily to academics doing research, and does not have any bearing on the business world.³¹⁹ In this aspect, it is very similar to the experimental use defense in American common law before *Madey v. Duke Univeisity*.³²⁰ On the other hand, those countries that confine the research exception to activities that “solely” serve research or experimental goals³²¹ do not allow their scientists to enjoy such latitude as discussed above.

The European-style exception does have one major shortcoming: it excludes pure research tools from its purview.³²² This exclusion is derived from the fact that, by definition, scientists do not intend to find anything novel with regard to these research tools. Rather, the tools are used simply to generate new knowledge on the targets of the research.³²³ Given the problems generated by patents for this type of invention, such as delays, costs, and occasional blockages on biomedical research, pure research tools also need an exemption to save them from the stagnated license system that is currently in place.

2. Certain Proposed Exemptions Are Not Sufficiently Comprehensive

American scholars have proposed various types of exemptions as solutions for the anticommons and blockage problems. Rebecca Eisenberg originally suggested a categorical approach, classifying research use of patents into four categories.³²⁴ Infringement liability is exempted when the alleged use is aimed at verifying the validity of the patent, but it remains intact with regard to research tool patents, in order to preserve incentives for their inventors.³²⁵ As for follow-on research on the same subject as the patent, if the end result is an improvement falling within the scope of the original patent, no liability is imposed for using the patent during the

³¹⁸ CORNISH, *supra* note 48, at 30. For an opposing view, see BENTLY & SHERMAN, *supra* note 49, at 544.

³¹⁹ CORNISH, *supra* note 48, at 28-29.

³²⁰ *See supra* text accompanying notes 39-41.

³²¹ *See supra* note 308.

³²² CORNISH, *supra* note 48, at 29 n.61.

³²³ For the definition of pure research tools and their distinction from research targets, see *supra* note 38.

³²⁴ Eisenberg, *supra* note 50, at 1074-78.

³²⁵ *Id.* at 1074-75, 1078.

research.³²⁶ The utilization of the improvement is subject to the patentee's authorization, whether or not the improvement itself receives a patent. If through the original patent, the follow-on research identifies an alternative way to cope with the same technical problem, a reasonable royalty for its use in the research is required, as if a compulsory license had been granted.³²⁷ This proposal suffers from the same deficiency as the European research exception, that is, the exclusion of research tools, especially pure research tools. Given the problem arising from these tools is currently one of the central issues in the biomedical sector, a more inclusive exemption would be preferable to this proposal.

Arti Rai, along with Professor Eisenberg, recently put forth another proposal on this issue.³²⁸ They believe that the NIH should undertake the responsibility of securing the public domain in the biomedical sector. Specifically, they suggest expanding the existing authority of the NIH to retain patent rights arising from publicly funded research.³²⁹ They also suggest that when the NIH "marches in" and requires the patentee to license the patent for the purpose of achieving practical applications, such as alleviating public health or safety concerns, or fulfilling legally required public use,³³⁰ the NIH's order should take effect immediately upon issuance, rather than being held in abeyance pending exhaustion of legal appeals. This resolution is limited and depends on the discretion of the NIH in exercising its authority on a case-by-case basis. In the past, the NIH has refused to exert its march-in rights, such as in the *CellPro* case.³³¹ Given the NIH's reluctance, to date, to use its statutory authority to interfere with the ownership and licensing of biomedical patents, this approach should be a last resort, for use only in the most egregious situations.

Maureen O'Rourke suggests a fair use exception to the exclusive rights of patents in order to settle the problem of research use.³³² Modeled after a similar exception that exists in copyright law, Professor

³²⁶ *Id.* at 1076-78.

³²⁷ *Id.* According to the definition adopted in this Article, however, research inputs that are not embodied in the end result are research tools, including those technologies that are used in inventing or designing around themselves.

³²⁸ Rai & Eisenberg, *supra* note 148, at 310-11.

³²⁹ 35 U.S.C. § 202(a)-(b)(1) (2000 & Supp. 2003).

³³⁰ *Id.* § 203.

³³¹ Nat'l Inst. Health, Determination in the Case of Petition of CellPro, Inc., Aug. 1, 1997, available at <http://www.nih.gov/news/pr/aug97/nihb-01.htm>. A search of the Westlaw database, conducted on December 24, 2006, yielded no administrative or court decisions in which the U.S. government was asserting march-in rights against public-funded patentees.

³³² Maureen A. O'Rourke, *Toward a Doctrine of Fair Use in Patent Law*, 100 COLUM. L. REV. 1177, 1205-11 (2000).

O'Rourke's proposal is a five-factor test for the fair use exception. The factors are: (i) the nature of the technical advance made by the infringing use; (ii) the purpose of the infringing use; (iii) the nature and strength of market failures in licensing; (iv) the impact on innovation incentives and overall social welfare; and (v) the nature of the patented invention. These factors not only determine whether the research use will be permitted without a relevant license, but they also determine whether or not a reasonable royalty will still be required. In comparison to copyrights, patents are more commodified and have less bearing on freedom of expression. A royalty-collecting mechanism is also easier to establish for patents. Thus, positive grounds exist for imposing royalties on already permitted uses. On the other hand, if a use generates positive externalities, or if in an individual case the royalty requirement inherently conflicts with the goals of patent law, such as encouraging innovation and disclosing claimed inventions, it would be inappropriate to allow patent owners to stake a claim for reasonable royalties.

