What Does the Public Get? Experimental Use and the Patent Bargain

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INTRODUCTION

We award patents, as the Constitution requires, “To promote the Progress of... useful Arts.”1 Patents are intended to provide incentives to invest in research and development, but they can also make it more difficult to build on the inventions of others. The difficulty may arise either because an improved invention still falls within the claims of a prior patent, necessitating a license from the prior patentee for implementation of the improvement or, as is the focus of this Article, because the research and development process for a new invention requires the practice of a prior patent. In such cases, there has been considerable concern that prior patentees may be unwilling to license the experimental use of their inventions on reasonable terms to potential competitors. An experimental-use exemption from infringement liability might be used to skirt such prior patentee reluctance, but such an exemption raises another specter—the possibility that depriving patentees of control over the research uses of their inventions might diminish incentives to invest in developing the initial invention.

A recent Federal Trade Commission (FTC) report that was based on extensive hearings into the effects of the patent system on competitiveness concluded that an experimental-use defense was favored by scholarly analysis and the participants in the hearings when experiments on an invention were merely aimed to “see how or if it

The report concluded, however, that an experimental-use exemption for use of a patented invention as a research tool to investigate another subject was “problematic” and found “no basis” for such an exemption. With respect to experimentation directed toward improving a patented invention, the report concluded that “the ideal balance” between the potential effects of an experimental-use exemption on the pace of follow-on innovation and the effects on the incentives of primary inventors was “unclear” and made no recommendation.

This Article contends that there are general reasons to believe that a well-designed experimental-use exemption from infringement liability can promote faster cumulative technological progress without significantly diminishing incentives to invest in the original invention. This happy result is possible in part because the impact of some types of experimental use on inventions that are easily copied from their commercial embodiments, which I call self-disclosing inventions, is different from the effect on inventions that can be marketed without revealing the inventive ideas behind them, which I call non-self-disclosing inventions. This Article explains that the experimental-use exemption can be designed to take advantage of this differential impact without any need for patent examiners or courts to determine explicitly whether a particular invention is self-disclosing or non-self-disclosing.

The distinction between self-disclosing and non-self-disclosing inventions is highly significant for research aimed at understanding or improving upon the prior invention. It is of less importance in situations in which the prior invention is used as a research tool to investigate a separate topic. Analysis of the research tool case suggests a different solution to the experimental-use exemption issue. In both types of cases, application of the proposed exemption framework requires only a factual determination of which type of experimentation is involved; no other factors need be considered.

Unfortunately, the experimental-use exemption in current U.S. law is not formulated to discriminate between recouping investment in an original invention and maintaining dominance over prospective technological progress. Instead, current law has focused on the distinction between commercial and noncommercial use, with commercial use categorically ineligible for the experimental-use exemption. Yet the commercial versus noncommercial distinction has not proved to be stable,
and recent decisions from the U.S. Court of Appeals for the Federal Circuit threaten to shrink the experimental-use exemption to extinction.\textsuperscript{6} This instability occurs because the commercial versus noncommercial distinction does not “line up” with the incentive-based structure of patent law. Recent Federal Circuit precedent demonstrates that the commercial versus noncommercial rubric does not produce sensible results in today’s innovation environment.\textsuperscript{7}

Thus, in a recent Federal Circuit case, \textit{Madey v. Duke University}, the court found university research ineligible for the experimental-use exemption because it “unmistakably furthers the institution’s legitimate business objectives, including educating and enlightening students and faculty participating in these projects.”\textsuperscript{8} This outcome conflicts with the widespread understanding on the part of university researchers that purely academic research is categorically excused from patent infringement liability.\textsuperscript{9} With the expansive understanding of “business” articulated in \textit{Madey}, few activities will be unrelated to any potential infringer’s “legitimate business.” The experimental-use exemption remains viable, according to the court, for experimentation that is “for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry.”\textsuperscript{10} The court thus draws a strained distinction between research aimed at “enlightening students and faculty” and research aimed at “strictly philosophical inquiry.”\textsuperscript{11} The court does not suggest where, outside of the halls of academe, such scientific philosophers are to be found in this modern age, but surely their ranks are thin indeed.

Why was the Federal Circuit reduced to such linguistic gymnastics? A quick look at the facts of the \textit{Madey} case provides some insight. In

\begin{itemize}
\item \textsuperscript{6} See \textit{Madey v. Duke Univ.}, 307 F.3d 1351, 1362–63 (Fed. Cir. 2002) (“On remand, the district court will have to significantly narrow and limit its conception of the experimental use defense.”); \textit{Embrex}, 216 F.3d at 1349 (“While the SEC tries to cloak these tests in the guise of scientific inquiry, that alone cannot immunize its acts.”); \textit{Roche Prods.}, 733 F.2d at 863 (holding that courts should not “construe the experimental use rule so broadly as to allow a violation of the patent laws in the guise of ‘scientific inquiry,’ when that inquiry has definite, cognizable, and not insubstantial commercial purposes”); see also \textit{Integra Life Scis. I, Ltd. v. Merck KGaA}, 331 F.3d 860, 872–78 (Fed. Cir. 2003) (Newman, J., concurring in part and dissenting in part) (disputing recent Federal Circuit interpretations of the common-law experimental-use exemption).
\item \textsuperscript{7} See \textit{Madey}, 307 F.3d at 1362–63; \textit{Embrex}, 216 F.3d at 1349.
\item \textsuperscript{8} See \textit{Madey}, 307 F.3d at 1362.
\item \textsuperscript{9} See, e.g., John P. Walsh et al., \textit{Effects of Research Tool Patents and Licensing on Biomedical Innovation}, PATENTS IN THE KNOWLEDGE-BASED ECONOMY 324–28, 334–35 (Wesley M. Cohen & Stephen A. Merrill eds., 2003) (providing evidence that researchers presume a relatively broad “informal research exemption” and noting the potential of the \textit{Madey} case to undercut reliance on such an assumption).
\item \textsuperscript{10} \textit{Madey}, 307 F.3d at 1362 (citing \textit{Embrex}, 216 F.3d at 1349). The exemption for “philosophical experiments” dates back to the inception of the experimental-use exemption in a nineteenth-century opinion by Justice Story. See \textit{Whittemore v. Cutter}, 29 F. Cas. 1120, 1121 (C.C.D. Mass. 1813) (No. 17,600).
\item \textsuperscript{11} \textit{Madey}, 307 F.3d at 1362.
\end{itemize}
Madey, a Duke University physics professor had patented various parts of a free electron laser used for scientific research. When he and the university had a falling out, the university continued to use his patented research equipment without his authorization. The university then tried to invoke the experimental-use exemption to excuse its infringing research. It is easy to understand the court’s dilemma in this situation. The patented laboratory equipment was designed specifically for basic research, or “strictly philosophical inquiry,” in a nonprofit research laboratory. Because this type of research was the primary intended use of the patented equipment, a judicial exemption of such research as noncommercial experimental use would have gutted the core grant of exclusivity supposedly provided by the patent—the market for direct sales or licensing of embodiments of the patented invention. Rather than approve that result, the Federal Circuit stretched the concept of commercial use beyond recognition so that it could encompass the university’s actions and protect the heart of Professor Madey’s exclusive rights.

Because Madey contradicted a widespread belief—whether or not justified by earlier law—in the research community that all nonprofit research was exempt from infringement liability, many commentators fear that the decision may have a significant chilling effect on university research. Even when universities negotiate licenses for research involving patented inventions, they are notoriously conservative and, some would say, inept at the process, which can result in significant research delays. Moreover, though not highlighted by the Madey case, other recent trends have served to blur the distinction between commercial and noncommercial uses. Since passage of the Bayh-Dole Act, intended to encourage technology transfer between federally funded university researchers and the private sector, universities have become increasingly involved in patenting and licensing their own discoveries, and university researchers are increasingly involved in technology start-up companies. Moreover, at least in some technical disciplines, basic research has increasing relevance to technological

12. Id. at 1352.
13. Id. at 1353.
14. Id. at 1355.
15. See id. at 1362–63; see also Integra, 331 F.3d at 878 n.10 (Newman, J., concurring in part and dissenting in part) (taking a similar view of the Madey case, agreeing with the decision on its facts but disagreeing with its “sweeping dictum” about the narrowness of the experimental-use exemption).
applications. The blurring of the boundary between commercial and noncommercial research also provides opportunities for strategic behavior, such as firms’ placing of particular research projects into the nonprofit sector so as to gain access to the patented technology of competitors.

The problems with the commercial versus noncommercial distinction are not confined to the noncommercial end of the spectrum. Another recent Federal Circuit case, Embrex v. Service Engineering Corp., illustrates the equally troubling consequences of giving patentees complete veto power over all “commercial uses” of a patented invention regardless of the purpose of the use. In Embrex, the patent covered an in ovo method for inoculating chickens against disease. Embrex was the exclusive licensee of the patent rights. Service Engineering Corp. (“SEC”), one of Embrex’s commercial competitors, conducted experiments that were aimed at “designing around” the patented inoculation method. The patented method involved injecting vaccines into a particular region of a chicken egg. SEC’s experiments were intended to design around the patent by injecting a different part of the egg than was covered by the patent claims. The experiments were unsuccessful because the injections leaked into the areas of the egg protected by the patent.

Despite the fact that any infringement was a literal spillover from an attempt to invent an alternative to the patented invention and the fact that there was no evidence that the plaintiffs lost any profits as a result of the experiments, the Federal Circuit refused to apply the experimental-use exemption, basing the refusal on the commercial intentions of the experimenters. Embrex presents an almost trivial application of the commercial versus noncommercial rubric of the current experimental-use test. Yet the result is uncomfortably out of line with the law’s encouragement to competitors to use the inventive ideas disclosed in a patent to design around the invention.

17. See, e.g., Philippe Ducor, Are Patents and Research Compatible?, NATURE, May 1, 1997, at 13 (discussing the blurring between commercial and noncommercial research).
18. See, e.g., Walsh et. al., supra note 9, at 326.
19. Embrex, 216 F.3d at 1343.
20. Id. at 1346.
21. Id.
22. Id. The development of alternatives to a patented invention is known as “designing around the patent.” See infra note 45 and accompanying text. The incentive to “design around” a patent is one way in which patents promote technological progress.
23. Embrex, 216 F.3d at 1346.
24. Id.
25. Id. at 1347.
26. Id. at 1349.
27. See Integra, 331 F.3d at 863 n.2 (declining to discuss the applicability of the common-law experimental-use exemption to the research on improved pharmaceutical
The upshot is that the experimental-use exemption has been reduced to a mere *de minimis* exception that bears little relation to the implications of a particular experimental use for the public benefits of follow-on innovation. Continued reduction in scope of the current experimental-use doctrine seems inevitable because the commercial versus noncommercial distinction is not a coherent basis to distinguish the reward intended for the patentee from the benefit due to the public under the patent bargain.\(^{28}\) The distinction does not illuminate the extent to which the infringing experimental use interferes with the patentee’s ability to recoup her research and development investment or the extent to which the use is primarily aimed at follow-on invention.

This Article argues that it is possible to extricate the experimental-use exemption from the mess it is currently in by stepping back from the commercial versus noncommercial distinction and refocusing attention on the basic incentive structure of patent law. That structure seeks to provide means to recoup appropriable investment, as an “incentive to invent,” while permitting continued technological progress based on the inventive idea, through its “incentive to disclose.”\(^{29}\)

\(^{28}\) See Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1023–24 (1989) (noting that basing the experimental-use defense on lack of any commercial motivation makes the exemption both too narrow because even much nonprofit research has commercial motivations and too broad because it would deprive holders of patents with significant markets among “strictly philosophical” researchers of a large number of their potential customers).

\(^{29}\) This work builds upon and incorporates many of the insights in the pioneering work of Ronald Hantman and Eisenberg on the experimental-use exemption and is in agreement with many of their conclusions. *See generally id.; Ronald D. Hantman, Experimental Use as an Exception to Patent Infringement, 67 J. PAT. TRADEMARK OFF. SOC’Y 617 (1986).* However, while Eisenberg reaches outside of patent theory to justify her proposals because she concludes that “[n]either the incentive to invent theory nor the incentive to disclose theory offers any clear guidance in formulating a research exemption,” Eisenberg, *supra* note 28, at 1031, this Article contends that considerable progress can be made by considering more fully the conventional incentive justifications for patents.

In its focus on the internal logic of the patent law, this analysis also differs from the work of Professor Maureen O’Rourke, in which she advocates adoption of a multifactor test modeled on copyright law’s fair-use exception. *Maureen A. O’Rourke, Toward a Doctrine of Fair Use in Patent Law, 100 COLUM. L. REV. 1177 (2000).* While acknowledging the relevance of many of the factors that O’Rourke identifies, this analysis seeks a more practical regime that will not require judges and juries to make complicated assessments of market failure, patentee incentives, and so forth. Instead, many of the ...
The distinction between recouping investment in appropriable invention and controlling follow-on innovation is a well-defined and meaningful criterion that can be used to design a robust experimental-use exemption. 30 Concentrating attention on this distinction highlights two different types of experimental use of patented inventions—“experimenting on” and “experimenting with.” 31

“Experimenting on” is experimentation aimed at verifying, designing around, or improving upon a patented invention (as in the Embrex case). Reverse engineering a patented software program so as to determine how to design an improved program or to make the patented program interoperable with another application is “experimenting on” the patented software. Research aimed at developing improvements to a patented manufacturing process or mechanical device is also “experimenting on.” Such “experimenting on” serves the same function as, and is arguably part and parcel of, the required disclosure of the invention in the patent specification. 32 As explained in this Article, because of differences between self-disclosing and non-self-disclosing inventions that have not been widely recognized, such “experimenting on” a patented invention has relatively little impact on the incentive to invent and should be broadly permitted—without regard to the commercial or noncommercial nature of the user. Such a broad exemption for “experimenting on” patented inventions is already available in many countries, including


31. This distinction is similar to the recognition of “three distinct scenarios” of experimental use in the recent FTC report. Fed. Trade Comm’n, supra note 2, at 35–36. The first two scenarios identified there would constitute “experimenting on” and the third “experimenting with.”

32. 35 U.S.C. § 112; see Integra, 331 F.3d at 875–76 (Newman, J., concurring in part and dissenting in part) (discussing the relationship between disclosure and experimentation on patented subject matter).
Germany, the United Kingdom, and Japan. The United States would do well to follow these countries’ examples.

“Experimenting with” is experimentation in which a patented invention is used (as in the Madey case) as a research tool. Using a patented software program for computer-aided design of a mechanical device or to control an electronic microscope used in materials research is “experimenting with” the invention. “Experimenting with” is more difficult to analyze because when a primary use of a patented invention is as a research tool, researchers are a core market for the invention. In such cases, it is harder to separate the exclusivity a patentee needs to recoup research and development investments from the counterproductive use of a research tool patent to control research so as to maximize the tool patentee’s profits at the expense of slower technological progress. As Professor Rebecca Eisenberg pointed out, “[a]n experimental use exemption seems most likely to undermine critical patent incentives when the researcher is an ordinary consumer of an invention with a primary or at least significant market among research users.” Yet a number of scholars, notably Professor Janice Mueller, have raised concerns that patentees of certain important research tools may delay research progress by restricting the access that “ordinary consumers” of the tools would normally anticipate.

This Article supports Mueller’s proposal for a limited exemption for “experimenting with” research tools that compensates the patentee for use of the tool through a compulsory licensing requirement. However, after examining how best to separate a patentee’s need to recoup investment


36. Indeed, Professor John Duffy has argued that the availability of this research exemption overseas will simply provide an incentive to outsource “experimenting on” research activities to one of the many countries that already recognize such an exemption. See John F. Duffy, Harmony and Diversity in Global Patent Law, 17 BERKELEY TECH. L.J. 685, 718–19 (2002).


38. Eisenberg, supra note 28, at 1074.


40. Id. at 58.
from a socially detrimental attempt to maintain a stranglehold on research results and considering some criticisms of compulsory licensing proposals, I would modify the compulsory licensing proposal. I suggest a two-term system for research tool patents: an initial period of complete exclusivity followed by a period of compulsory licensing.