On balance, the fair use exception as proposed above is highly fact dependent. Furthermore, with five convoluted factors to consider and two rounds of judgment—freedom of operation and royalty—this proposal is full of ambiguity and uncertainty. It is difficult to predict outcomes when applying this exception to real-life scenarios. In the realm of biomedical research, factor (ii) counts against commercial research,³³³ while factor (iii) may weigh in favor of research use under the status quo. But if courts think of factor (iii) as the Second Circuit Court of Appeals did in *American Geophysical Union v. Texaco Inc.*,³³⁴ where the court ruled that as long as there is a channel for securing voluntary licenses, the unauthorized use will not be privileged, then this factor will turn against research use.

Factor (iv) is the most important, yet also the most unpredictable factor in the fair use proposal. Research tools provide a good illustration. An exemption for research use will erode the primary market for research tools and adversely impinge upon the incentives for their innovation. Meanwhile, research activities have significant spillover effects and are now suffering from stagnated license negotiations, which conversely weighs in favor of an exemption. It is thus difficult to tell which side factor (iv) will ultimately support.

The most unique proposal to date is from Rochelle Dreyfuss, who contemplated an opt-in exemption.³³⁵ According to her suggestion, if independent researchers sign a waiver in advance, thereby promising to publish their findings instantly and abandoning the right to apply for

³³³ *Id.* at 1206.

³³⁴ 60 F.3d 812 (2d Cir. 1995).

³³⁵ Rochelle Cooper Dreyfuss, *Varying the Course in Patenting Genetic Material: A Counter-Proposal to Richard Epstein's Steady Course*, in PERSPECTIVES ON PROPERTIES OF THE HUMAN GENOME PROJECT, *supra* note 137, at 195, 204-08.

patents on their discoveries, the researchers can instead receive a free pass to use patents in their research. This exemption also seems to be a highly limited one. Scientists may be unwilling prior to their research even beginning to rule out future possibilities for commercializing their discoveries, just to secure this exemption. Moreover, this proposal is intended only for scientists performing basic research for non-commercial purposes.³³⁶ Patents, however, are fundamental to commercial research, which requires the exclusive rights to avoid free-riding and to preserve the market for its outcomes. The no-patent requirement will prevent commercial researchers from making use of this exemption. Compared to pure academic research, commercial research makes an equally important contribution to society and also suffers from the same blockage problem. Although commercial researchers have more resources and a greater willingness to negotiate licenses, upstream patentees usually ask for various kinds of reach-through rights that downstream pharmaceutical companies are repulsed by.³³⁷ Assuming that the quantity of patents now involved in biomedical research is still sustainable for businesses, research targets are, to a large extent, under the strict control of patentees, and thus making it difficult to secure a license.³³⁸ Therefore, commercial research also needs an exemption in order to overcome the blockage problem.

All in all, these proposals have similar shortcomings. The scope of the proposed exemptions is either too limited or yields unpredictable results. One of the resolutions excludes research tools from its coverage. Though others cover these tools, the extent of their coverage is quite limited. The O'Rourke proposal is the most inclusive, but the boundaries and outcomes of the fair use exemption are uncertain. Except for certain aspects of the exemptions proposed by Eisenberg and O'Rourke, no royalties are required for privileged use, and this feature may undermine the incentives for innovation that the patent system is aimed at providing in the first place. The Dreyfuss proposal excludes commercial research, and the O'Rourke recommendation faces the same pitfall. Because of these deficiencies, the proposed resolutions are not comprehensive enough to deal with the blockage problem now confronting the biomedical sector.

VI. COMPULSORY LICENSES BEARING REACH-THROUGH ROYALTIES

As explained in Section IV.D, the informal research exception is now essential for biomedical research. And with the exception being so important and indispensable, there is no reason for it to remain informal. Keeping it informal creates uncertainty and vulnerability to attacks from those outside the biomedical sector.³³⁹ A compulsory license system

³³⁶ The waiver system is designed for scientists to identify themselves as basic researchers and opt in the exemption. *Id.* at 204-05.

³³⁷ See *supra* text accompanying notes 49-50.

³³⁸ See *supra* Subsection IV.C.1 for details.

³³⁹ See *supra* text accompanying notes 253-263. Cf. Weschler, *supra* note 250, at 1566-69

charging reach-through royalties, however, could fortify the advantage of the existing informal exception, alleviate the blockage problem, and streamline the process of royalty negotiations.

A. THE PROPOSAL

The idea of a research exemption charging reach-through royalties was originally proposed by Janice Mueller.³⁴⁰ This Article modifies her resolution and further elaborates on it in creating the present proposal. Under the proposal set forth in this Article, independent researchers are exempted from liability for employing unauthorized inputs that they request during the course of the scientific investigation. Correspondingly, they bear an obligation to submit royalties, as if the law automatically and compulsively granted a license. The royalty obligation arises when their research achieves certain outcomes or otherwise comes to an end.³⁴¹ This royalty is determined in a reach-through way, based on the contributions that respective research inputs make to the commercial value of the research result. When the research yields no specific outcome, a reasonable royalty can be assessed in the way that is currently followed by the courts. Under this method, the amount of royalties is gauged based on the market price of the infringing research inputs, without taking into account the value of the downstream products that are made with these inputs.³⁴²

Compared to the normal licensing procedure, this resolution shifts royalty negotiations from *ex ante* to *ex post*. When the payment obligation arises at the end of the research, independent researchers must notify the patentees whose inventions were used in order to negotiate an agreement with those who desire royalties for the use of their invention for an adequate amount of reimbursement. If the parties cannot reach a consensus, the patent owners can file a lawsuit to recover royalties for the amount as calculated by the methods outlined above.

(asserting that notwithstanding this fact, university research systems will not collapse for lack of a formal research exemption).

³⁴⁰ Mueller, *supra* note 5, at 58-66. Katherine Strandburg has also proposed a compulsory license system. She divides the patent term into two periods. In the first period—three to five years after the patent is initially granted—the patentees retain full exclusivity over the claimed inventions, as vested by current law. During the rest of the patent term, however, compulsory licenses are available in order to alleviate the delays that research tool patents may pose to follow-on innovations. *See* Strandburg, *supra* note 73, at 142-46.

³⁴¹ For research that generates specific outcomes, the timing of the royalty payment can be determined using the rule for the statutory “on-sale” bar. *See* 35 U.S.C. § 102(b) (2000). For the current rule regarding use of the “on-sale” bar, see *Pfaff v. Wells Electronics, Inc.*, 525 U.S. 55 (1998).

³⁴² *See* *Georgia-Pacific Corp. v. United States Plywood Corp.*, 318 F. Supp. 1116 (S.D.N.Y. 1970), *modified and aff’d sub nom.* *George-Pacific Corp. v. United States Plywood-Champion Papers Inc.*, 446 F.2d 295 (2d Cir. 1971).

In order to keep the total amount of royalties within a reasonable limit and to ensure a fair distribution between various patentees, independent researchers would enjoy a counteracting right to interpleader, which requires that all notified patentees participate in the litigation, or else lose their claim to the royalties for good.³⁴³ In view of both preserving the incentives for downstream innovation and assigning adequate credit to independent researchers for the discoveries they make, a ceiling should be placed on the total volume of royalties attributed to research inputs, to be determined on a case-by-case basis. Thus, the royalties as a whole share the essential feature of those that qualify for an interpleader proceeding, which are normally intended to reach a coherent conclusion on the attribution or distribution of a limited resource before one of the contending claimants achieves recourse, in whole or in part, through litigation.³⁴⁴ The ceiling on royalties is nonetheless not as clearly fixed as the boundaries of a physical asset or a specific monetary amount. Hence, interpleader might be inapplicable to these royalties.³⁴⁵ Yet considering that defendants in a royalty litigation are confronted with a situation similar to that of defendants in interpleader—namely, facing multiple contending claims for a limited fund—it would be advisable to include a clause in the patent statute to facilitate independent researchers' use of interpleader.

The compulsory license system as outlined above would not sabotage voluntary licensing. Rather, the automatic license is a waivable right of independent researchers. Pursuant to mutually agreed upon terms and conditions, independent researchers can abandon this right and pay instead either lump-sum royalties before the research gets started, or else divide the royalties into milestone payments made to the patentees over the course of the research. The royalties determined by the parties can also be calculated in a way other than the reach-through formula. The waiver mechanism may encourage patentees to accelerate the *ex ante* negotiation process and to eliminate the unnecessary requirements of reach-through rights, in order to strike a deal with independent researchers for the purpose of acquiring early profits. On the side of independent researchers, pharmaceutical companies prefer paying royalties upfront.³⁴⁶ This inclination matches the incentives that the waiver mechanism generates on the side of patentees and also promotes voluntary licensing prior to the beginning of the research. In turn, biotechnology companies may benefit from the timely cash flow, as their working funds run low from time to time due to the lack of instant revenue from research tool inventions.

³⁴³ Thanks to Professor Kevin Emerson Collins for inspiring me to design a mechanism for interpleader.

³⁴⁴ *See, e.g.*, *State Farm Fire & Casualty Co. v. Tashire*, 386 U.S. 523, 533-34 (1967); *see also* SAMUEL ISSACHAROFF, *CIVIL PROCEDURE* 65-66 (2005).

³⁴⁵ *State Farm*, 386 U.S. at 536.

³⁴⁶ *See supra* text accompanying note 143.