Part I of this Article provides background on the United States’s experimental-use exemption and compares it to the different approach taken by many other nations. Part II of this Article proposes a theoretical analysis of the patent system’s incentive to invent and incentive to disclose as they affect self-disclosing and non-self-disclosing inventions and explains why a broad exception for “experimenting on” a patented invention bolsters the benefits of disclosure without significantly lessening the incentives to invent. Part III analyzes the more difficult research tool problem and concludes that a more limited form of the experimental-use exemption—a compulsory licensing provision that kicks in after a period of complete exclusivity—will best promote technological progress. Part IV offers conclusions and summarizes the comprehensive approach to experimental use suggested by the analysis of this Article.

I. THE FAILURE OF THE CURRENT EXPERIMENTAL-USE DOCTRINE TO SUPPORT THE PATENT INCENTIVE STRUCTURE

A. Patent Incentive Basics

According to the conventional wisdom, patents are needed to promote the progress of the useful arts because inventive ideas can easily be appropriated by competitors once they are developed. Because inventions often cannot be developed without significant upfront investment, the law must step in to provide a way to recoup such investments or else inventors (or their financial backers) will have insufficient incentive to make research and development investments. Patents, which have a term of twenty years from the date the application is filed, provide a period of exclusivity in the market in which to recover such investments.

The effect patents have on technological progress is complicated because, in principle, most inventions have the potential to benefit society in two ways: (1) through their direct utility to the users or consumers of embodiments of the invention; and (2) through the use of the inventive idea as a springboard to further innovation. Patent exclusivity, while promoting inventive progress by providing incentives for innovation, can slow technical progress if the best follow-on inventors are prevented from building upon the inventive idea during the patent term.\(^4^1\) Considerable
effort has gone into analyzing the ways in which characteristics of the patent grant, such as scope and term, might be optimized to balance these effects, but, as a recent extensive review of the literature by Professors Nancy Gallini and Suzanne Scotchmer concludes, “the jury is still out” as to the optimal design to achieve cumulative invention.  

Because inventive results are also inventive inputs, the most rapid technological progress will result if the law provides a patentee the opportunity to recoup investments in appropriable research and development by commercializing her invention, while at the same time preventing the patentee from obtaining a stranglehold over technological progress that may flow from the invention. This principle is well rooted in current law. The patent system grants a period of exclusive rights in embodiments of the invention but simultaneously requires that patentees provide immediate public access to inventive ideas by disclosing them in published patents.  

Other inventors are not only permitted, but encouraged to avoid patent infringement by “designing around” patented inventions using the patent disclosure as a springboard. Similarly, the system permits patents on improvements even when they incorporate the patented inventive ideas of others. Third-party inventors are free to build upon patented inventions in these ways during the patent term without any authorization whatsoever from the original patentee. The permission of the original patentee is required only if and when a follow-on inventor seeks to use or sell an improved product or process that actually embodies the original invention. These patent doctrines reflect the principle of separating a patentee’s ability to recoup research and development investment from her ability to control and perhaps hamper further progress.

Gallini and Scotchmer emphasize the key role that private licensing agreements can play in allocating profits so as to provide balanced incentives for original and follow-on invention. However, as pointed out by Professors Michael Heller and Eisenberg and others, efficient licensing arrangements may not always be concluded for a variety of

43. Eisenberg, supra note 28, at 1021.  
44. Westvaco Corp. v. Int’l Paper Co., 991 F.2d 735, 745 (Fed. Cir. 1993) (citing London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538 (Fed. Cir 1991)); State Indus., Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1236 (Fed. Cir. 1985) (describing one of the patent system’s primary goals as insuring competition through the “negative incentive” to ‘design around’ a competitor’s products, even when they are patented, thus bringing a steady flow of innovations to the marketplace”); see also Craig Allen Nard, Certainty, Fence Building, and the Useful Arts, 74 IND. L.J. 759, 759–60 (1999) (discussing competition between patented technologies by “designing around”).  
reasons including the transaction costs of coordinating multiple licenses, the inability of inventors to agree upon the appropriate division of rewards for original and follow-on inventions, and the possibility of anticompetitive behavior resulting in licensing failure or in collusive licensing practices.\textsuperscript{46}

Experimentation is a primary path toward technological and scientific progress. When patents restrict experimentation, the tension between incentives for initial invention and the progress that comes from building upon the available store of knowledge is palpable. A properly designed experimental-use exemption promises to relieve some of this tension. Under the experimental-use exemption, which is based on a judicial gloss on the infringement provision of the patent statute,\textsuperscript{47} unauthorized “experimental uses” of patented inventions are permitted.\textsuperscript{48}

Because no license is required for exempted experimental uses, anticompetitive refusals to license can, in principle, be overcome. Unlike more general modifications of the terms of the patent grant that might be accomplished by judicial adjustment of doctrines such as nonobviousness or equivalents or by legislative adaptation of the patent term, the experimental-use exemption is targeted at those activities that contribute most directly to technological progress.

B. Development of the Current De Minimis Experimental-Use Exemption

U.S. courts have oscillated between a true experimental-use exemption and a mere \textit{de minimis} approach in attempting to define the circumstances, if any, under which unlicensed use of patented inventions

\textsuperscript{46} Id. at 65, 67–69, 71–72 (discussing the issues posed by licensing); Michael A. Heller & Rebecca S. Eisenberg, \textit{Can Patents Deter Innovation? The Anticommons in Biomedical Research}, \textit{Science}, May 1, 1998, at 698, 698–99 (1998). \textit{But see} John P. Walsh et al., \textit{supra} note 9, at 324–28 (presenting evidence that biomedical innovation has not been stymied by research tool patents but suggesting that this has resulted at least in part from reliance on strategies that include taking research overseas to avoid patents and ignoring patents by invoking a presumed “informal research exemption” that is considerably broader than the research exemption actually available under current law). It is notable, however, that the Walsh study was based on anecdotal evidence from seventy interviews and focused on whether research was actually stymied by anticommons and patent-blocking problems. As Walsh and his coauthors note, the strategies undertaken to avoid being stymied may impose high social costs. \textit{Id.} at 332; \textit{see also} \textit{Fed. Trade Comm’n, supra} note 2, at 23–25 (discussing these issues in the biotechnology context).

\textsuperscript{47} 35 U.S.C. § 271(a).

\textsuperscript{48} See \textit{id.} § 271(e) (stating “[i]t shall not be an act of infringement to make, use, offer to sell, or sell within the United States . . . a patented invention . . . solely for uses reasonably related to the development and submission of information under a Federal law which regulates the manufacture, use, or sale of drugs or veterinary biological products”); 5 \textsc{Donald S. Chisum, Chisum on Patents,} § 16.03 (1997); 3 \textsc{William C. Robinson, The Law of Patents for Useful Inventions} § 898 (1890).
should be permitted. The commercial versus noncommercial distinction that has evolved as the ostensible litmus test for experimental use is fundamentally flawed when applied to either type of experimental use: “experimenting on” a patented invention, as in *Embrex*, in hopes of developing an improvement or design-around or “experimenting with” a patented invention by using it as a research tool, as in *Madey*.

The history of the U.S. common law experimental-use exemption has been reviewed in numerous articles, and I do not attempt to reproduce an extensive review here. Rather, this brief reprise focuses on how the exemption has evolved to lose track of the need for an exemption to permit “experimenting on” the invention and become mired in an all-encompassing focus on the commercial versus noncommercial distinction.

The experimental-use defense to patent infringement has its origins in the jurisprudence of Justice Story, in his days riding circuit in the early nineteenth century. In *Whittemore v. Cutter*, Justice Story first addressed the issue in an aside while discussing a jury instruction describing infringement as “the making of a machine fit for use, and with a design to use it for profit.” In the absence of today’s specific statutory enumeration, the defendant objected to including the “making” of a machine within the realm of infringement. Justice Story upheld the jury instruction, commenting that it was in fact favorable to the defendant because of its recognition that “it could never have been the intention of the legislature to punish a man, who constructed such a machine merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its described effects.” With this observation the experimental-use exemption to infringement liability was born.

Justice Story elaborated on experimental use later the same year in *Sawin v. Guild*, where he reiterated his statements and added that an infringing use “must be with an intent to infringe the patent-right, and deprive the owner of the lawful rewards of his discovery.” Interestingly, these first references by Justice Story contain the seeds both of the emphasis on whether the use is “for profit” or for “philosophical experiments” and of the need to protect unauthorized uses to ensure the functional availability of the patent disclosure to the public or “the

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49. This history may be contrasted with the law’s longstanding recognition of the need for a “fair-use” exemption in copyright law. O’Rourke, supra note 27, at 1177.
51. 29 F. Cas. at 1121.
53. *Whittemore*, 29 F. Cas. at 1121.
54. 21 F. Cas. 554, 555 (C.C.D. Mass. 1813) (No. 12,391).
55. *Id.*
sufficiency of the machine to produce its described effects."\textsuperscript{56} They also presage an issue that continues to haunt the exemption to this day—the circularity in defining an exception in terms of "the lawful rewards of [the patentee's] discovery."\textsuperscript{57}

Few judicial opinions addressed the fledgling experimental-use exemption during the rest of the nineteenth century.\textsuperscript{58} The exception was given renewed legitimacy—and a \textit{de minimis} direction—when it was adopted by the famous Robinson patent treatise of 1890.\textsuperscript{59} Robinson interpreted the exception as based entirely on the pecuniary interests of the patentee:

\begin{quote}

\textsuperscript{58} See, \textit{e.g.}, Poppenhusen v. Falke, 19 F. Cas. 1048, 1049 (C.C.S.D.N.Y. 1861) (No. 11,279) (stating that "an experiment with a patented article for the sole purpose of gratifying a philosophical taste, or curiosity, or for mere amusement, is not an infringement of the rights of the patentee"); Byam v. Bullard, 4 F. Cas. 934, 935 (C.C.D. Mass. 1852) (No. 2,262) (interpreting the experimental-use exemption as founded on an assumption of \textit{de minimis} injury).
\end{quote}

\begin{quote}

\textsuperscript{59} 3 Robinson, \textit{supra} note 48, § 898.
\end{quote}
such employments of a patented invention the law is diligent to protect the patentee, and even experimental uses will be sometimes enjoined though no injury may have resulted admitting of positive redress.\textsuperscript{60}

Robinson’s still-influential treatise, with its exclusive focus on pecuniary effects on the patentee, its failure even to mention the social goal of trading exclusivity for enhanced progress, and its failure to discuss the category of experimental uses aimed at “experimenting on” the invention to “ascertain the verity and exactness of the specification,”\textsuperscript{61} shaped the direction of experimental-use doctrine in the United States throughout the twentieth century. Justice Story’s statement of an experimental-use exemption for “philosophical experiments”\textsuperscript{62} has been widely cited and discussed. The second prong of his analysis focused on experimentation to understand the operation of the patented invention more fully, is rarely discussed by the courts and remains essentially undeveloped.

As the courts attempted to apply the Robinson formulation of the doctrine, the emphasis on pecuniary effects on the patentee evolved into a distinction between commercial and noncommercial users.\textsuperscript{63} Some such evolution was perhaps inevitable because of the inherently circular character of a “pecuniary interests of the patentee” test.\textsuperscript{64}

The pecuniary interests approach cannot tell us which unauthorized uses, if any, should be excused. Thus, the “emoluments which [a patentee] does or might receive from the practice of the invention by himself or others”\textsuperscript{65} are necessarily defined by the legal boundaries of the patentee’s rights.\textsuperscript{66} To decide whether a particular unauthorized use deprives the patentee of legitimate returns, one must know whether the unauthorized use falls within the experimental-use exemption. A more well-defined test is needed.

The commercial versus noncommercial distinction is an attempt to capture the pecuniary effects idea, but it has not been entirely successful in doing so because, as the Madey and Embrex cases illustrate, the financial impact on the patentee is not always captured by the financial

\begin{itemize}
\item \textsuperscript{60} Id. (footnotes omitted) (emphasis added).
\item \textsuperscript{61} Sawin, 21 F. Cas. at 555.
\item \textsuperscript{62} Whittemore, 29 F. Cas. at 1121.
\item \textsuperscript{64} See Eisenberg, supra note 28, at 1034–35.
\item \textsuperscript{65} 3 Robinson, supra note 48, § 898.
\item \textsuperscript{66} Alternatively, one could view the pecuniary interests test as encompassing any use for which the law could provide compensation to the patentee. Interpreted in this way, a pecuniary interests test is simply a de minimis exception.
\end{itemize}
motives of the infringer. The “legitimate business” expansion of the idea of “commercial use” is an attempt to deal with unauthorized uses which, though not undertaken “for profit” by the infringer, appeared to have substantial pecuniary effects on the patentee. Thus, while in 1935 a district court based an experimental-use exemption entirely on the fact that the infringing user was an academic research institution, by the 1970s the Federal Court of Claims, in Pitcairn v. United States, rejected the government’s argument that the manufacture and use “for testing, evaluational, demonstrational or experimental purposes” of certain infringing helicopters should be permitted under the experimental-use doctrine.

Although the government clearly was not putting the invention to “commercial” use, the court held that the tests in that case were necessary for any new helicopter and were “intended uses of the infringing aircraft manufactured for the defendant and [were] in keeping with the legitimate business of the using agency” and not exempted.

The commercial versus noncommercial focus of the experimental-use exemption was enshrined in present-day law by the Federal Circuit’s decision in Roche Products v. Bolar Pharmaceutical Co. Roche dealt with an issue unique to the pharmaceutical industry. In Roche, the holder of a pharmaceutical patent sought to enjoin a generic drug manufacturer from using a patented ingredient during the term of the patent to conduct testing that was required by the Food and Drug Administration (FDA) before the generic could be put on the market. The purpose of the testing was to allow the generic drug to be marketed as soon as possible after the patent term expired. The district court held that the testing was excusable experimental use, but the Federal Circuit reversed. Though quoting Justice Story’s “‘sufficiency to produce the described effects’” test, the court did not consider whether the FDA testing might fall into that category.

Nor did the court rely, as it might have, on the overall impact of FDA testing requirements on the patentee’s ability to recoup research and

67. See Madey, 307 F.3d at 1351; Embrex, 216 F.3d at 1343. In other words, a completely nonprofit use by an alleged infringer may have an unambiguously commercial effect on the patentee by depriving the patentee of a sale or licensing fee. Eisenberg, supra note 28, at 1035 (recognizing that “the difference between commercial and non-commercial research in fact often has little to do with the financial interests of patent holders.”).

68. See Ruth, 13 F. Supp. at 697.
69. 547 F.2d 1106, 1125 (Ct. Cl. 1976).
70. Id. at 1125–26.
71. See 733 F.2d at 863.
72. Id. at 860.
73. Id.
74. Id. at 861.
75. Id. at 862 (quoting Whittemore, 29 F. Cas. at 1121).
development investments. While Bolar had argued that failing to permit generic testing before the expiration of a patent would result in an effective patent term extension, Roche had countered that the even more extensive testing requirements for pioneer drugs shortened the patent term at the outset so that the effective “extension” was necessary to preserve invention incentives. Rather than grapple with these policy issues, the court based its ruling on a categorical rejection of any exemption for experimentation with “definite, cognizable, and not insubstantial commercial purposes.”

Congress eventually enacted specific provisions to deal with the patent term problems posed by FDA drug regulations, permitting generic manufacturers to perform potentially infringing tests during the patent term in preparation for sales immediately after expiration, while also providing for patent term extensions to drug patentees to compensate for market time lost because of testing they were required to perform at the beginning of the patent term. This legislation superseded the specific holding of Roche Products but left the Roche Products opinion’s more general discussion of the common-law experimental-use exemption intact.

A proposal for broader statutory reform to the experimental-use exemption, more in line with Justice Story’s “ascertaining the sufficiency” prong and with the foreign exemption for “experimenting on” patented inventions, was considered by Congress but never enacted. The proposed “Patent Competitiveness and Technological Innovation Act of 1990” included the following language:

It shall not be an act of infringement to make or use a patented invention solely for research or experimentation purposes unless the patented invention has a primary purpose of research or experimentation. If the patented invention has a primary purpose of research or experimentation, it shall not be an act of infringement to manufacture or use such invention to study, evaluate, or characterize such invention or to create a product outside the scope of the patent covering such invention.