From the waiver system there derives a practical limitation on the resolution. To make use of patented research inputs, independent researchers may sometimes need certain equipment, materials, or technical guidance from the patentees. When this situation occurs, the patentees can request a waiver of the automatic license in exchange for providing these necessary articles or information. A mandatory transfer of these items may amount to a taking, which according to the Constitution may only be done for the purpose of “public use.”³⁴⁷ A research use, though likely to result in great benefits to the public, may not necessarily constitute a public use. In actuality, however, this limitation is aligned with the current practice of biomedical research and would not be a drawback to this proposal. Scientists usually pay for experimental equipment and chemical reagents, securing the necessary license before they begin using the inventions embodied in those objects.³⁴⁸

There is a notable difference between this proposal and Professor Mueller’s. My proposal finds it unnecessary to require independent researchers to notify patentees of their use of the claimed research inputs at the outset of the research.³⁴⁹ Upstream patentees in the biomedical sector are usually interested in developing downstream innovations by themselves or through their exclusive licensees so as to forge their own blockbuster products.³⁵⁰ Given the concerns of independent researchers about competition with upstream patentees in the downstream market, requiring prior notification would not be practical for these researchers and would drive them away from the compulsory license system. The reluctance of independent researchers may turn the entire system into a dead letter and reinstate the informal research exception. Although in Mueller’s plan, independent researchers do not need to reveal details of their research in the notification,³⁵¹ this adjustment cannot effectively eradicate the competition concerns resulting from prior notification. After all, the last thing that a research enterprise wants is to give a signal to competitors about its business plans before the enterprise is prepared to carry them out on the market.

B. ANALYSIS

The primary advantage of this proposal is that it retains the use-as-needed feature of the informal research exception. Independent researchers can use whatever inputs they need for their research, whenever

³⁴⁷ U.S. CONST. amend. V.

³⁴⁸ Commentators used to exclude experimental equipment and chemical reagents from the coverage of research exemption. *See, e.g.,* Mueller, *supra* note 5, at 58; Strandburg, *Experimental Use, supra* note 73, at 131.

³⁴⁹ *Cf.* Mueller, *supra* note 5, at 58-59.

³⁵⁰ *See supra* text accompanying notes 121–122.

³⁵¹ Mueller, *supra* note 5, at 59.

they have to, without prior authorization. This characteristic allows scientists to avoid the blockages that patentees may impose on research targets in order to control the follow-on innovation of these upstream discoveries. By preserving the key element of the informal exception that is currently in place, this proposal would keep possible progress that a new exemption scheme might bring to the biomedical research community to the least extent.

The use-as-needed feature can also help avoid the delays and excessive costs incurred by protracted license negotiations for pure research tools.³⁵² At the same time, by adopting the reach-through approach, this resolution will not diminish the royalties that are enjoyed by patentees. In essence, the proposal simply institutes a time-shifting scheme that postpones the royalty payment, but simultaneously streamlines the license procedure and prevents stagnation in negotiations.

This ex post reach-through method for determining royalties provides the parties involved with an excellent basis upon which to estimate the real value of the research inputs. With a concrete outcome in hand and the ability to look forward together to the future market, independent researchers and input patentees are more likely to feel that they are in the same boat and share similar perspectives, which is helpful in harmonizing their heterogeneous interests. The research outcomes may also contribute to correcting their cognitive biases and alleviating the difficulty of assessing the value of research intermediates.³⁵³ These virtues will greatly reduce the chances that the breakdowns, delays, and costs of license negotiations will continue to impact the progress of biomedical science.

Reach-through royalties are common in contemporary licensing practices. To date, this method for calculating reasonable royalties has not been officially recognized by the law or the judicial system.³⁵⁴ By introducing the reach-through approach into current patent law, this proposal calibrates the amount of royalties to the actual value of the patented research inputs utilized in individual projects. It may provide more compensation to inventors than an upfront lump-sum royalty does when the research inputs help to accomplish invaluable findings. This feature also amplifies the incentives for researchers to engage in more challenging and more fruitful investigations that are aimed at the scientific upstream. The calibration of royalties should not be considered as an

³⁵² For an analysis of the problems currently happening with biomedical patent licensing, see *supra* Section IV.C.

³⁵³ For a discussion of the difficulties and transaction costs that are now arising in license negotiation, see *supra* Subsections III.C.1–4.

³⁵⁴ Eisenberg, *supra* note 137, at 217; Donald R. Ware, *Research Tool Patents: Judicial Remedies*, 30 AIPLA Q.J. 267, 281–82 (2002). In *Integra Lifesciences I, Ltd. v. Merck KGaA*, 331 F.3d 860, 871 (Fed. Cir. 2003), *rev'd on other grounds*, 545 U.S. 193 (2005), the Federal Circuit indicated that “this court does not opine on the applicability of a reach-through royalty in this case.”

example of pernicious royalty stacking. The value of research inputs, especially research tools not embodied in final products, lies primarily in their contribution to the proceedings and the outcomes of the research. This proposal uses the same logic as the current judicial approach to calculating the reasonable royalties, which is based principally on the proportion of net profits attributable to the patents at bar from the infringing products. The quality of calibration also separates reach-through royalties from other types of reach-through rights, which leverage the exclusivity of upstream patents to downstream markets, enabling patentees to control follow-on development and likely amounting to patent misuse or antitrust violations.³⁵⁵

Although the feature of ex post negotiation might make the cost of doing upstream research appear uncertain when the research begins, the real situation is quite the opposite. By shifting the negotiation from ex ante to ex post, the compulsory licensing scheme is pretty much like a distribution system, apportioning the value of innovation that is created by the research to individual patentees. If the research does not come to any valuable result, the contribution of individual inputs to the research would diminish accordingly. The researchers thus do not need to worry about the royalties that would be charged at end of the research. Even if this arrangement did generate some degree of uncertainty, considering the high transaction costs and difficulties in ex ante negotiations, this concern may still be less significant.