The proposed Act was reported favorably to Congress by the House Judiciary Committee but was never brought to a vote. Had it been

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76. See id. at 864.
77. Id. at 862–64.
78. Id. at 863–64. The Federal Circuit’s reluctance to engage the issues of patent policy presented in Roche Products was largely due to the fact that Congress was considering the same issues at the time. Id.
80. See id. § 156(a).
82. Id. at 1. More recently, the National Institutes of Health Working Group has taken the position that the distinction between “experimenting on” and “experimenting
enacted, it might have been read to have adopted the “experimenting on” versus “experimenting with” distinction.\textsuperscript{83}

Failing further congressional action, the broad approach set out in \textit{Roche Products} continued in force. Any doubts about the Federal Circuit’s continued commitment to the commercial versus noncommercial distinction were erased by the \textit{Embrex} ruling.\textsuperscript{84} \textit{Embrex} relied heavily on \textit{Roche Products}, despite the legislative supersedence of its specific holding, and emphatically reaffirmed the rule that any experimentation with “definite, cognizable, and not insubstantial commercial purposes” constituted infringement.\textsuperscript{85} The court appeared to give no weight to the fact that the infringement in \textit{Embrex} occurred during an attempt to design around the patent.\textsuperscript{86}

With \textit{Madey}’s disqualification of experimental use in keeping with the “legitimate business” of a nonprofit research institution, the Federal Circuit’s reading of the experimental-use exemption was confirmed to be “very narrow” indeed.\textsuperscript{87} In fact, it seems unlikely that even this “very narrow” exemption can survive for long since, as \textit{Madey} demonstrates, the “legitimate business” concept can (and inevitably will) be expanded to cover almost any conceivable use that could cut into the patentee’s potential market for the invention.

While the United States currently embraces a \textit{de minimis} interpretation of the exemption, elsewhere in the world, as noted above, patent law has recognized the distinction between “experimenting on” (experimental use aimed at understanding the invention itself) and “experimenting with” (using an invention as a tool for research into another matter) and provided an exemption for “experimenting on.”\textsuperscript{88}


\textsuperscript{83} Though it is not entirely clear how the provision would have been interpreted because it purported simply to clarify, and not to change, existing law. H.R. REP. NO. 101-960, pt. 1, at 55.

\textsuperscript{84} \textit{Embrex}, 216 F.3d at 1349.

\textsuperscript{85} \textit{Id.} (citing \textit{Roche Prods.}, 733 F.2d at 863).

\textsuperscript{86} \textit{Id.} at 1346 (describing attempts to design around the patent by changing the position of the injection).

\textsuperscript{87} \textit{Madey}, 307 F.3d at 1362.

\textsuperscript{88} Generally, western European nations are exempt from infringement experiments directed at the subject matter of the invention. \textit{See}, e.g., VI C. INTELL. PROP., tit. 1, art. L613-5(2) (France), available at Legifrance, http://lexinter.net/ENGLISH/intellectual_property_code.htm (last visited Apr. 15, 2004); German Patent Act, § 11(2); U.K. Patents Act of 1977, § 60(5)(b). For cases interpreting the experimental-use exemption, see \textit{Monsanto Co. v. Stauffer Chemical Co.}, [1985] R.P.C. 515 9 (Eng. C.A.); \textit{Klinische Versuche (Clinical Trials) I}, [1997] R.P.C. 623, 639 (BGH); \textit{Klinische Versuche (Clinical Trials) II}, [1998] R.P.C. 423, 432 (BGH). Likewise, the statutory schemes of several other European nations, including Spain, Italy, Belgium, the Netherlands, and Ireland, permit experimentation relating to the subject matter of the
The United States’s current de minimis approach, which virtually untethers “experimental use” from its origins in the connection between experimentation and technological progress, should be reconsidered. A focus on experimentation and its role in achieving technological progress is crucial to devising an exception that can serve the public interest in providing incentives for invention while maintaining a robust public domain. The purpose of an experimental-use exemption should be to protect the patentee’s ability to recoup her research and development investment while preventing her from using her exclusive rights to exercise unwarranted control over subsequent innovation. On the other hand, a rule that treats “experimenting on” a patented invention, as in Embrex, differently from “experimenting with” an invention, as in Madey, can begin to sort out these effects.89

II. “EXPERIMENTING ON” A PATENTED INVENTION: WHY THE DE MINIMIS APPROACH MISSES AN OPPORTUNITY TO PROMOTE TECHNOLOGICAL PROGRESS

“Experimenting on” and “experimenting with” have very different effects on the incentives for current and follow-on innovation, yet the two types of experimental use have been conflated in U.S. case law.90 Without explicitly recognizing the distinction, it has been impossible for U.S. courts to devise a reasonable standard for either type of experimental use.

89. Madey, 307 F.3d at 1362; Embrex, 216 F.3d at 1349.
90. The notable exception to this conflation is Judge Newman’s Integra opinion, where she notes the “fundamental distinction between research into the science and technology disclosed in patents, and the use in research of patented products or methods, the so-called ‘research tools.’” 331 F.3d at 877–78 (Newman, J., concurring in part and dissenting in part). The majority opinion declined to discuss the common-law experimental-use exemption but made reference to the NIH definition of research tools as: “tools that scientists use in the laboratory, including cell lines, monoclonal antibodies, reagents, animal models, growth factors, combinatorial chemistry and DNA libraries, clones and cloning tools (such as PCR), methods, laboratory equipment and machines.” Sharing Biomedical Research Resources: Principles and Guidelines for Recipients of NIH Research Grants and Contracts, 64 Fed. Reg. 72,090, 72,092 n.1 (Dec. 23, 1999). Id. at 872 n.4
A. The Relation Between the Patent Law’s Disclosure Requirements and Follow-On Innovation

An exception for “experimenting on” a patented invention would be consistent with the broader approach to follow-on innovation taken in U.S. law because “experimenting on” a patented invention is primarily a way of effectuating the patent disclosure to achieve its recognized purposes. As the Federal Circuit recognized, even in its opinion in *Roche Products*, “the word ‘use’ in [the infringement provision] has never been taken to its utmost possible scope.”\(^91\) It has always been anticipated that competitors will “use” the inventive idea to improve upon or design around the invention.\(^92\) Though Judge Rader stated emphatically in his *Embrex* concurrence that he would prefer to “lay to rest permanently [the defendant’s experimental-use] infringement excuses which find no support in the Patent Act,”\(^93\) he has recently provided a clear explication of the importance to society of competitors using the inventive idea during the patent term.

Enablement already requires inventors to disclose how to make (reproduce, replicate, manufacture) and how to use the invention (by definition rendering it a “useful art”). Therefore, because the competitor can make the invention, it can then acquire the DNA sequence or any other characteristic whenever it desires. Meantime the competitor can use, exploit, commercialize (outside the patent term) or improve upon and design around (within the patent term) as much of the invention as it cares to make. In other words, the statutory standard for sufficiency of disclosure serves masterfully the values of the patent system.\(^94\)

As Judge Rader explains, the disclosure requirements are intended to benefit the public interest in faster-paced follow-on innovation by privileging the “use” of a patented inventive idea in developing improved or alternative follow-on inventions during the patent term.\(^95\) No license or

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91. *Roche Prods.*, 733 F.2d at 861.
92. See *The Telephone Cases*, 126 U.S. 1, 533 (1888) ("Other inventors may compete with him for the ways of giving effect to the discovery, but the new art he has found will belong to him and those claiming under him during the life of his patent.").
93. *Embrex*, 216 F.3d at 1353 (Rader, J., concurring).
95. See *id*. In fact, the law now provides in many cases for disclosure of patent applications even before a patent is granted since most U.S. patent applications are now published eighteen months after filing. See, e.g., Reiko Watase, Note, *The American
authorization is required for this activity. Moreover, a follow-on innovation can be patented, published, or discussed without anyone's permission—even if it incorporates the original inventive idea—as long as no one makes an embodiment of the follow-on invention that incorporates an infringing embodiment of the original invention.

Similarly, the Federal Circuit stated in *Westvaco v. International Paper Co.*:

Designing or inventing around patents to make new inventions is encouraged. Keeping track of a competitor’s products and designing new and possibly better or cheaper functional equivalents is the stuff of which competition is made and is supposed to benefit the consumer. One 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 innovations to the marketplace.\(^96\)

Even though design-arounds and improvements are intended public benefits of the patent system, patentees have little incentive to license their competitors to experiment “on” their inventions to produce such follow-on innovations. As cases like *Embrex* illustrate,\(^97\) patentees are not primarily concerned with collecting royalties for such uses but with impeding their competitors’ ability to use the patentees’ inventive ideas as a basis for new inventions. Decisions such as *Embrex*, while indisputably correct as to the commercial intentions of the unauthorized user, are certain to have a chilling effect on this socially beneficial experimentation.

In a perfect world, perhaps the written patent disclosure alone would be up to the task of facilitating improvements and design-arounds. For a variety of reasons, however, this expectation is unrealistic. First, when there is no exception for experimentation aimed at a more complete understanding of the patented invention, there is an incentive for patentees to provide a bare minimum of disclosure to satisfy a patent examiner whose workload and expertise may preclude a stringent enablement investigation. Indeed, the inability of competitors to “experiment on” a patented invention provides an incentive for as much obfuscation as the system will tolerate.

Second, there is an inherent mismatch between science and technology and verbal explanation. This fact has been recognized by the

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\(^{96}\) 991 F.2d at 745 (citations and internal quotations omitted).

\(^{97}\) See *Embrex*, 216 F.3d at 1350 (noting that the infringing tests “were not shown to cause any loss of profits to Embrex” and remanding for computation of a reasonable royalty rate).
U.S. Supreme Court in the doctrine of equivalents context, where one of the primary justifications for expanding infringement beyond the literal language of the claims is the difficulty of expressing physical phenomena in words.\textsuperscript{98} The enablement doctrine also recognizes the limitations of written expression of technological matters, upholding as sufficient a patent specification that requires some experimentation to enable the practice of the invention as long as the amount of experimentation required is not “undue.”\textsuperscript{99}

As these legal doctrines already recognize, for scientists and engineers, understanding is often, if not virtually always, a hands-on experience. Published results are reproduced by those seeking to build on them not only, or necessarily even primarily, to verify them—but also to understand them—to see in detail how they were obtained and to explore their limitations and features not presented in the published description. As \textit{Embrex} vividly illustrates, the attempt to build on what has been established will almost unavoidably touch upon the previous results.\textsuperscript{100}

An experimental-use exemption for experiments directed at understanding, designing around, and improving upon the subject matter of the invention would permit the disclosure requirement to achieve its intended result.\textsuperscript{101} Because the patent system anticipates that competitors will use the patent disclosure to make improvements or design-arounds, there is no reason to confine this type of experimental use to noncommercial applications.

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99. \textit{See}, \textit{e.g.}, \textit{In re Wands}, 858 F.2d 731, 736–37 (Fed. Cir. 1988); \textit{see also} Julie E. Cohen & Mark A. Lemley, \textit{Patent Scope and Innovation in the Software Industry}, 89 CAL. L. REV. 1, 18–19 (2001) (noting that reverse engineering would be unnecessary if disclosure were fully enabling).
100. \textit{See} \textit{Embrex}, 216 F.3d at 1346–47.
101. \textit{See} \textit{Integra}, 331 F.3d at 875 (Newman, J., concurring in part and dissenting in part) (stating “there would be little value in the requirement of the patent law that patented information must be removed from secrecy in consideration of the patent right to exclude, if the information is then placed on ice and protected from further study and research investigation”); \textit{see also} Ned A. Israelsen, \textit{Making, Using, and Selling Without Infringing: An Examination of 35 U.S.C. Section 271(e) and the Experimental Use Exception to Patent Infringement}, 16 AIPLA Q.J. 457 (1989) (stating “[i]t could not have been the intent of Congress that once an invention is patented, and the public has received the ‘early disclosure’ of the invention, all progress that requires investigation of the discovery claimed in the patent should cease for 17 years”). Eisenberg similarly stated that:

[I]f the public had absolutely no right to use the disclosure without the patent holder’s consent until after the patent expired, it would make little sense to require that the disclosure be made freely available to the public at the outset of the patent term. The fact that the patent statute so plainly facilitates unauthorized uses of the invention while the patent is in effect suggests that some such uses are to be permitted.

Eisenberg, \textit{supra} note 28, at 1022.
\end{flushright}
A potential objection to a proposal to exempt “experimenting on” a patented invention from infringement liability is that the unauthorized use will decrease the patentee’s returns from the patent and thus decrease the incentive to make the invention in the first place. However, as Part II.B shows, a close examination of the relationship between disclosure and the patent system’s incentive to invent shows that increasing the effectiveness of disclosure will be unlikely to have a significant impact on incentives to invent because disclosure has an inherently greater impact on inventions that could have been maintained as trade secrets, for which the patent system’s incentive to invent is unnecessary.

B. The Relation Between the Incentive Theory of Patent Law and Follow-On Innovation

1. Unappreciated Differences Between the Incentive to Invent and the Incentive to Disclose

Over and over, scholars and courts have explained that the patent system is justified by the twin theories: “incentive to invent” and “incentive to disclose.”102 In most scholarly and judicial expositions, the incentive to invent is featured, while the incentive to disclose is mentioned in passing and then set aside as though it merely supplements the free-rider analysis of the incentive to invent.103 What seems to go unnoticed in these discussions is that these two theories are not mutually reinforcing justifications but alternatives that apply quite differently to different types of inventions.

The “incentive to invent” theory is a classic free-rider theory based upon the observation that ideas are nonexcludable public goods, “peculiarly and benevolently designed by nature, when she made them, like fire, expansible over all space, without lessening their density in any


103. See, e.g., Eisenberg, supra note 28, at 1028 (stating that the incentive to disclose argument is “more popular with the courts than with commentators”); Kurt M. Saunders, Patent Nonuse and the Role of Public Interest as a Deterrent to Technology Suppression, 15 HARV. J. L & TECH. 389, 397–98 (2002).
point, and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation.” ¹⁰⁴ The production of patentable inventions is understood to be different from other commercial activity because the investment in new ideas, unlike the investment in capital equipment or materials, is assumed to be appropriable by competitors at very little expense. Thus, the theory goes, patents must be awarded “as an encouragement to men to pursue ideas which may produce utility” ¹⁰⁵ lest would-be inventors be disinclined to make the investments necessary to develop a new invention. The “incentive to disclose” theory, on the other hand, is based on the notion that a patent is a quid pro quo in which an inventor teaches her invention to the public in exchange for a limited period of exclusive rights to the invention. ¹⁰⁶

Though usually mentioned in the same breath, these two justifications for the patent system are actually in tension. The “incentive to invent” theory assumes that inventions are self-disclosing—that is, that competitors can immediately appropriate inventive ideas and begin commercial competition almost as soon as an inventor brings a patented product to market. Many mechanical inventions, for example, fit this rubric perfectly, as do many pharmaceuticals and business methods. The free-rider “incentive to invent” analysis is eminently reasonable for such inventions, suggesting that without the patent system such inventions will be underproduced. ¹⁰⁷ For such inventions the societal trade-off is clear: the higher consumer prices presumably resulting from the grant of exclusivity during the patent term are compensated (at least in theory and on average) by “Progress of . . . useful Arts” ¹⁰⁸ in the guise of inventions that would not otherwise have been made.

Note, however, that while the incentive to invent is highly pertinent to such self-disclosing inventions, the disclosure quid pro quo has little relevance. Because the free-rider theory assumes that an invention is disclosed and its reproduction enabled by its mere commercialization, the patent disclosure can add little to society’s store of technical knowledge and serves almost exclusively to define the “metes and bounds” of the invention.

The patent system’s incentive to disclose is quite germane, on the other hand, to another category of inventions—those for which trade

¹⁰⁵ Id.
¹⁰⁶ See Kewanee Oil Co., 416 U.S. at 484 (citing Universal Oil Co. v. Globe Co., 322 U.S. 471, 484 (1944)).
¹⁰⁷ Though, of course, even self-disclosing inventions may provide certain natural market advantages to their inventors, such as the temporary exclusivity that inures to the first market mover.
¹⁰⁸ U.S. CONST. art. I, § 8, cl. 8.
secret protection is a viable option. Such inventions are non-self-disclosing and not easily copied. For such non-self-disclosing inventions, the disclosure of the invention in the patent specification is valuable to society over and above merely defining the scope of the grant because it adds something the inventor could have kept secret to the store of public technical knowledge. Examples of such non-self-disclosing inventions include industrial processes or complex software programs. While products are probably more likely to be self-disclosing and processes more likely to be non-self-disclosing, there are many self-disclosing processes—such as many business methods—and non-self-disclosing products that are difficult to reverse engineer. The discussion in this Article does not distinguish between products and processes.