Another virtue of the proposal is that it preserves competition. As indicated in Section IV.D, the informal exception is vulnerable to aggressive patent enforcement. Should the informal exception collapse, independent research, including inventing- and designing-around, could be sabotaged, and competition in technological innovation and downstream products would be seriously constrained. This is not a scenario that patent law would like to experience.

In a few cases, the Federal Circuit has acknowledged the significance of the competition brought about by independent research. The endeavors of inventing and designing around, which are aimed at finding alternatives to patented inventions and competing with them, have long been encouraged by the patent system.³⁵⁶ In *State Industries, Inc. v. A.O. Smith Corp.*,³⁵⁷ the defendant did not successfully design around and

³⁵⁵ John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 461 (1997).

³⁵⁶ See, e.g., *London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1538 (Fed. Cir. 1991); *Slimfold Mfg. Co. v. Kinkead Indus., Inc.*, 932 F.2d 1453, 1457 (Fed. Cir. 1991); *Yarway Corp. v. Eur-Control USA*, 775 F.2d 268, 277 (Fed. Cir. 1985); *Kimberly-Clark Corp. v. Johnson & Johnson*, 745 F.2d 1437, 1457-58 (Fed. Cir. 1984); CHISUM ET AL., *supra* note 54, at 71.

³⁵⁷ 751 F.2d 1226 (Fed. Cir. 1985); see also *Westvaco Corp. v. Int'l Paper Co.*, 991 F.2d 735, 745 (Fed. Cir. 1993) (citing *State Industries* with approval).

was further held to be infringing. In explaining the reason why enhanced damages were not adequate in this situation, the court pointed out that

[o]ne of the benefits of a patent system is its so-called “negative incentive” to “design around” a competitor’s products, even when they are patented, *thus bringing a steady flow of innovation to the marketplace*. It should not be discouraged by punitive damage awards except in cases where conduct is so obnoxious as clearly to call for them. *The world of competition is full of “fair fight,” of which this suit seems to be one.*³⁵⁸

In *Read Corp. v. Portec, Inc.*,³⁵⁹ after summarizing the famous nine factor test for assessing the proper amount of enhanced damages, Chief Judge Nie incorporated the competition concern into the fundamental question of damage enhancement: the willful nature of the infringement.³⁶⁰ By looking hard at the plaintiff’s side of the case regarding the counsel opinion issue, Judge Nie allowed more leeway for independent researchers to design or invent around. Had the defendants requested and received a counsel opinion as to whether their new designs, which competed with patented products, would infringe the plaintiffs’ patents, they would have avoided the punishment of enhanced damages, assuming the opinion was not evidently incompetent and that the defendants relied on it in good faith.³⁶¹ Moreover, only those counsel opinions that comment on the design at issue count towards damage calculation. Opinions that are given before the specific design comes forward are irrelevant to the assessment of enhanced damages.³⁶² Later on, in an en banc case, the Federal Circuit continued to make clear that an opinion from patent attorneys was not required for defendants to avoid enhanced damages.³⁶³ The leniency that the court demonstrated towards designing-around indicates its appreciation for the competition that independent research generates in the development of science and technology.³⁶⁴

³⁵⁸ *State Industries*, 751 F.2d, at 1236 (emphasis added).

³⁵⁹ 970 F.2d 816 (Fed. Cir. 1992).

³⁶⁰ *Id.* at 828 (citing *Slimford Mfg.*, 932 F.2d at 1457 and *State Industries*, 751 F.2d. at 1235-36).

³⁶¹ *Id.* at 830.

³⁶² *Id.* at 829-30.

³⁶³ *Knorr-Bremse Systeme Fuer Nutzfahrzeuge GmbH v. Dana Corp.*, 383 F.3d 1337, 1345–46 (Fed. Cir. 2004) (en banc).

³⁶⁴ Restricting enhanced damages in designing around bears a resemblance to the situation of contractual breaches. No punitive damages are granted for breach of contract, except when tortious behavior is present, for which punitive damages are available under tort law; RESTATEMENT (SECOND) OF CONTRACTS § 355 (1981). The rationale behind this conservative attitude is the idea of efficient breach. Oftentimes,

In addition, this proposal materializes the primary goal of the disclosure requirement. The requirement would be in vain if independent researchers could only read about the inventions in patent documents, but were not allowed to examine their efficacy and validity in the real world. Providing incentive to invent or to design around earlier inventions is one of the main justifications for the patent system.³⁶⁵ Without practicing the inventions, scientists may not be able to fully grasp their teachings and effectively utilize the scientific breakthroughs that the inventions have brought about. The proposal here may cure the paradox between disclosure and exclusivity in patent law, therefore enhancing the function of the disclosure requirement. At the same time, this proposal would not materially decrease the incentives for new technologies and scientific findings.

For initiatives that attempt to adjust patent protection in this way, the greatest challenge comes for the impact on innovation incentives. This concern, however, is not implicated in this proposal. On the whole, this proposal will not decrease the incentive level from the status quo. Rather, it tailors the incentives to the actual contribution the inventions make to each individual research endeavor. Furthermore, even under the status quo, the incentive level for biomedical research inputs is not as high as it is in other fields. For research inputs that require additional equipment, materials, or know-how from the patentees, independent researchers have to obtain the patentees' cooperation. Voluntary licensing is hence the most probable result of this scenario. For research inputs that do not need the patentees' cooperation, independent researchers might make use of the inputs without the knowledge of patentees. Should patentees detect such use, the informal exception would for the most part, shield academic researchers from patent infringement liability. Although enforcement would occur in certain scenarios, the damages that are awarded in infringement litigation might not be particularly munificent. For example, in *Embrex Inc. v. Service Engineering Corp.*,³⁶⁶ a non-biomedical case, the Federal Circuit determined that \$500,000 in direct damages was excessive

breach of contract is efficient and benign for the economy as a whole. *See* 3 E. ALLEN FARNSWORTH, FARNSWORTH ON CONTRACTS § 12.3, at 157–61 (3d ed. 2004). In the same vein, specific performance is frequently unavailable as a remedy for contract violations. Monetary damages are usually considered adequate for protecting expectation interests; RESTATEMENT (SECOND) OF CONTRACTS §§ 357, 359(1), 359(3), ch. 16 introductory note (1981). Thus, monetary damages are the most frequent remedy for breach of contract. The approach and rationale is analogous to the compulsory license system, where the only remedy for the exempted research use is reasonable royalties. *Cf.* Epstein, *supra* note 228, at 175-79 (criticizing unilateral breach of contract in light of its crippling effects).

³⁶⁵ See *supra* text accompanying note 54.

³⁶⁶ 216 F.3d 1343 (Fed. Cir. 2000).

for the infringement at issue, as it occurred only at the research and development stage.³⁶⁷

The compulsory license system proposed here provides a more fruitful alternative to the status quo. Through its time-shifting design, the new resolution saves the costs that both parties would spend in protracted ex ante negotiations. In the ex post negotiations created by this proposal, it is much easier for the parties to bridge the gap between their interests and come to an agreement on the amount of royalties that reflects the value of the patents in individual research. In addition, incentives for innovation come with costs.³⁶⁸ If there is no compulsory license or any kind of exemption in place for research use, patentees will have the right to block independent research through injunctive relief. Biomedical outsiders such as DuPont and patentees of genetic tests would assertively enforce their injunctive right and cause the fall of the informal exception.³⁶⁹ This would give biomedical patentees a controlling position over the development of science, decrease the competition for novel discoveries, and consequently slow down the progress of biomedical science.³⁷⁰

A common drawback to compulsory license systems is the difficulty independent entities have in determining an appropriate license fee for the patentees and patent users involved in specific cases.³⁷¹ This proposal, however, does not give rise to the same defect. Through its time-shifting arrangement, this proposal mitigates the transaction costs incurred in license deals by moving the negotiations to a later, but better time that allows both parties to evaluate the research inputs objectively. These features facilitate, rather than displace, voluntary negotiations. Compulsory licenses spare independent researchers from infringement liability, and might take away part of the incentives for these researchers to strike an agreement with patentees. Still, this proposal sets up an obligation to provide royalty payments at the end of the research. The clear stipulation of such payments would let the informal research exception fade away and thus boost scientists' willingness to negotiate royalties—a quality of this proposal that is unique in the realm of compulsory license systems.

C. OBSTACLES IN INTERNATIONAL PATENT LAW

The proposed resolution does not face much difficulty fitting in with U.S. patent laws. The condition is nonetheless quite different in the international arena. The compulsory license system may encounter legal

³⁶⁷ *Id.* at 1340-50.

³⁶⁸ *See supra* text accompanying notes 65, 67.

³⁶⁹ *See supra* text accompanying notes 264-267.

³⁷⁰ For the negative impact of restricting competition on scientific progress, see *supra* Subsections III.B.4-5, and Section IV.C.