The free-rider “incentive to invent” theory does not apply to non-self-disclosing inventions. Because these inventions could have been maintained as trade secrets for a sufficient time after commercialization to recoup the costs of their development, an exclusive patent grant is not necessary to stimulate invention.109 These inventions can and will be invented and then commercialized if an appropriate market for them exists whether or not they are patentable.

If any public benefit is to be had from patents on non-self-disclosing inventions, then it must be obtained through the patent system’s disclosure requirements. Patent disclosure serves the public good because it enhances the potential for follow-on inventions by releasing into the public domain technical information upon which other inventors can build.110 Disclosure of non-self-disclosing inventions also steers others away from duplicative efforts to reinvent the patented invention. Technological progress is enhanced when society’s creative resources can be focused on unsolved problems.

The role of the patent system for non-self-disclosing inventions is therefore not to encourage primary invention (for which trade secret protection is sufficient) but to enable more rapid follow-on invention by disclosing new technical discoveries that can be used as building blocks and by providing notice of work that has already been completed.

As discussed in Part II.D of this Article, this distinction between self-disclosing and non-self-disclosing inventions makes it possible to devise an experimental-use exemption that, to a great extent, resolves the “tension” between society’s interest in promoting improvements and

109. See Dan L. Burk & Mark A. Lemley, Policy Levers in Patent Law, 89 VA. L. REV. 1575, 1584 (2003). Burk and Lemley point out that the value of a patent depends not only on research costs but on the “imitation cost” for imitating the patented invention. Id. at 1585–86. Their “imitation cost” is closely related to the self-disclosing nature of the invention and to the “trade secret return.” See infra Part II.B.2 for a definition of the trade secret return.

110. See, e.g., Hantman, supra note 29, at 643 (stating “in exchange for the patent monopoly given to an inventor, the inventor discloses his invention to the public and runs the risk that his invention may be made obsolete”).
design-arounds and the patent system’s incentive to invent.\footnote{For a discussion of this “tension” between promoting improvements and the incentive to invent, see Eisenberg, \textit{supra} note 28, at 1035–36.} A key insight gained by focusing on the different functions patenting serves for different inventions is that we can strengthen the disclosure doctrine by broadly permitting experimentation aimed at follow-on innovation without substantially diminishing the patent system’s incentive to invent in those cases where it counts.

2. \textbf{DISTINCT ROLES PLAYED BY THE INCENTIVE TO INVENT AND THE INCENTIVE TO DISCLOSE FOR SELF-DISCLOSING AND NON-Self-DISCLOSING INVENTIONS}

To probe the likely effects of an “experimenting-on” exemption similar to the exemption provided by many foreign patent systems, a somewhat more detailed look at the distinction between self-disclosing and non-self-disclosing inventions is helpful. That distinction, while a useful heuristic, is not black and white, of course. There is a gray scale between the simple screw and the trade secret formula for Coca-Cola. A useful way to characterize this scale is by what might be called the “expected trade secret return,” $T$—the extra amount that an inventor expects to recoup from commercializing the invention because the inventor can maintain exclusivity in the market for the invention for a period of time (without obtaining a patent). The trade secret return can be used to define the extent to which an invention is self-disclosing. Inventions that can be easily copied (self-disclosing inventions) will have low values for $T$ while inventions that must be invented independently (non-self-disclosing inventions) will have higher values. $T$ is strictly capped by the possibility of independent invention by a third party. Other factors, such as the difficulty of reverse engineering and the costs of maintaining secrecy, can reduce $T$ further by limiting the time during which the inventor can maintain an exclusive market.\footnote{The theoretical analysis presented here does not distinguish between “invention” and “innovation,” where innovation is understood to include any necessary nonpatentable but appropriable investment needed to commercialize an invention once it has been invented. For a discussion of the distinction between invention and innovation, see \textit{id.} at 1036–40. Invention and innovation both are accounted for by the trade secret return, however, because it includes any extra income generated by the ability to maintain secrets. Focusing on the trade secret return also permits us to distinguish between disclosure of the technical idea to the public, which is the goal of the incentive to disclose, and disclosure to \textit{potential investors}, which is sometimes necessary for commercialization. Any needed disclosure to potential investors will be reflected in the trade secret return. If an inventor needs to attract outside capital to commercialize the invention, then various scenarios are possible. For example, it may be possible for the inventor to disclose the invention privately to potential investors under confidentiality agreements. In such a case, the trade secret return for the invention is largely unaffected by the disclosure to investors and depends only on the properties of the commercialized inventive product or process.} Other
investment—such as investment in capital equipment, generating sales leads, or personnel training—though some of it might be protected by trade secret law, is not exclusive to intellectual property and does not depend on whether the inventive idea has been disclosed. Such investments are not part of the appropriable research and development investment.

In the absence of a patent system, the simplest analysis suggests that an invention will be brought to market if the extra income needed to recoup the appropriable investment in developing and commercializing the invention, which I will call $R$, is less than the expected trade-secret return, $T$. Thus, all other things being equal, the invention can profitably be made if $T > R$ and will not be made if $T < R$. When

On the other hand, there may be inventions that will attract sufficient capital only if information about the invention is “leaked” to produce a “buzz” of excitement about its potential. In such cases, the trade secret return may be affected by the amount of information about the invention that must be leaked. In the extreme case, the need to attract investors may require releasing so much information that a technically non-self-disclosing invention is effectively transformed into a self-disclosing invention. See id. at 1029–30. I am grateful to Professor Justin Hughes for pointing out the need to consider the case in which a “buzz” about the invention is necessary to attract investors.

Moreover, Long has argued in her recent discussion of patent “signaling,” that it is also possible that patenting itself—as distinct from the information about the invention disclosed in a patent—is used by investors as a signal of potential commercial success so that the private returns from patenting should include returns from signaling. See Long, supra note 102, at 641–43. The analysis here is based on the trade secret return and patent return, which can be defined for all of the possibilities described. The trade secret return and patent return also incorporate any possible first-mover advantages.

A distinction between invention and innovation is not necessary to the analysis because both can be absorbed in the appropriable investment. $R$, which should be understood to include whatever investment in technical knowledge is unique to the firstcomer in the market and appropriable by others once the invention is fully disclosed, including any part of the investment in commercialization that is subject to free riding by competitors. Where appropriate, $R$ should also be interpreted to include investments in related research that did not bear fruit. In other words, a prospective inventor will consider the possibility that some research efforts are unsuccessful when comparing expected returns to expected investment.

113. A distinction between invention and innovation is not necessary to the analysis because both can be absorbed in the appropriable investment. $R$, which should be understood to include whatever investment in technical knowledge is unique to the firstcomer in the market and appropriable by others once the invention is fully disclosed, including any part of the investment in commercialization that is subject to free riding by competitors. Where appropriate, $R$ should also be interpreted to include investments in related research that did not bear fruit. In other words, a prospective inventor will consider the possibility that some research efforts are unsuccessful when comparing expected returns to expected investment.

114. See infra Fig. 1. This way of putting it is a slight oversimplification. It is always possible that there will be no investment in an invention even if $T > R$ simply because some other investment is more attractive. More precisely, the point at which $T = R$ is the point at which secrecy is sufficient to “level the playing field” between the invention and other potential investments that do not involve intellectual property. The analysis here implicitly assumes, as does the free-rider theory, that this is the goal of the patent system.

One might, of course, argue that investment in research and development should be encouraged by giving rewards that will tilt the playing field toward such investment. It is not necessarily clear why this should be the goal. Once the playing field is leveled, the success of the commercialized invention will presumably be determined by its societal value. There may be no obvious reason to encourage investment in patentable inventions if the result is less valuable than noninventive alternatives. Long-term research, which does not produce results that are attractive in the short-term perspective of investors, is generally not patentable and generally publicly funded. Government-funded research
When a patent on the invention is available, the time of exclusivity in the market can in some cases be increased by obtaining a patent, thus increasing the amount that the inventor can recoup over and above what would be available without patent protection. We can define the expected patent return, $P$, as the amount that an inventor expects to recoup from commercializing the invention if she chooses the market exclusivity available from patenting. Thus, we would expect that the invention will be made if either the patent return, $P$, or the trade secret return, $T$, is sufficient to recoup the research and development investment, $R$. On the other hand, if both $P$ and $T$ are less than $R$, the inventor cannot expect to recover her research and development investment either by obtaining a patent or by keeping a trade secret. Thus, the potential inventor will not make the investment necessary to the invention and neither trade secrecy nor patenting provides sufficient incentive to invent.

If either the patent return or the trade secret return is greater than the research and development expenditures, then the incentive to invent is sufficient. The inventor will decide whether to patent the invention based on a comparison of $P$, $T$, and $R$. Thus, if the trade secret return is insufficient to enable the inventor to recover the investment in research and development, $T < R$, then the inventor will have to obtain a patent simply to justify making the invention. A small trade secret return correlates with a shorter period of market exclusivity, signifying that the invention is relatively easily copied by competitors once it is commercialized—in other words, the invention is self-disclosing. For such self-disclosing inventions, where $T < R$, the primary function of the patent system is to increase the period of market exclusivity enough to provide a sufficient patent return to give an incentive to invent.

On the other hand, inventions for which the trade secret return is sufficient to offset the research investment, where $T > R$, are different because they are the non-self-disclosing inventions. Because these inventions can be successfully commercialized as trade secrets, the patent


115. Because this discussion focuses on inventor incentives, all “investments” and “returns” refer to the expectations of the prospective inventor. As such, they should be discounted to deal with risk aversion and averaged over all possible outcomes.

116. Just as the trade secret return depends on the cost of maintaining secrecy, the patent return can be defined to take into account the costs of obtaining and enforcing the patent.

117. See infra Fig. 2a.
118. See infra Fig. 2b.
119. See infra Fig. 3a.
120. See infra Fig. 3b.
121. See infra Fig. 3b.
system is not needed to level the playing field to stimulate invention in these cases. In these cases the primary public benefit of the patent system is to provide an incentive to disclose the invention rather than keep it secret.\footnote{Throughout this discussion “disclosure” refers to everything that is disclosed in the patent specification, which includes the disclosure meeting each of the written description, enablement, and best mode requirements of 35 U.S.C. § 112. There is no attempt to isolate the effects of these different types of disclosure, any of which may assist a third-party researcher in coming up with a follow-on invention. Moreover, since each of these aspects of disclosure may affect the ability to reproduce an invention, a self-disclosing invention presumably discloses whatever aspects are necessary to permit another to compete in the marketplace for the invention.}

An inventor will decide whether to obtain a patent on such a non-self-disclosing invention by comparing the expected patent return, \( P \), with the expected trade secret return, \( T \). If the trade secret return is greater, \( T > P \) (most likely because the invention can be kept secret for longer than the patent term), the inventor has no incentive to obtain a patent and will be expected simply to keep the invention a trade secret.\footnote{See infra Fig. 4.} From the inventor’s perspective, obtaining a patent would only force a premature disclosure of the invention. The inventor can maintain market exclusivity longer by eschewing the patent system in favor of trade secret protection. Such inventions, in a sense, are beyond the reach of the patent system unless patent return is increased by changes in patent scope or term.

The most interesting case for our purposes is the situation in which the trade secret return is larger than the inventor’s research investment, \( T > R \), but less than the patent return, \( T < P \).\footnote{See infra Fig. 4.} Because \( T > R \), the inventor does not need a patent as an incentive to invent. However, because \( T < P \), the inventor may wish to obtain a patent to increase his or her return from market exclusivity. On the other hand, the inventor may prefer to keep the invention secret to avoid disclosing information to competitors that could be used for follow-on innovation.

In a case such as the one illustrated in Figure 4, the inventor faces a choice. The inventor can choose not to patent the invention, thus avoiding the required patent disclosure but settling for a lesser return from the current invention. Alternatively, the inventor can patent the invention, make the required disclosure, and obtain the benefit of a greater return from commercializing the current invention, usually because the patent will provide a longer period of market exclusivity for this invention. Here we see the quid pro quo of patent disclosure in operation. Because there is no free-rider problem to overcome, society’s “payment” for the extra return that the patent provides to the inventor is the disclosure itself.\footnote{In some sense, the existence of this class of inventions reflects the law’s inability to calibrate the patent term to the invention. If the patent term were adjusted precisely to offset the research investment, then there would be no inventions for which the disclosure quid pro quo was predominant. One way to view patent disclosure is as}
is in this set of circumstances, and this set of circumstances alone, that the so-called “quid pro quo of patent disclosure” operates.

Thus, to sum up the analysis so far: the incentive to invent is active for self-disclosing inventions for which a patent is necessary to stimulate invention because the research investment is greater than the trade secrecy return (that is, \( T < R < P \)).\(^{126}\) The patent disclosure plays a relatively minor role for this category of inventions, because the ineffectiveness of trade secrecy demonstrates that the inventive idea is relatively quickly appropriated once the invention is commercialized. The patent disclosure adds little to the disclosure already inherent in commercializing the invention. On the other hand, the incentive to disclose is central for those inventions for which the grant of a patent is not necessary to compensate for the ability of free riders to appropriate the inventive idea (that is, \( R < T < P \)). In such non-self-disclosing cases, the patent disclosure is the only thing the public gets in exchange for the extra return that patenting provides to the inventor.\(^{127}\)

3. THE IMPORTANCE OF DISCLOSURE IN DETERMINING WHETHER THE PUBLIC BENEFITS FROM THE PATENT BARGAIN FOR NON-Self-DisCLOSING INVENTIONS

Once we focus on the different regimes in which the incentive to disclose and incentive to invent operate, it becomes crucial to consider whether the doctrines of patent law are designed to ensure that the public actually benefits from patent disclosure in non-self-disclosing cases. If there is insufficient public benefit from disclosure, then a patent may be simply a windfall for the patentee.

To begin analyzing the effectiveness of the patent system for non-self-disclosing inventions, we must ask in what way the patent disclosure advantages the public. It might seem reasonable that the patent disclosure may be useful to the public after the patent expires. Indeed, it is often assumed that the patent quid pro quo is satisfied by the availability of the inventive idea at the end of the patent term.\(^{128}\) However, this assumption

\(^{126}\) See infra Fig. 4.

\(^{127}\) This is the case for non-self-disclosing inventions even if the mere existence of a patent performs a signaling function according to Long’s theory. See generally Long, supra note 102. Depending upon the accuracy of the signal sent by patenting the signaling function may benefit the public by increasing the patent return for a self-disclosing invention enough to cover the research and development investment and thus provide an incentive to invent. See id. at 659–64. However, by definition, trade secrecy is sufficient to recoup the research and development costs for non-self-disclosing inventions. In such cases the patent signal may not provide a public benefit.

is generally incorrect. Unless there are very substantial costs related to trade secret protection, an inventor’s choice to patent will ordinarily signify that patenting gives a longer period of exclusivity than trade secret protection. Because this is the case, the choice to patent will ordinarily be made only if the inventive idea would have been independently discovered or trade secrecy lost before the end of the patent term. Thus, for most inventions that will be patented—and thus for which the patent disclosure has no value to the public by the end of the patent term because competitors would have uncovered the patentee’s secret before the end of the term even without the disclosure in the specification—

The public benefit of patent disclosure must therefore generally result from some kind of use of the disclosure during the patent term. Such “use” can be of two types: use as a warning against wasteful and duplicative efforts to develop or steal what the patentee has already invented, or as a direct input to follow-on innovation. Either way, the patent disclosure advances the “Progress of . . . useful Arts” by permitting societal resources to be put to their best use in advancing more quickly beyond the patentee’s contribution. To summarize: in general, the patent disclosure provides a benefit to the public only if it steps up the pace of follow-on innovation.

Disclosure can speed up follow-on innovation only if there are third parties who can make better use of the information than the patentee would if she maintained exclusive control of the information. When the disclosure quid pro quo functions properly for non-self-disclosing inventions, both sides make tradeoffs: the inventor gives up some control of follow-on innovation in exchange for a bigger return from the original invention while the public accepts less competition in the market for the

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129. There can be rare situations in which the patent return is larger than the trade secret return even if the optimal trade secret time is longer than the patent term. For this to occur, two conditions must be satisfied: (1) \( P > T(t^*) \); and (2) \( t^* > p \). Here, \( T(t^*) \) signifies that the trade secret return is maximized at the trade secret term, \( t^* \). The patent term is \( p \). The time for independent third-party invention, \( t_i \), limits the trade secrecy term. The condition that \( p < t_i \) thus requires, at least, that \( p < t^* \). There are relatively few modern-day research fields in which independent invention of a patentable invention would take longer than the twenty-year patent term. Of course, the optimal trade secret term, \( t^* \), may be even shorter than \( t_i \) due to the possibility of reverse engineering or industrial espionage. Also, because the income from an invention strictly increases with time, the only way for \( P > T(t^*) \) and \( t^* > p \) is for the costs of the optimal term of trade secrecy to be substantially larger than the costs of patent enforcement. But those costs are limited by the requirement that \( T(t^*) \) be a maximum. For these reasons, the cases where \( t^* > p \) are likely to be rare.


131. See Eisenberg, supra note 28, at 1055–60.


133. As I use the term in this Article, “follow-on” innovation may include either improvements or alternatives to a prior invention. Any socially useful innovation that is inspired by the patent disclosure is a public benefit of patenting.
original invention in exchange for faster follow-on innovation by a third party.

Thus, for non-self-disclosing inventions, unless the patent disclosure leads to faster or broader follow-on innovation than the original inventor would produce, the public has in general not been compensated for the patent grant because it results in a longer period of exclusivity than necessary to recoup the appropriable research and development investment for those inventions. Indeed, there might be adverse public effects from disclosure if it leads third parties to waste resources when they attempt to come up with improvements that the patentee could more quickly discover. The law should seek to ensure that the public gets the benefit of the patent bargain for non-self-disclosing inventions by encouraging these trade-offs when it is possible to do so without significantly decreasing the incentives to make the original invention in the self-disclosing case.

The situation with respect to follow-on innovation is illustrated in Figure 5. As do the earlier diagrams, Figure 5 shows the trade secret return on the vertical axis. Now, however, the horizontal axis illustrates the effect of disclosure on follow-on innovation. The horizontal axis, labeled $I$, represents the time the original inventor would take to come up with a follow-on invention. The dashed line illustrates what is likely to happen to third-party follow-on innovation when a patent is obtained and disclosure is made. The ability of third parties to create follow-on innovations will be relatively unaffected by the patent disclosure if the original invention is

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134. More accurately, $I$ represents the time for follow-on innovation coordinated by the original inventor, whether or not the original inventor actually performs the follow-on research.

135. For purposes of exposition, I use a simplified model here, which assumes a single follow-on innovation time. In reality, disclosure may benefit the public by increasing not only the pace of follow-on innovation but also its breadth because third-party inventors might develop improvements that the original inventor would miss because of lack of resources or failure of creativity. Including the possibility of greater—as well as faster—innovation because of disclosure would not change the qualitative analysis presented here because the general point that disclosure benefits the public only if it produces increased follow-on innovation remains sound.
self-disclosing (T is small).\textsuperscript{136} This is just another way of saying that the patent disclosure adds little to the public store of information about those inventions. Disclosure will have an increasingly greater impact on third-party innovation time as the trade secret return increases. Again, this is another way of saying that the patent disclosure is more valuable to the public the longer it would have taken the public to unravel the secret or discover the invention on its own. The position of the dashed line (that is, the extent to which disclosure speeds up third party follow-on innovation) will depend on how extensive the patent disclosure is—a point to which we shall return in discussing the experimental-use exemption.

Given the analysis illustrated in Figure 5, we can make some general prescriptions for beneficial disclosure requirements. Consider the region in Figure 5 in which the potential trade secret return, T, is greater than the research and development expenditure, R, but less than the potential patent return, P (that is, focus attention on the non-self-disclosing inventions to which the disclosure quid pro quo potentially applies). The third-party innovation timelines divide this region into three pieces.

To the left of the dashed line representing the third-party innovation time in the presence of patenting is a region—marked I in Figure 5—in which the original inventor will be the winner of the follow-on innovation race \textit{in spite of the patent disclosure}. In this situation, patenting does not affect the pace of follow-on innovation because the patent disclosure does not add enough to the state of the art to permit another inventor to win the follow-on innovation race. In such cases there is no quid pro quo—the inventor is in a win-win situation. By patenting the invention, the inventor generally benefits from both a period of market exclusivity longer than needed to recoup her research investment and from maintaining control of the follow-on innovation. The public, on the other hand, generally gains nothing by awarding a patent in Region I—losing out on a period of beneficial competition in the market for the original invention, which could have been marketed as a trade secret—but seeing no faster progress in follow-on innovation as a result of patenting.\textsuperscript{137} In

\textsuperscript{136} Figure 5 incorporates the assumption that the effect of disclosure is nil for strictly self-disclosing inventions. One may question this assumption on the grounds that, even for inventions for which inspection of the commercialized product completely discloses the invention, the patent disclosure may be more widely available (and more easily located because of the searchability of patent databases) than the commercial product itself, particularly if the product is costly. Patenting might permit faster third-party follow-on innovation for such inventions. This is a possibility, but the definition of self-disclosing in terms of the trade secret return accounts for it to a great extent. An invention that is not widely available to potential competitors will presumably garner some trade secret return even if the invention can be discerned from inspection of its commercialized form.

\textsuperscript{137} As discussed \textit{supra} note 129, there may be an occasional case in which \( P > T \) even though the optimal trade secrecy term is longer than the patent term. In those cases, patenting allows earlier, rather than later, competition in the market for the original invention, but these cases are not typical.
this region, the patentee will very likely choose to patent the invention, but the public may well be worse off than if the invention had been maintained as a trade secret for a shorter period of time.\textsuperscript{138}

To the right of the bold line in Figure 5, which represents the third-party innovation time without patent disclosure, is another region—marked III—in which the original inventor faces no trade-offs. In this region, a third party will win the follow-on innovation race regardless of whether the original invention is disclosed in a patent. Because the original inventor will lose the follow-on innovation race whether or not the invention is patented, there is no reason from the inventor’s perspective not to patent the invention and gain the extra period of market exclusivity. Region III differs from Region I from the public’s perspective, however. Though the patent disclosure is immaterial to the inventor, the public may gain a substantial benefit from the disclosure because it will enable third parties to quicken the pace of follow-on innovation (as reflected in the difference between the bold and dashed lines in Figure 5).

Between the bold line and the dashed line is a more complicated region—marked II in Figure 5. In this region, the public gains from patent disclosure (because the patent disclosure permits third parties to beat the inventor’s follow-on innovation pace), while the patentee is forced to relinquish her hold on the follow-on innovation. Conversely, the patentee gains a period of exclusivity because the patent term is generally longer than the trade secret term, while the public loses the advantages of market competition during that period. The inventor must make a trade-off in this region, deciding whether the extra exclusivity or the chance to control follow-on innovation is more valuable. Importantly, the public benefits in this region \textit{whichever choice the inventor makes}. If the inventor chooses trade secrecy, the public is saved the cost of a longer-than-necessary patent exclusivity period. If the inventor chooses to patent, then the public gains the advantage of faster follow-on innovation.

Based on these observations, we can make a general prescription. Region I is a set of inventions for which the patent system is ordinarily a giveaway to inventors. Inventors get a greater return from patenting than necessary to recoup research and development expenditures, but the patent disclosure does not serve its purpose of speeding up the pace of follow-on innovation. In Region II, on the other hand, there is a quid pro quo: the public gets the benefit of the patent bargain. Therefore, it is generally in the public’s interest to reduce the size of Region I by

\textsuperscript{138} As already noted, the discussion here treats only a single follow-on innovation. Of course, this is an oversimplification because multiple follow-ons can flow from a single initial invention. But the general point that the excess returns to a patentee from exclusivity can outweigh the innovative benefits to the public of disclosure—Region I—remains.
increasing Region II, even though the inventors of some of the inventions thus pushed into Region II may choose trade secret protection over patenting.\footnote{This analysis makes the assumption that the original inventor’s follow-on innovation time is unchanged by patenting. In reality, the original inventor’s follow-on innovation time depends on the resources she invests, which will presumably be chosen to maximize her private benefit. Thus, there are really two original inventor follow-on innovation times: (1) determined assuming trade secret protection, which can be denoted \( IT \); and (2) determined assuming patenting, which can be denoted \( IP \). In principle, the original inventor might maximize private benefit by investing more resources in follow-on innovation if by doing so she could maintain control over the follow-on race while also obtaining the benefits of the patent market exclusivity period. Thus, it is possible that \( IP < IT \). Assuming that the original inventor can correctly estimate the effect of the patent disclosure on the ability of third parties to win the follow-on race, there are a limited set of cases to which this possibility applies.

In Region I, there is no reason for the original inventor to invest additional resources in follow-on innovation when patenting the invention since third party inventors do not pose a threat to her dominance in the follow-on race; thus in Region I, \( IT = IP \). In fact, there is no reason for an original inventor to invest in faster follow-on innovation when patenting unless by doing so she can change the outcome of the follow-on race, which can only happen if she beats the fastest third-party innovation time. Thus, even if we relax the assumption that the original inventor’s follow-on time is unaffected by patenting, the conclusion regarding the relative public benefits of Regions I and II remains the same.

In Region II, the patent disclosure benefits the public either by permitting third party faster follow-on or by motivating faster follow-on by the original inventor. In Region I, however, there is no benefit because the original inventor has no reason to invest in faster follow-on in return for the patent exclusivity. Of course, all of this analysis assumes that original and third-party inventors correctly assess the likely outcome of the follow-on race. It is possible, for example, that an original inventor who is actually in Region I might mistakenly believe herself to be in Region II and behave accordingly or that a third-party inventor might incorrectly estimate the likelihood of winning the follow-on race and thus invest either too much or too little in follow-on research. A serious exploration of these possibilities is beyond the scope of this paper, but the more effective the patent disclosure, the less reason there is to expect any particular bias toward patentee or third party of such information failures. On average, the assumption of correct estimates should be fairly robust.

\footnote{There is no general way to predict the magnitude of the public benefit resulting from moving the line between Region I and Region II by increasing disclosure. However, the benefit is bounded above by the difference between the patent and trade secret return because an inventor can always choose to keep the invention as a trade secret if the loss of profits from follow-on innovation that would result from patent disclosure is too great.}
Referring again to Figure 5, we may consider the effects of increased patent disclosure for self-disclosing inventions. Here, because the trade-secret return is insufficient to compensate for the research investment needed for invention, the potential inventor faces a choice between inventing with the expectation of patent protection and not inventing at all. Trade-secret protection is not an option. How does disclosure affect the potential patentee’s choices? We can expect minimal effects for two reasons.

First, because these inventions are self-disclosing, the patent disclosure is much less likely to have an appreciable effect on third-party innovation than it is for non-self-disclosing inventions. Second, there would seem to be no particular reason for the inventor to give up on making a self-disclosing invention because of stiffer disclosure requirements because patenting guarantees that research expenses can be recouped from commercializing the original invention alone. The inventor of a self-disclosing invention might choose to delay commercial introduction and patenting of a primary invention until the follow-on is in hand, but stiffer disclosure requirements are unlikely to have much impact on that choice.

Because the effects of disclosure are inherently targeted at inventions for which patenting already provides excessive returns, it seems safe to conclude, therefore, that there is an overall public benefit to be gained by

141. This point is illustrated in the shape of the bold and dashed lines infra Figure 5.
142. Another way to describe the effects of more and less stringent disclosure requirements is by looking at an effective patent return defined to include returns from follow-on innovation. Increasing disclosure requirements can result in decreased returns to the patentee if third parties can appropriate the increased disclosure. But there are three situations in which increased disclosure requirements will have little impact on patent returns: (1) if disclosure requirements do not add significantly to the available public knowledge (i.e., for self-disclosing inventions); (2) if the additional disclosure adds significant knowledge but the original inventor is still able to capture most of the returns from follow-on innovation by virtue of being the fastest inventor (i.e., Region I of Figure 5); and (3) if the additional disclosure adds significant public knowledge but the original inventor would not have captured the returns from follow-on innovation in any event (i.e., Region III of Figure 5). Only if the additional disclosure adds sufficient knowledge to the public domain to permit a third party to appropriate returns that the patentee would otherwise have obtained can the disclosure affect the patentee’s incentives regarding invention and patenting (i.e., in Region II). Because the extent to which additional disclosure adds usable knowledge to the public domain is related to the efficacy of trade secret protection, additional disclosure tends to decrease the patentee’s returns preferentially for those inventions for which patents provide returns in excess of what would be needed to recoup research and development investments. The ability of third-party follow-on innovation to restrict patent returns is related to the concept of effective patent life explored by Scotchmer and others. See Gallini & Scotchmer, supra note 42, at 68 (citing Ted O’Donoghue et al., Patent Breadth, Patent Life, and the Pace of Technological Progress, 7 J. ECON. MGMT. STRATEGY 1, 1–2 (1998); Suzanne Scotchmer, Standing on the Shoulders of Giants: Cumulative Research and the Patent Law, 5 J. ECON. PERSP. 29, 30 (1991)).
imposing stringent disclosure requirements to increase the size of the region. In this case, a true disclosure quid pro quo exists so that the public is ensured the benefit of the patent bargain.

C. An “Experimenting On” Exemption: A Means of Effectuating Disclosure and Ensuring the Public Its Due

With the above framework in mind, we can draw some inferences about the effect an exception for “experimenting on” might have on the incentives of potential patentees. The primary effect on a patentee of others “experimenting on” her invention is the effect of the research on the likelihood that the patentee will win the follow-on innovation race. It is unlikely, for a commercially successful invention, that such research use will make much of a dent in the prior inventor’s income stream from marketing the invention. Moreover, there are many patented inventions—those self-disclosing inventions available for anonymous purchase in the market—for which an experimental-use exemption of this type may be irrelevant. If the follow-on researcher can obtain the necessary information by using a purchased product, which comes with an implied license to use it, then there is no need for a special exemption. Thus, an exception for “experimenting on” a patented invention is the equivalent of more thorough disclosure of the inventive idea.

Referring back to Figure 5, when the patent disclosure is made more complete and effective by allowing follow-on researchers to perform experiments on the subject matter of the patent, the third-party follow-on time is decreased (that is, the dotted line in Figure 5 moves further to the left). As discussed above, increasing the effectiveness of the disclosure is generally advantageous because it has little effect on self-disclosing inventions, for which the incentive to invent dominates, and a salutary effect on non-self-disclosing inventions, for which the public’s primary compensation for the award of a patent is a faster pace of follow-on invention.

To summarize, when the commercial versus noncommercial distinction is dropped and the focus is returned to the underlying goals of the patent system, the analysis of “experimentation on” the subject matter of an invention shows that it is essentially a species of enabling disclosure. Such disclosure enhancement promises to have beneficial effects on the pace of follow-on innovation for non-self-disclosing inventions and minimal effects on the invention incentives for self-
disclosing inventions. Moreover, because the patentee of a non-self-disclosing invention has already been compensated for the disclosure of her invention by the award of a greater patent return than necessary to recoup her investment in invention, such disclosure-based experimental use need not be compensated separately.

D. A Proposed Exemption for “Experimenting On” a Patented Invention

The above analysis explains why an exception for “experimenting on” a patented invention is desirable. In the United States, such an exception could be enacted legislatively, perhaps by reviving the “Patent Competitiveness and Technological Innovation Act of 1990” proposal. But a statutory amendment may not be necessary. Any common law experimental-use exemption is premised on judicial interpretation of the statutory prohibition of unauthorized “use” of a patented invention. As discussed, the prohibition of “use” is already interpreted to permit use of the inventive idea during the patent term for the purpose of improving upon or designing around the patent.

The disclosure law requires that the patent teach a person of ordinary skill in the relevant art to understand the patented invention. The intention is that this understanding will be sufficient to provide the public benefit of design-arounds and improvement on the patented invention. A common-law exemption for “experimenting on” a patented invention to produce would simply extend judicial recognition of the inadequacy of written depictions of inventions from its established place in the law of the doctrine of equivalents and enablement to a more realistic interpretation of “use” of the inventive idea to produce improvements or design-arounds.

most cases be fruitfully coordinated by a single patentee. In any event, the prospect theory is at odds with the general principle that it is socially beneficial to facilitate third-party follow-on innovation through patent disclosure, but the effective disclosure provided by “experimenting on” a patented invention is no different from the patent disclosure in the specification in this respect. Any doctrine—such as the doctrine of enablement—that encourages third-party attempts at follow-on innovation seems suspect from the prospect theory perspective.