³⁷¹ *See, e.g.,* Epstein, *supra* note 228, at 177-78.

obstacles in the TRIPS Agreement of the WTO,³⁷² an international intellectual property agreement with comprehensive membership and an effective enforcement mechanism.³⁷³ The agreement lays out extensive patent protection requirements for WTO members and contains several impediments to solutions similar to this proposal.³⁷⁴

Article 27 of the TRIPS Agreement requires that patents shall be available for inventions in all fields of technology except for, inter alia, “plants and animals other than micro-organisms, and essentially biological processes for [their] reproduction . . . other than . . . microbiological processes.”³⁷⁵ Though the proviso originates from Article 53(b) of the European Patent Convention (EPC), which excludes “plant and animal varieties” from its subject matter, the disparity between the above language arguably allows for a reading of the TRIPS Agreement that excludes something more than “plant and animal varieties” from the list of subject matters for which patents have to be available in member economies.³⁷⁶ Even so, it is still unclear whether this proviso applies to biomedical upstream inventions, which seldom, if ever, cover a whole animal.³⁷⁷ Nonetheless, given the fact that upstream inventions such as DNA sequences are usually treated as chemical compounds in the patent offices of WTO members, perhaps this proviso would not stretch so far as

³⁷² Agreement on Trade-Related Aspects of Intellectual Property Rights, available at http://www.wto.org/english/docs_e/legal_e/27-trips.pdf [hereinafter TRIPS].

³⁷³ Rochelle Cooper Dreyfuss & Andreas F. Lowenfeld, *Two Achievements of the Uruguay Round: Putting TRIPS and Dispute Settlement Together*, 37 VA. J. INT'L L. 275, 276-77 (1997).

³⁷⁴ Professor Mueller downplays this problem, only mentioning the requisite condition of bargaining breakdowns for compulsory licenses. See Mueller, *supra* note 5, at 58 n.283 (referring to TRIPS Art. 31(b)). She found her proposal to be in compliance with that limitation. *Id.*

³⁷⁵ TRIPS art. 27(3)(b).

³⁷⁶ For similar views, see Joseph Straus, *Implications of the TRIPS Agreement in the Field of Patent Law*, in FROM GATT TO TRIPS—THE AGREEMENT ON TRADE-RELATED ASPECTS OF INTELLECTUAL PROPERTY RIGHTS 160, 184-85 (Friedrich-Karl Beier & Gerhard Schrickler eds., 1996).

³⁷⁷ There is still no settled definition in patent law for “microorganisms,” an exception to this proviso. As construed in some member economies, the term denotes any cellular life form and sub-cellular biological elements. It can also be interpreted as simply embracing “bacteria, fungi, algae, protozoa or viruses.” CARLOS M CORREA, INTELLECTUAL PROPERTY RIGHTS, THE WTO AND DEVELOPING COUNTRIES: THE TRIPS AGREEMENT AND POLICY OPTIONS 67–68 (2000). In its patent examination guidelines, the Japanese Patent Office adopted a third definition that includes “yeasts, molds, mushrooms, bacteria, actinomyces, unicellular algae, virus, protozoa, etc. and further includes undifferentiated animal or plant cells as well as animal or plant tissue cultures.” Provisional Translation—Implementing Guidelines for Inventions in Specific Fields, http://www.jpo.go.jp/tetuzuki_e/t_tokkyo_e/txt/bio-e-m.txt (last visited Nov. 7, 2005) (referred to in the section “2. Microorganisms”).

to release them from the mandatory patent coverage of the TRIPS Agreement.³⁷⁸

The TRIPS Agreement erects extensive regulation on compulsory licenses in Article 31. A categorical compulsory license system will violate paragraph (a), which stipulates that “authorization of such use shall be considered on its individual merits.”³⁷⁹ In other words, compulsory licenses shall be examined and granted on a case-by-case basis.³⁸⁰ This provision is meant to forestall the automatic license system, such as the one that appears in Indian patent laws for foods and pharmaceuticals.³⁸¹ Accordingly, the categorical licensing system as proposed above is not compatible with this provision.

TRIPS Article 31 is titled “Other Use Without Authorization of the Right Holder.” Footnote 7 further defines the “other use” as a “use other than that allowed under Article 30.”³⁸² From this perspective, Article 30 seems to be another possible ground for this proposal. Article 30 is a very vague provision governing various kinds of exceptions found in domestic patent laws. The core of this Article is a three-part test, which requires domestic exceptions to be (1) “limited exceptions”; (2) “not unreasonably conflict[ing] with a normal exploitation of the patent”; and (3) “not unreasonably prejudic[ing] the legitimate interests of the patent owner, taking account of the legitimate interests of third parties.”³⁸³

According to the interpretation handed down in the panel report of *Canada—Pharmaceutical Patents* case³⁸⁴—the only WTO dispute settlement decision thus far on Article 30—for an exception to be limited, it must be “only a narrow curtailment of the legal rights” bestowed on patentees.³⁸⁵ As a result, there have to be significant limitations and tight boundaries on each exception to exclusive patent rights. It is hard to discern whether or not the all-inclusive proposal is narrow enough. On the one hand, it is confined to research and commercialization only. On the other hand, all research inputs are subsumed to the comprehensive scheme

³⁷⁸ Charles R. McManis, *Patenting Genetic Products and Processes: A TRIPS Perspective*, in PERSPECTIVES ON PROPERTIES OF THE HUMAN GENOME PROJECT, *supra* note 137, at 79, 85–93; Rai, *Reply*, *supra* note 161, at 711.

³⁷⁹ TRIPS art. 31(a).

³⁸⁰ See CORREA, *supra* note 377, at 93.