145. See generally H.R. REP. NO. 101-960; see also supra notes 81–83 and accompanying text.
147. Id. § 112.
148. Westvaco Corp., 991 F.2d at 745.
149. Integra, 331 F.3d at 875–76 (Newman, J., concurring in part and dissenting in part) (“The patentee’s permission is not required whenever a patented device or molecule is made or modified or investigated. Study of patented information is essential to the creation of new knowledge, thereby achieving further scientific and technological progress.”); see also Israelsen, supra note 96, at 475–76 (arguing that the goals of the patent system are served by permitting comparison, development of improvements, and
The proposed categorical exemption for “experimenting on” a patented invention may be compared with other proposed approaches to the experimental-use question. In addition to being theoretically grounded in the distinction between recovering research and development investment and controlling subsequent innovation, a rule permitting “experimenting on” patented inventions has the advantage of relative clarity and simplicity of administration. Unlike proposals that echo copyright’s “fair use” analysis and require courts or juries to make complicated multifactor analyses, the proposal for a categorical “experimenting on” exception reduces the question to an objective analysis of the nature of the research in question. While difficult line-drawing issues may still arise in particular cases, the difference between “experimenting on” a patented invention to improve it and using it as a tool for other research is a factual question that can be evaluated by judges and juries without the need for policy-driven balancing. Also, because there is no need to determine whether a potential infringer is commercial or nonprofit, or whether the research is part of its “legitimate business,” there is a greatly reduced incentive for strategic attempts to disguise commercial ventures as university research and so forth.

As a practical matter, if legislation is required to implement the exemption, it is far more likely to succeed if the proposal stands to promote faster innovation in both the commercial and nonprofit sectors. Indeed, because many commercial innovators are both patent owners and potential infringers, an “experimenting on” exception may achieve its public benefits with relatively little net cost to the private actors involved.

III. “EXPERIMENTING WITH” A PATENTED INVENTION: THE MORE DIFFICULT PROBLEM OF RESEARCH TOOLS

designing around patented inventions and suggesting that making, using or selling be considered to occur “only if the invention is practiced primarily to secure the benefits thereof”). While Israelsen’s identification of activities that serve the goals of the patent system is consistent with the analysis here, his proposed “secure the benefits” test seems to have the same potential pitfalls as the “pecuniary effects” test. Israelsen, supra note 101, at 475–76.

150. Embrex, 216 F.3d at 1348.


152. COUNCIL OF THE ROYAL SOC’Y, KEEPING SCIENCE OPEN: THE EFFECTS OF INTELLECTUAL PROPERTY POLICY ON THE CONDUCT OF SCIENCE para. 3.23 (2003) (discussing research tools and the ambiguities in interpreting the European exemption for “acts done for experimental purposes” (citing Community Patent Convention 1975, art. 31(a)–(b) (Eng.)), and noting “doubtful ground” between the “two extremes” of exempted “experiments to establish the scope and application of a patented invention, including experiments to discover an improvement to it” and prohibited “experiments simply to prepare to duplicate and sell what is already on the market”).
Once we separate out the disclosure-related instances of “experimenting on” a patented invention from the more problematic “experimenting with” a patented invention—that is, using a patented invention as a research tool—we can hope to address the more complicated research tool issue more adequately.

Indeed, once we distinguish the two types of “experimental use,” it may seem that they have little besides a name in common. “Experimenting on” a patented invention is focused on gaining a better understanding of the inventive idea to facilitate further innovation. The embodiment of the idea is ancillary. It merely supplements the written patent disclosure and would have been unnecessary if the written disclosure had been completely effective. “Experimenting with” a research tool involves using an embodiment of the invention for its intended purpose. It is not an extended form of patent disclosure. Indeed, though as a practical matter unauthorized experimentation employing a research tool will usually require an understanding of the patented invention, it need not in principle. For example, laboratory use of an unauthorized copy of the computer object code embodying a patented software invention might not rely at all on the experimenter’s understanding of how the software functions.

In the “experimenting on” context, because of the distinction between self-disclosing and non-self-disclosing inventions, the public interest in disclosure can be advanced by an expansive exception with little adverse impact on the public interest in encouraging invention. “Experimenting on” an invention, like any form of disclosure, has only an indirect impact, through potentially competitive follow-ons, on the market for embodiments of the original invention. In contrast, unauthorized use of a research tool has a direct impact on the market for the tool. Thus, uncompensated “experimenting with,” like garden-variety patent infringement, directly implicates the incentive to invent by letting some of the free riders back into the marketplace. Analysis of the potential benefits of any exception for “experimenting with” a research tool is thus fraught with much greater uncertainty than the “experimenting on” inquiry.

A. Research Tool Patents: Recouping Investment or Stalling Progress?

Nonetheless, “experimenting with” a research tool bears closer scrutiny because, as many commentators have recognized, it shares with “experimenting on” a patented invention the potential for significant impact on scientific and technological progress. Indeed, the research tool patent question has generated at least as much scholarly concern as the problems with prohibiting experimentation aimed at improving a patented
invention. This concern is due to the obvious fact that research tool inventions have a special relationship to technological progress.

For ordinary inventions, the most important contribution that the invention makes to subsequent innovation is the inventive idea. When ordinary inventions are patented, the inventor’s market for embodiments of the primary invention is protected, while disclosure allows follow-on inventors to use the inventive idea to make technological progress by improving upon or designing around the original invention. During the patent term, both the embodiments of the invention (through commercialization by the patent holder and licensees) and the inventive idea (through self-disclosure or the patent document) are generally available for the public benefit. Thus, as long as disclosure is complete, the inventor cannot use her exclusive market in the primary invention to slow the pace of follow-on innovation.

In contrast, when research tools are patented, the most significant “Progress [in the] . . . useful Arts” usually depends upon using an embodiment of the invention—the research tool itself—to make a further, and often patentable, innovation. The primary financial return may flow from exclusive control of the research results rather than from widespread commercial use of an embodiment of the invention. Thus, to determine whether an experimental-use exemption should apply to patented research tools, the effects of patenting on subsequent innovation using the tool—not just the idea—must be considered.

To begin the inquiry, we must examine what is meant by a “research tool.” For the purposes of this discussion, a research tool is an invention the primary function of which is to facilitate scientific or technological progress. The concern with patented research tools arises from the fear that a research tool may give the tool inventor the ability to block technological progress by controlling the research that may be performed using the tool in a way that maximizes the return to the tool patentee at the expense of society. To determine under what circumstances, if any,

153. See generally Eisenberg, supra note 28; Hantman, supra note 29; Mueller, supra note 37; O’Rourke, supra note 29.
154. Patentees are not required to commercialize their inventions, of course. Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1547 (Fed. Cir. 1995). However, the incentive theory assumes that they generally will if they can. Thus, ordinarily, if a research tool is not commercialized, then it is reasonable to assume that there is not a sufficient market for the invention to justify society’s “reimbursing” the inventor for her research efforts. Because society’s interest in the availability of improved commercial products and processes is generally aligned with the inventor’s interest in recouping investment, there is generally little reason to police whether inventors commercialize their inventions. As discussed herein, however, the research tool case may be an exception to this generally felicitous alignment.
156. See Integra, 331 F.3d at 878 (Newman, J., concurring in part and dissenting in part) (stating that “[a] research tool is a product or method whose purpose is use in the conduct of research”); Mueller, supra note 37, at 10–17.
this concern is justified, we must ask two questions. First, under what conditions does a research tool patent permit the patentee to control the direction and pace of subsequent innovation? Second, when, if ever, will a tool inventor’s control over subsequent technical progress pose a problem for the public? Only after considering these questions can we determine whether a well-crafted infringement exception for “experimenting with” can or should be devised.
1. **CAN A TOOL PATENTEE CONTROL THE PROGRESS OF RESEARCH?**

There are two prerequisites for a tool patentee to exercise significant control over the progress of research in the applicable field: there must be no close substitutes for the tool and there must be no close substitutes for the research projects that require the tool. As Mueller has pointed out, there is no “research tool issue” if the patentee commercializes the research tool and sells or licenses it on the open market.157 If there are close substitutes for the tool available to researchers, then a tool patentee’s decisions about whether to commercialize or license the tool invention will not have a major impact on the progress of research for which the tool might be used.158 Similarly, if researchers are relatively indifferent between problems requiring a patented tool and a whole host of interesting problems for which they do not need to use the tool, then the patentee will not exercise significant power over research progress.159 Unless these two prerequisites are satisfied, a patentee is likely to market the tool widely in an attempt to recoup the investment in developing it, rather than to refuse to license it in an attempt to control forthcoming research. Only when the research tool is of unique importance to a uniquely important problem, does the potential for serious adverse public impact from a research tool patent arise.160

2. **SHOULD WE MIND WHETHER A TOOL PATENTEE CAN CONTROL THE PROGRESS OF RESEARCH? POTENTIAL PROBLEMS WHEN THE TAIL WAGS THE DOG**

From the public perspective, the important issue is not who controls the research but whether the research is performed effectively. At first blush, the research tool patent would seem to be the quintessential realization of the prospect theory of patenting developed by Professor

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157. See Mueller, supra note 37, at 15. This is an oversimplification, of course, because a patented research tool will presumably still be more expensive than it would be if not patented. But this kind of price increase is an unavoidable and necessary result of patenting any type of invention. The important characteristic of widespread commercial availability is that it decouples control over research using the tool from recovering the toolmaker’s investment.

158. For this reason, the tool inventor is also likely to make the tool commercially available or otherwise to ensure access by the most effective researchers because the alternative is not to profit from the eventual research at all.

159. For an exploration of these issues in the molecular biology context and some case studies of research tools that are and are not made broadly available, see National Research Council, Intellectual Property Rights and Research Tools in Molecular Biology (1997), at Nat’l Academy Press, http://books.nap.edu/html/property/ (analyzing case studies in chapter five).

160. For a similar discussion of the conditions under which problems with access to research tools can arise, see John P. Walsh et al., supra note 9, at 332–33.
Edmund Kitch.\textsuperscript{161} Kitch analogized patents to mineral claims, arguing that patents—especially broad patents granted at an early stage of the inventive process—can increase social value by permitting the patent holder to manage exploitation of the invention efficiently, thus avoiding wasteful duplicative effort.\textsuperscript{162} Patents on research tools for which no close substitutes are available are “broad” in the sense that they give the patent holder exclusive control over the development of the research they facilitate and “early” in the sense that they are granted before the research, which will presumably lead to some kind of commercially useful result, is performed.\textsuperscript{163} Research tool patents also may avoid, at least to some extent, one of the principal criticisms of the explanatory power of the prospect theory, which is that the ability of others to obtain improvement patents that can potentially block further development of the patented technology casts doubt on the claim that patent holders are actually able to coordinate exploitation of the technology within the scope of the patent.\textsuperscript{164}

While patentable improvements are likely to stem from the broad pioneer patents traditionally associated with the Kitch theory, a research tool patent may be much more specific (and less susceptible to patentable improvements) yet still control access to a relatively broad scope of tool-based research.\textsuperscript{165} As already discussed, where research tool patents can easily be designed around or where they have close substitutes, they do not exert special control over research progress and do not warrant special treatment. Where research tools do not have close substitutes, they really may provide the control over exploitation of the patent that the prospect paradigm assumes.

The Supreme Court has opined that “a patent is not a hunting license.”\textsuperscript{166} However, a research tool patent may, in the absence of close

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\textsuperscript{161} See Kitch, supra note 144 (arguing that the patent system performs a function not previously noted: to increase the output from resources used for technological innovation); see also Yoram Barzel, \emph{Optimal Timing of Innovations}, 50 Rev. Econ. Stat. 348, 349 (1968).

\textsuperscript{162} Kitch, supra note 144, at 276.

\textsuperscript{163} They are also frequently “early” in the sense that development of the tool may require significantly less investment than the subsequent research.

\textsuperscript{164} See, e.g., John F. Duffy, \emph{Rethinking the Prospect Theory: A Neo-Demsetzian View} (2003), at Chicago Intellectual Property Colloquium, http://www.chicagoip.com/Papers/Duffy.pdf \textsuperscript{71} U. Chi. L. Rev. XX (forthcoming 2004) [hereinafter Duffy, \emph{Rethinking the Prospect Theory}] (citing and discussing authorities); Merges, supra note 102. Indeed, critics of the prospect theory have argued that the current patent system seems inconsistent with the prospect theory because it does not eliminate the potential for inefficient races to produce patentable improvements within the scope of a broad, early patent.


\textsuperscript{166} Brenner v. Manson, 383 U.S. 519, 536 (1966).
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substitutes, be exactly that. The question then becomes whether there is any reason to be concerned about the award of an exclusive “license to hunt” the solutions to important research problems to the first one to develop the research tool.

Because research tool patents fit so well into the prospect theory, they are also particularly susceptible to criticisms of that theory that have been made. Criticisms that are particularly relevant to research tools focus on the differences between research, which depends critically and somewhat unpredictably on the expertise and creativity of the researcher, and mineral prospecting, depicted as a fairly straightforward task that requires coordination but no flashes of insight.

These criticisms are particularly appropriate where, as is often the case, obtaining a research tool patent may be relatively “easy,” with many potential inventors competing to stake out a claim, in comparison to the research using the tool, which may be relatively “hard,” requiring creativity, specialized expertise, and substantial resources. In fact, as I discuss below, this “tail wagging the dog” aspect of research tool patenting underlies much of the skepticism about whether the inventor will exploit the patents to best effect.

It is in society’s interest to have the research performed by the quickest and most effective researcher. The pace of research is important not only to “To promote the Progress of . . . useful Arts” but also, at least for some research problems, because of the threats to health and safety that inspire the research (as though the hunting license is a license to hunt a man-eating tiger). It is also in the interest of the patent holder to solve the research problem so as to obtain the rewards of exclusive control of the research results. But do the patentee’s incentives align with those of the public at large? Not necessarily. Several factors may prevent the research tool patent holder from making the tool available (through license or employment) to the most effective researcher.

First, the tool patent holder may not necessarily have the expertise necessary to correctly identify the best researcher—even if it is possible to determine in advance who that researcher may be. Research may require a unique combination of expertise and luck. Depending on the tool in question, the knowledge and skills relevant to tool development may not be cognate with those relevant to performing the research.

167. See Dreyfuss, supra note 165, at 4.
168. See Eisenberg, supra note 28, at 1040–44; Heller & Eisenberg, supra note 46, at 699–700; Lemley, supra note 102, at 1048–52; Merges & Nelson, supra note 41, at 872–73.
169. See generally Cohen & Lemley, supra note 99; Eisenberg, supra note 28; Merges & Nelson, supra note 41.
170. As discussed below, however, the case of a research problem that is easily solved once the appropriate tool is developed is also not uncommon. Any proposed “experimenting with” exemption must account for both types of research tool.
Indeed the concept of a tool carries with it the connotation, as already discussed, of a device that is simpler than, and supplemental to, the primary work at hand. 172 And while obtaining the broad pioneer patents generally considered in the context of the prospect theory may be a reasonably good signal of competence to make further developments in the field, developing an easy research tool is less likely to be a reasonable signal of competence to manage the difficult research that employs the tool. For the same reasons, the tool patent holder may not be best qualified to identify the research problems to which the tool might be fruitfully applied. 173

Most importantly, however, the holder of a research tool patent does not necessarily share society’s incentives to speed the pace of research. Employing or licensing the most efficient researchers may require sharing the profits—both monetary and reputational—of the discoveries resulting from the research in a way that is not to the private advantage of the tool patent holder. In this respect, research tool patents may be significantly different from mining claims. If mining is performed primarily by hired workers who are in plentiful supply, it could be a reasonable assumption for mining prospects that the claim holder’s incentives to maximize profits will align with society’s interest in efficient exploitation of the claim. Both claim holder and society have an interest in mining in a cost-effective way.

Patent prospects may be quite different, however, especially when the patented invention is a relatively easily developed research tool. Exploiting the research tool efficiently may require the cooperation of expert researchers, who may reasonably insist on a substantial share in the profits from the eventual research results. 174 A profit-sharing arrangement with the most effective researcher might be quite sufficient to address the free-rider problem by reimbursing the tool patentee for her investments in

172. Again, it is important that this connotation is not always accurate in the research context. Developing a complicated piece of research equipment may be a very good indicator of competence to use it in research.

173. Offhand, this might be expected to be less of a problem than the incapacity to identify the best researchers because proposals to license the tool for use on various problems should find their way to the patentee.

174. See Gallini & Scotchmer, supra note 42, at 65–66 (discussing and citing authorities regarding the problem of dividing profits between cumulative innovators). Gallini and Scotchmer point out that inventors of research tools, for which all of the social value resides in the results of the research, must be able to claim some of the profit from research using the tool or they will have insufficient incentives to invent. Id. This is true, but only in the sense that any manufacturer of raw materials or other components of a product depends on income from the eventual sales of the marketed product. The profit to the research tool inventor can come in the form of a purchase price for the tool. It need not take the form of a reach-through royalty on the research results. More important to the research tool problem is the issue, also highlighted by Gallini and Scotchmer and the researchers they cite, of “dividing the profit between innovators in a way that respects their costs.” Id. at 66. Such a division is the goal of a research tool exemption.
tool development. However, it may be in the tool patent holder’s interest to settle for a larger share of the results of less effective research. In other words, the holder of the tool patent may not be able to internalize the benefits of cooperative research and may thus not have incentives to exploit the patent in the most socially beneficial way.\textsuperscript{175}

Professor John Duffy has argued that the primary benefit of early, broad patenting is a race for earlier invention (and corresponding earlier patent expiration).\textsuperscript{176} He argues that the prospect theory should be modified to emphasize the incentives to speed the pace of invention that result from early, broad patenting.\textsuperscript{177} According to Duffy’s analysis, broad, early patenting produces a socially beneficial trade-off of rent dissipation in duplicative research, which has no social benefits, for rent dissipation in a race for earlier innovation, which benefits society.\textsuperscript{178} As Duffy explains:

policies that permit patenting of embryonic research results—i.e., that allow patenting prior to the bulk of the investment needed to bring the innovation to market—increase the efficiency of the competition by ensuring that the predominant private cost of earlier patenting is the earlier expiration of the patent right (which has a private but not a social cost), not the premature expenditure of resources on innovation or the duplication of innovative efforts (both of which are private costs and social costs).\textsuperscript{179}

Unlike the race to obtain the earliest patent that Duffy describes, which speeds the pace of innovation and leads to earlier patent expiration,\textsuperscript{180} the grant of a research tool patent, despite its seeming fit with the prospect theory, may in some circumstances have the opposite effect. This contrary effect may occur because important question for society may be the incentive for rapid research using the tool rather than the incentive for earlier tool development.

If a research tool has no effective substitutes and is not made widely available, the relatively long period of exclusive control of the tool granted by a patent may give the patent holder such a significant head start on the relevant research as to permit him or her to slow the pace of innovation substantially so as to capture a greater proportion of the profits of the research. While the race to patent the tool may lead, as in Duffy’s

\textsuperscript{175.} A related problem arises when the patentee or an improver undervalues the social benefits created by an invention because those benefits do not inure to the patentee or improver. See Lemley, supra note 102, at 1056–58.
\textsuperscript{176.} Duffy, Rethinking the Prospect Theory, supra note 164, at 5.
\textsuperscript{177.} Id.
\textsuperscript{178.} Id. at 33–34
\textsuperscript{179.} Id. at 7–8.
\textsuperscript{180.} Id. at 33–34.
analysis, to earlier expiration of the tool patent, it need not lead to earlier expiration of the more important eventual patent on the research results since the successful tool patentee need not “race” to those results. When the research project is aimed at addressing important societal problems, such as disease or agriculture, the societal detriment of such delay may be very severe while the private incentives to delay so as to keep a larger share of the monetary and nonmonetary benefits of the research may be correspondingly great.

Duffy also identifies the prospect of third-party improvement patents as an incentive for the original inventor to continue developing the invention as quickly as possible. In the research tool context, while there may be continuing incentives to improve the tool, these need not necessarily translate into incentives to speed the pace of research using the tool.

Thus, when there are a limited number of highly valuable research projects that can be performed with a patented tool, and the tool has no close substitutes, there are two possibilities. It is possible that, as in Kitch’s prospect theory, the patent holder may perform the socially useful function of limiting wasteful and duplicative expenditures by many researchers. Alternatively, though, the patent holder may, either by mistake or by design, significantly slow the progress of research by excluding the best researchers from the project or failing to license the optimum number of researchers.

At this point, a judgment call must be made. The question is whether society is most likely to benefit from competitive (and hence potentially duplicative) research or from coordinated (and hence potentially delayed by private rent-seeking or ineptitude) research. Economic arguments have been advanced for both positions. We have, as a society, generally presumed that competition fosters innovation. This

181. See supra notes 176–79 and accompanying text.
182. See Lemley, supra note 102, at 1059–61 (discussing other noneconomic incentives).
183. See generally Kitch, supra note 144. It should be noted that, to the extent competing researchers share information or explore different approaches to the problem, their efforts may be neither duplicative nor wasteful. In principle, the holder of a research tool patent could take such effects into account in organizing the research effort. In practice, the holder of a research tool patent may lack the necessary expertise to do this or be unable to internalize the benefits of doing so.
184. Lemley, supra note 102, at 1052–60.
presumption is echoed by the scientific community, which views research as an activity that is not susceptible to central planning.  

Moreover, as discussed, there are good reasons to suspect that the private incentives of tool patent holders are not aligned with the best interests of society. For these reasons, the analysis that follows assumes that it is in society’s interest to encourage the inventors of “easy” research tools to commercialize their inventions so as to make them broadly available to interested researchers rather than to award control of the research to the one who happens to get the patent on the tool. This approach focuses the competitive—though potentially duplicative—efforts on the more difficult problems and places more control in the hands of those who are capable of performing the more difficult research tasks.

B. An “Experimenting-With” Exception for Research Tool Patents: Would It Help?

Now that we have identified the circumstances under which problems may arise from research tool patenting, we may consider whether some kind of experimental-use exemption to infringement liability is a useful antidote. Here, as in the “experimenting on” context, the commercial versus noncommercial distinction, is not necessarily focused on the potentially problematic circumstances. As noted by Mueller in her article on experimental use of research tools, there are many patented research tools, including chemical reagents, laboratory equipment such as lasers and microscopes, and certain genetically modified mice, that are widely available on the market from parties whose business consists in selling such items. There is no immediately obvious reason that nonprofit research laboratories should avoid paying the going rate (or an appropriately discounted rate based on the patentee’s

186. Eisenberg, supra note 28, at 1059–65. Of course, there have been notable successes of highly focused large scientific enterprises such as the space program and the Manhattan Project. But projects involving such great expense or such national security ramifications are the exception rather than the rule. The scientific norm calls for bottom-up proposals for research projects, evaluated by shifting groups of peer reviewers, and performed by fluid collaborations of globetrotting researchers.

187. This choice is also supported by the likelihood that, given the option to license a research tool, mainly those researchers who have a reasonable chance of success will take licenses and make the investment necessary to perform the research. While some researchers may be susceptible to erroneous assessments of their own research abilities, they have many advantages over the research tool patentee in performing this self-selection. They have more accurate information about their own abilities to perform the research and, because they do not have exclusive rights to the tool, have no capacity to delay the research for strategic reasons.

188. Mueller, supra note 37, at 12–15.
ability to price discriminate) for such inventions, just as they do for patented copy machines, computers, and staplers.\textsuperscript{189}

1. \textsc{Theoretical Analysis of the Incentives of Research Tool Inventors: Distinguishing Tails From Dogs}

If it is desirable to modify the incentive structure in some instances to encourage commercialization of a research tool, we must consider whether it is possible to do so without unduly discouraging the development of such tools or driving tool inventors to keep the tools secret so that they can control the pace of research. It is also important to bear in mind that not all research tools fit the “tail wagging the dog” paradigm. Any legal approach to research tool patents must make allowance for complex tools with relatively simple applications. An analysis similar to that in Part II.B can help to sort out the options.

Having developed a research tool, an inventor has two basic options: to either commercialize the tool by making it widely available on the market or to use the tool to perform in-house research.\textsuperscript{190} Depending on whether the tool is self-disclosing in the sense as discussed in Part II, the inventor may commercialize the tool with or without patenting it. Likewise, the inventor may perform in-house research either by patenting the tool or by keeping it as a trade secret during the research period.

To analyze the research tool question, a plot similar to those used in Part II.B can be used.\textsuperscript{191} The vertical axis of the diagram represents the secrecy time, $S$, during which the inventor of the tool can perform research using the tool in secret without competition from others.\textsuperscript{192} $S$ will be the shorter of the time it takes for a third party to invent the tool independently and the time it takes for a third party to reproduce the tool using information obtained from the tool inventor through industrial espionage or by other means.\textsuperscript{193} The horizontal axis represents the time, $I_R$, it will take for the research tool inventor to perform successful research using the tool. Because $S$ depends on expenditures on secrecy by the researcher, we expect generally $S < I_R$ because there is no point in

\textsuperscript{189} Eisenberg, \textit{supra} note 28, at 1084–85; see Mueller, \textit{supra} note 37, at 33–35.

\textsuperscript{190} Of course there are actually intermediate options involving licensing the tool exclusively to a limited number of researchers. For present purposes, I have lumped all of these options, which maintain control of the research process in the hands of the tool inventor together under the “in-house” umbrella. It is to be assumed that, if permitted, the tool inventor will choose whichever combination of such options maximizes private benefit, taking into account the nonmonetary rewards of being the successful researcher.

\textsuperscript{191} See \textit{infra} Fig. 6.

\textsuperscript{192} $S$ is similar to, but not the same as, a trade secrecy term. $S$ can be longer than a trade secrecy term because the tool is not available on the market for reverse engineering.

\textsuperscript{193} $S$ may depend on secrecy expenditures by the patentee. It is assumed that the patentee will optimize her total anticipated return from the research in choosing the amount to spend on secrecy.
investing in keeping the tool secret longer than necessary to complete the research project. Thus, the most interesting part of Figure 6 is the region below the line $S = I_R$.\footnote{Assuming that the costs of maintaining tool secrecy are minimal compared to the expected payoff from successful research, the tool inventor will invest as necessary to keep the tool secret until the important research is completed, but not substantially longer. Thus, $S$ will usually be close to or less than $I_R$.}

In the absence of a patent on the research tool, the time for a third party to complete the research project, denoted $I_3$, is the sum of the time it takes the third party to obtain the tool and the time it takes the third party to use the tool to obtain research results, which we will denote $I_{3R}$. If the tool is commercialized, then the third party will be able to begin research almost immediately, thus $I_{3C} = I_{3R}$. If the third party must develop or steal the tool, then the time for third-party invention will be lengthened by the secrecy time, $S$. Thus, if the tool is not commercialized, then $I_{3S} = I_{3R} + S$.

As long as the tool is commercialized, patenting will not affect the third-party research time, which will be $I_{3C} = I_{3R}$. On the other hand, if the tool is not commercially available during the patent term, then third parties may begin using the tool only after the patent expires. Third-party research will be substantially delayed in this situation, with $I_{3P} = I_{3R} + p$, where $p$ is approximately the patent term.\footnote{Actually $p$ may be somewhat less than the patent term since there may be some delay between patenting the tool and being able to use it and we have set our “zero” at the time the tool is available for use.}

To analyze the research tool problem, we first focus on cases in which tool development is much easier than tool-based research. In Figure 6, this is the region where $S << I_R$ (because $S$ is limited by the time required for independent tool invention, which is assumed to be much less than the time required for research).

The various possibilities depicted in Figure 6 can be understood as divided into the following regions. In Region $A$ cases, where $I_R < I_{3R}$, the tool inventor is either the most effective researcher or the tool inventor has been able to identify and license the most effective researcher. When this is the case, the tool inventor may commercialize the tool or not, patent it or not, without affecting the pace of research using the tool. There is no public benefit to commercializing the tool because a commercially available tool can only induce competitors to waste resources on duplicative (and ultimately ineffective) research. The social value of patenting is ambiguous in these cases because patenting can be used either to monopolize tool-based research (thus eliminating ultimately unfruitful duplicative efforts) or to commercialize the tool (thus inducing duplicative and unfruitful research).

In Region $B$ cases, where $I_{3R} < I_R < I_{3S}$, the tool developer is not the most effective researcher but can maintain control of tool-based research through secrecy or, in most such cases, by patenting. Though
commercializing the tool would make it available to the most effective researcher, the tool inventor has no incentive to give up control of the lucrative research by commercializing the invention. An experimental-use exemption cannot help in these cases because the tool inventor can perform her research in secret rather than patenting the tool. Because the tool inventor can keep control of the research, tool-based research will be delayed. However, as long as research tools are relatively easily developed, \( S \) is small and the delay in these cases will not be substantial. Recall that \( I_{3S} = I_{3R} + S \). Thus, \( I_{3R} < I_{R} < I_{3S} \) only if \( 0 < I_{R} - I_{3R} < S \). Because \( S \) is short relative to \( I_{R} \), this condition implies that \( (I_{R} - I_{3R}) / I_{R} \ll 1 \). In other words, these are cases in which the tool inventor can perform the ultimate research almost as effectively as any other researcher.

In Region C cases, where \( I_{3R} < I_{3S} < I_{R} < I_{3P} \), the tool developer is not the most effective researcher, as was also the true in Region B. Here, though, the tool inventor cannot keep the tool secret long enough to catch up to the fastest researcher either because someone else will discover the tool independently or because word of the tool will leak out. The tool inventor thus prefers to patent the tool (but not to commercialize it) so as to obtain the profits from tool-based research. Unless the tool inventor is spurred by some kind of experimental-use exemption to commercialize the tool, she is in a position to delay significantly the societal benefits of tool-based research. The potential delay in these cases is limited only by the patent term because \( I_{3S} < I_{R} < I_{3P} \) implies that \( S < I_{R} - I_{3R} < P \). Thus, in these cases there may be significant public benefit to be gained if the tool developer can be persuaded to commercialize the tool.

In Region D cases, not only is \( I_{3R} < I_{R} \), indicating that the tool developer is not the most effective researcher, but also is \( I_{3P} < I_{R} \), indicating that the tool inventor is more than twenty years slower at getting the research done than a third-party researcher! Tool inventors in this possibly unusual situation can benefit from inventing the tool only if they commercialize it. They will never win the research race. They may choose to patent tools that are self-disclosing in the sense of Part II, but they gain nothing by delaying the research race since they cannot win

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196. We have already assumed that we are dealing with a case in which the tool inventor’s private benefit is maximized by controlling the research using the tool rather than by commercializing the tool because the payoff from research is very high.

197. These tool patentees will face choices about how to exploit their control to maximize their private benefit. They may, of course, choose to give the license to the best researcher rather than invest in their own slower research. There is no guarantee, however, that the maximum private benefit to the tool holder coincides with the public interest in faster research.

198. This situation may not be as unusual as one might suppose if the tool is uniquely important for a wide variety of research problems. In such a case, the tool inventor may simply lack the resources, interest, or expertise to quickly pursue all of the available lucrative uses for the tool.
it in any event. In this region, if the tool has sufficient market value—
according to the analysis in Part II—it can be developed and made
available to third-party researchers, presumably including the fastest
researcher.

Before considering the implications of this analysis for a potential
experimental-use exemption for research tools, it is important to see how
the analysis differs if we consider the case of complex research tools with
relatively easy research application. In such cases we can no longer
assume that \( S \ll I_R \). Instead, we expect \( S \sim I_R \), where \( I_R \) itself is relatively
short because the research applications are relatively easy. In fact, we
would normally anticipate that \( I_R \) is substantially less than \( p \) in these
cases. Finally, there are good reasons to anticipate that \( I_R \sim I_{3R} \), where \( I_{3R} \)
is the research time for the fastest third-party researcher.

There are several reasons to expect a narrow spread in research times
for relatively simple research projects. For one thing, in contrast to the
developer of a “simple” research tool, who may not have the expertise for
carrying out the tool-based research, the inventor of a complex piece of
research equipment is likely to have the necessary expertise to carry out
the research. Even if the tool inventor does not have the expertise, the
inventor has every incentive, having already made the lion’s share of the
necessary investment, to contract for quick performance of the research.
Because the research is relatively “easy,” the choice of researcher should
not be critical and there should be a reasonable supply of research
“labor.” Thus, the region of Figure 6 most relevant for complex tool
inventions is the region where \( I_R \sim I_{3R}, S = \sim I_R, \) and \( I_R \) is considerably less
than \( p \). Thus, complex research tools do not raise the same concerns for
potential research delay as simple research tools. There is little reason to
encourage the transaction costs and potential duplicative effort of
commercialization or licensing in these cases.