³⁸¹ JAYASHREE WATAL, INTELLECTUAL PROPERTY RIGHTS IN THE WTO AND DEVELOPING COUNTRIES 322–33 (2001) (arguing that the automatic feature only exists on the face of the law, not in actual practice).

³⁸² TRIPS art. 31 n.7.

³⁸³ TRIPS art. 30.

³⁸⁴ Panel Report, *Canada—Patent Protection of Pharmaceutical Products*, WT/DS114/R ¶ 7.69 (Mar. 17, 2000), available at <http://docsonline.wto.org/DDFDocuments/t/WT/DS/114R.DOC>.

³⁸⁵ *Id.* ¶ 7.44.

of compulsory licensing, though compensation from reach-through royalties.

For the second prong of the test, a qualified exception must not affect the right of the patentees to exclude “competition that could detract significantly from the economic returns anticipated from a patent’s grant of market exclusivity.”³⁸⁶ If the emphasis here is on the ability to control the market, given the fact that research use is the primary market for research tools, no matter how rewarding the royalties would be, the resolution will fail this part of the test. Specifically, failure will result because the resolution opens up the opportunity for independent researchers to break away from patentees and make use of the claimed inventions on their own.

Finally, for the third prong of the test, the panel mentioned in dictum that “both society and the scientist have a ‘legitimate interest’ in using the patent disclosure to support the advance of science and technology.”³⁸⁷ Since one merit of this proposal is that it makes full use of technical disclosure in patents to facilitate the development of biomedical science, it might pass the last prong. The three-part test, however, is a cumulative criterion. For a specific exception to survive the test, it must satisfy each of the three prongs.

In summary, it is hard to tell whether or not this proposal will fulfill the three-part test embedded in Article 30. From a systemic point of view, however, if Article 30 is read to provide a justification for compulsory license schemes, the twelve paragraphs of restrictions on the same schemes in Article 31 will turn out to be meaningless. Consequently, although this proposal is an adequate resolution for the current problems caused by upstream patent proliferation, there may be no room for it in the TRIPS Agreement.

VII. CONCLUSION

This Article identifies deficiencies of existing patent laws in the realm of biomedical science and provides a viable resolution for the problems that arise as a result. A compulsory license system charging reach-through royalties is a desirable approach for coping with the blockage problems created by the proliferation of upstream biomedical patents. Nevertheless, the proposed resolution would be frustrated by the TRIPS Agreement. This dilemma demonstrates the rigidity of existing patent systems, both domestically and internationally. At the national level, this proposal faces a difficult fight against the biotechnology industry, a group of upstream patent owners.³⁸⁸ At the international level,

³⁸⁶ *Id.* ¶ 7.55.

³⁸⁷ *Id.* ¶ 7.69.

³⁸⁸ A patent reform bill seeking to decrease the strength of patent protection has failed at least twice in Congress, but was reintroduced in 2007. John Bringardner, *Problems*

the proposed transformation might be even tougher. Judging by the past experiences of deliberation on amendments to the TRIPS Agreement,³⁸⁹ the task is very difficult and protracted, even for issues possessing a high consensus among member economies.

Another possible way of fulfilling the resolution is re-construing Article 30. At the moment, however, the WTO dispute settlement system is under fire for its alleged over-aggressiveness.³⁹⁰ Thus, it would be advisable for the Organization to leave big transformations, like reconstruing Article 30, to its decision-making branches, such as the Ministerial Conference or the General Council.³⁹¹ These obstacles exemplify how stubborn the existing patent system is and how its inflexibility can harm both the system and the progress of science. Removal of the impediments to progress and regaining the latitude for reform thus ought to be the first step taken towards improving our patent system.

with the Patent System: Nothing Cash Can't Cure, IP L. & Bus., Apr. 24, 2007, available at <http://www.law.com/jsp/article.jsp?id=1176887056916>.

³⁸⁹ The only amendment to the TRIPS Agreement, Article 31*bis*, partially waives the requirement of Article 31(f) that compulsory licenses shall be predominantly used in supplying the domestic market, allowing the export of pharmaceuticals in order to defuse public health crises arising in member economies that lack sufficient manufacturing capacities. TRIPS arts. 31(f), 31*bis*.

³⁹⁰ In fact, Robert Howse posits that the dispute settlement system has become “the most dangerous branch.” Robert Howse, *The Most Dangerous Branch? WTO Appellate Body Jurisprudence on the Nature and the Limits of the Judicial Power*, in *THE ROLE OF THE JUDGE IN INTERNATIONAL TRADE REGULATION: EXPERIENCE AND LESSONS FOR THE WTO 11* (Thomas Cottier & Petros C. Mavroidis eds., 2003).

³⁹¹ Claus-Dieter Ehlermann, *Six Years on the Bench of the “World Trade Court”: Some Personal Experiences as Member of the Appellate Body of the World Trade Organization*, 36 J. WORLD TRADE 605, 632–39 (2002); Claus-Dieter Ehlermann, *Tensions between the Dispute Settlement Process and the Diplomatic and Treaty-Making Activities of the WTO*, 1 WORLD TRADE REV. 301 (2002).