2. A PROPOSED EXEMPTION FOR “EXPERIMENTING WITH” RESEARCH
TOOLS

Having laid out this basic framework, we can now consider how
patent policy might be shaped to encourage inventors of “easy” research
tools to commercialize their inventions when they are not the most
effective tool-based researchers—particularly in Region C, \(^{199} \) where tool-
based research may be significantly delayed if the tool is not
commercialized. In considering whether and how to formulate an
experimental-use exemption, we consider whether any proposed
exemption would be effective in disentangling the incentives for tool
inventions from the ability to control the outcome of research using the

\(^{199} \) See infra Fig. 6.
tool. We also analyze the impact of any proposed exception on the development of complex tools.

Two types of proposals have generally been made for experimental-use exemptions for research tools. One type of proposal contemplates an exception for nonprofit institutions while another type suggests a compulsory licensing scheme for research tool inventions. Let us consider each of these proposals in light of the analysis discussed in Part III.B.1.

3. ANALYSIS OF PROPOSALS OF AN EXEMPTION FOR NONPROFIT INSTITUTIONS

Several commentators have advocated an out-and-out exemption for nonprofit experimental use of patented inventions or at least that nonprofit status be considered a factor in favor of exempting a particular experimental use of a research tool from liability. Indeed, prior to the Federal Circuit’s Madey decision, many may have assumed that a nonprofit research exception was implicit in the common law experimental-use exemption. As discussed above, there are compelling reasons to exempt any “experimenting on” a patented invention from infringement liability, whether or not it is commercially motivated. Should nonprofit institutions receive an additional exemption for “experimenting with” research tools? In fact, nonprofit institutions often do receive deep discounts on research necessities, such as computers or laboratory supplies, which are widely marketed. These discounts seem a reasonable form of price discrimination reflecting the disparate ability to pay of the nonprofit and private sectors. But it is a different question whether a nonprofit exemption would solve the issues raised by unsubstitutable research tools targeted at particular high impact research problems.

Looking again at Figure 6, one can ask whether a nonprofit exemption can solve the problems of potential research delay without an unacceptable negative impact on tool development incentives. A nonprofit exemption will have little impact on the incentives of tool inventors if nonprofit institutions are not among the most competitive

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200. For the most part, it must be recognized that “experimental use” in this context means “use.” Research tools are generally used for experimentation. However, there are inventions, such as certain medical diagnostic tests, that have both commercial and research applications. The proposed exemptions are targeted at research uses of such inventions.
201. E.g., Dreyfuss, supra note 165, at 8–11.
203. E.g., Dreyfuss, supra note 165, at 8–11; see also O’Rourke, supra note 29, at 1208–10 (arguing for a fair-use defense in patent law to address problems of market failure).
204. 307 F.3d 1351.
researchers who might use the tool. By “most competitive,” I mean “most likely to obtain a commercially valuable result.” Thus, if nonprofit researchers are most likely to use the tool for projects that do not compete with the primary commercial project, then a nonprofit exemption has much to recommend it. It seems likely that an assumption that this is the case often underlies proposals for a nonprofit research exemption. However, in such cases a formal nonprofit exemption may not be necessary because nonprofit researchers will probably be able to negotiate discounted licenses or simply infringe without repercussions. Empirical evidence suggests that this often happens, either because the infringement is not detected or because there is a norm disfavoring suits in such cases. Indeed, until government-funded researchers were given the right to patent their inventions and universities began partnering with commercial entities in technology transfer ventures; this kind of benign neglect of potential infringement by both patent holders and nonprofit researchers was undoubtedly the rule.

Recently, Professor Rochelle Dreyfuss and, with modification, Professor Richard Nelson have proposed a form of nonprofit research exemption that would serve primarily to “restore” what many had assumed existed before Madey was decided—an exemption for nonprofit research aimed at projects unlikely to result in significant short-run commercial value. Their proposed exemption would run in favor of noncommercial research organizations, universities, and their employees if (1) the patented materials they wish to utilize were not made available on reasonable terms; (2) the researcher agreed to publish the results of the work; and (3) the researcher agreed to refrain from patenting the results or to patent the results and then license them on a nonexclusive basis and on reasonable terms. The proposed waiver functions almost like a certification that the researcher will not preempt the tool inventor in commercially significant research.

The waiver proposal may restore part of the commercial market for the tools because it removes exempted researchers from the competition for commercially significant research. However, it simultaneously renders the exemption ineffective to solve the primary problem considered here—the potential for inventors of relatively simple research


206. See generally Dinwoodie & Dreyfuss, supra note 30; Dreyfuss, supra note 165.


208. Dreyfuss, supra note 165, at 15.

209. See id. at 8–10.
tools to have undue influence over the pace and course of tool-based research with potentially lucrative applications.

The case of interest for solving this problem is one in which the nonprofit researcher has a good chance of beating the tool inventor to a commercially interesting research result if given access to the tool. In that kind of case, a nonprofit exemption, like any other experimental-use exemption, will increase incentives for secrecy where secrecy is possible.210 As already discussed, though, Region B is small for relatively easily developed research tools. The more important question is the effect of a non-profit exemption on Region C. Here there are serious implications for tool development incentives.

In Region C, if there is a nonprofit exemption and any nonprofit is a more effective research unit than the tool developer is able to assemble, the tool developer will be unable to maintain control of the results of the tool-based research. The tool developer who patents her invention will thus need to commercialize the tool if she hopes to recoup her investment. But the tool developer cannot obtain any revenue from the use of the tool by any nonprofit entity if these entities are exempted from infringement liability. To recoup her tool development investment, the tool patentee may still make the tool commercially available to for-profit researchers. But the commercial research market is smaller and it may shrink further if commercial entities are unwilling to pay as much for a tool license—or even to take one at all—when they must compete with nonprofit researchers who get to use the tool for free. Because it may cut out a substantial part of the market for a commercialized tool, a nonprofit exemption seems more likely than a compulsory license to decrease incentives to develop and patent research tools for commercialization. Moreover, a nonprofit exemption will do nothing to solve any problem of research delay in fields dominated by the private sector.

It is also unclear whether any nonprofit exemption can adequately solve the problem, which Madey may have posed, of research tools that are difficult to develop. Concern is usually focused on making available to the nonprofit sector research tools—express sequence tags ("ESTs") being a prototypical example211—that are relatively trivially developed and can then be patented and used to lock up access to much more difficult and extensive research. But, as discussed in Part III.B.2, there are also examples, which are common in the basic research context, of research projects in which development of a complex new piece of equipment is the most difficult and important phase of the research. In other words, the research tool is the “dog,” not the “tail.” The inventor of such a tool may justifiably wish to limit the ability of others to free ride on her inventive efforts by performing the final—and in this case

210. See infra Region B, Fig. 6.
211. See Epstein, supra note 151, at 51–57; Mueller, supra note 37, at 10–17.
relatively trivial—application of the equipment to obtain results. This issue is not limited to commercially important results because nonprofit researchers are highly sensitive to reputational rewards—which may be significant for results that no one wishes to patent.

For such cases, a nonprofit exemption, even if it includes a waiver requirement, both reduces incentives to develop the equipment and increases incentives to work in secret—neither of which are desirable outcomes in the nonprofit context. Thus, a nonprofit exemption provides at best a partial solution to problems of research tool patenting.

4. ANALYSIS OF COMPULSORY LICENSING AS A VEHICLE FOR SEPARATING COMPENSATION FOR INVESTMENT FROM CONTROL OF RESEARCH

Commentators, most notably Mueller, have alternatively suggested some sort of compulsory licensing for experimental use of a patented research tool invention. Because compulsory licensing provides compensation to the tool inventor but frees others to perform tool-based research, it is a possible mechanism to separate recovery of investment in tool development from “tail wagging the dog” control of tool-based research. Because compulsory licensing requires payment from the user, it need not be confined to nonprofit researchers. Compulsory licensing effectively forces a tool inventor to choose between researching in secret and commercializing the tool. The option of using a patent to secure a longer period for in-house research is eliminated when a compulsory license is available.

Thus, referring to Figure 6, we can see that compulsory licensing of a research tool will have little impact in cases in Region A, where the tool inventor can win the race regardless of whether the tool is available to other researchers. Compulsory licensing will also have little impact in Region D, where the tool inventor can never win the research race and will thus choose to make the tool available on the market to recoup her development expenses, with or without a compulsory licensing incentive.

In Region B, tool inventors subject to a compulsory licensing regime will resort to secrecy because they are able to maintain control of the tool-based research in that way. But, as discussed earlier, for research tools that are relatively easy to develop, the delay occasioned by secrecy will be correspondingly small in Region B because the ability to perform secret research is limited by the ease with which third-party researchers can develop the tool independently. There is also little societal detriment if the inventor of a complex research tool can complete the research in

212. The inventor may wish to limit free riding even if the “others” are nonprofit researchers who are willing to forego patenting their results.

213. See, e.g., Mueller, supra note 37, at 54–59.
secret because there is likely to be little difference in the pace at which different researchers can perform “easy” research.

In Region C, secrecy is insufficient to protect the tool inventor’s lead in tool-based research and, if compulsory licensing is imposed, then the tool inventor will have to patent and commercialize her tool to reap any benefits from its invention. In this region, compulsory licensing would have a significant positive impact on the inventors of relatively “easy” tools because it precludes research delays that can range up to twenty years.

The effect of compulsory licensing for complex research tools whose inventors cannot finish their research in secret is much less positive, however. If such inventors cannot count on the royalty rate being high enough to offset their large investments in tool development, then they will be disinclined to invest in tool development. Perhaps equally important in many cases is the inability of compulsory licenses to allocate reputation rewards from research. Reputational rewards will tend to accrue to the one who performs the final research. This outcome is a reasonable outcome for easily developed tools because the final researcher actually has performed most of the difficult work. But this inability to allocate reputational rewards is a significant drawback of compulsory licensing for developers of complex tools. Moreover, as already noted, licensing—perhaps especially compulsory licensing—has transaction costs. These costs may be worthwhile to avoid significant research delay, but they are unlikely to be justified in the complex research tool context.

Because compulsory licensing limits the tool inventor in Region C to recovery of a royalty payment rather than offering the potential rewards from the research results, it will decrease the incentives for those who are not fast researchers to develop tools. These decreased incentives will apply even to easily developed research tools. In some circumstances, depending on how the royalty is determined, the commercial market for the tool might not be sufficient to induce the fastest potential tool developer to develop the tool.

Whether the specter of compulsory licensing deters some potential tool developers, the combined effectiveness of tool development and tool-based research for simple tools is still likely to improve in Region C under a compulsory licensing regime. When tool development is relatively easy compared to tool-based research, good researchers have strong incentives to engage in in-house tool development efforts because they can win the research race even if other researchers gain access to the tool. The public benefits from compulsory licensing as long as it results in a more effective combination of tool development and tool-based research. Ironically, such benefits can arise despite compulsory licensing having its feared effect of deterring some potential tool inventors. As long as the tools are relatively easy to develop, compulsory licensing
tends to put the tool-based research in the hands of the most effective researchers.

Compulsory licensing has long been proposed as a solution to perceived excesses of patentee exclusivity. More specifically, a detailed proposal for compulsory licensing of research tools has been made by Mueller. She proposes compulsory licensing for “research tools not readily available for licensing on reasonable terms or via anonymous marketplace purchase.” In her proposal, availability of the compulsory license would be limited to research use of the tools and the royalty would be a “reach-through royalty” based on the ultimate commercial value of the research results. Professor Donna Gitter has endorsed a similar proposal specifically for gene sequences.

Critics of compulsory licensing schemes for patents, of whom Professor Richard Epstein is a recent example, raise a litany of criticisms of such proposals ranging from philosophical objections to forced transfers of property rights to a parade of administrative horribles. As Epstein recognizes, and as Dreyfuss emphasizes in a response to Epstein’s paper, “the core significance of compulsory licensing requirements is that they act as credible threats, not as actual business deals.” Dreyfuss points to the experience of other countries in this regard, noting that “developed countries that have compulsory licensing requirements in their laws find that potential research licensees rarely need to resort to court to enforce them.”

Epstein complains that, besides being likely to “fail as an administrative matter,” compulsory licensing provisions do more than bring parties to the bargaining table. He argues that they “change the threat positions of the parties to any negotiation,” “deny a patent holder


215. Mueller, supra note 37, at 58.

216. Id.

217. Id.

218. See generally Gitter, supra note 214.


220. Id. at 29.


223. Epstein, supra note 151, at 36.
the right to choose the parties with whom he will do business in the first place,” and “make exclusive licenses a dead letter.” As Dreyfuss comments, these criticisms arise from an underlying concern that compulsory licensing depresses the returns that a patentee may capture.

One might agree that in the usual case, compulsory licenses are a poor substitute for freely negotiated arrangements. The problem of easily developed research tools is a special case, however, to which Epstein’s criticisms have questionable application. Dreyfuss has pointed out several practical reasons to expect compulsory licensing to be more successful in the research tool context than Epstein predicts. But the more basic response to criticisms of compulsory licensing is that, in the context of research tool patents that are being used to control and delay progress in research rather than to overcome the free-rider problem of appropriable investment, some of the purported disadvantages of compulsory licensing are precisely the point of the proposals.

Because the research tool patent holders in question are trying to “game the system,” it is precisely the goal of a research exemption to change the threat positions of the parties and to force the tool patent holder to deal with those who may beat her in the tool-based research race. To put an even finer point on it, when we are dealing with tools that are mere tails in comparison to the research dogs they control, we are not even too concerned that the administrative costs or reduced royalties associated with compulsory licensing might deter some potential tool developers. If necessary, we are willing to let the research dog wag the tool tail, removing incentives for unqualified researchers to grab control of downstream research through tool patents and leaving incentives for effective researchers to take care of tool development.

3. A PROPOSAL FOR A TWO-TIERED COMPULSORY LICENSING SCHEME FOR RESEARCH TOOL PATENTS

Of course these responses to criticisms of compulsory licensing are only convincing if a compulsory licensing proposal finds a way to identify the research tool patents to which they should apply. Here, I share with Epstein a preference for “all-or-nothing” rules that do not impose too many complicated judgment calls on judges and juries in these cases. The viability of a research tool exemption depends on having some sensible mechanism for applying it. The characteristics of problematic research tool patents identified above were: (1) no close substitutes; (2) developing the tool is much easier than doing the tool-based research; and (3) the tool patentee—in conjunction with her

224. Id. at 29.
225. Dreyfuss, supra note 165, at 7.
226. Id. at 9.
employees and exclusive licensees—is not the most effective researcher. While this list of factors is fine as a theoretical matter, it would clearly be preferable to avoid incorporating them into jury instructions. The question is whether there is a simpler rule that can serve as a reasonable proxy for these requirements.

Extant proposals for research tool exemptions confine them to tools that have not been commercialized. Failure to commercialize a research tool may indicate that there are no close substitutes for the tool. The availability of close substitutes eliminates the possibility of controlling tool-based research by controlling the tool and provides an incentive to commercialize the tool. However, relying on a failure to commercialize as a test for compulsory licensing has some important drawbacks.

First, failure to commercialize cannot identify the cases in which the tool inventor is the most effective researcher. In those cases, commercializing the tool would be wasteful and failing to commercialize is not indicative of a problem. Second, a commercialization test does not distinguish the true research tool cases discussed here, in which development of the tool is relatively trivial compared to the research, from the case of a very complicated research instrument that can be used easily to solve important research problems. Third, a commercialization requirement begs the question of timing. At what point is it reasonable to assess whether an invention has been commercialized? Finally, a commercialization test will often be difficult to assess, the question of whether a tool is “readily available for licensing on reasonable terms” is open to significant and inevitable dispute.

In light of these complications, I would like to float an “all-or-nothing” proposal that I believe might be effective in addressing the research tool issue. Looking at Figure 6, we can see that any difficulties that arise in the research tool case stem from the length of the patent term, which in principle permits tool patent holders to delay research by as much as twenty years. The twenty-year patent term performs two functions for research tool patents. As for ordinary inventions, it limits the time period over which a patentee can collect royalties or higher prices to recoup her investment in appropriable intellectual property. For research tools, however, it may also provide an excessive opportunity to delay important research for an inventor who has made a relatively minor contribution.

Compulsory licensing is a way of decoupling these two time periods. And there is no a priori reason that compulsory licensing must kick in at

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228. See, e.g., Mueller, supra note 37, at 58 (proposing compulsory licensing for tools “not readily available for licensing on reasonable terms or via anonymous marketplace purchase”).

229. See infra Region A, Fig. 6.

230. Mueller, supra note 37, at 58.
the beginning of the patent term. Instead, patent rights for research tools might consist of two periods: a few years—perhaps three to five—of complete exclusivity followed by a period to complete the patent term during which compulsory licenses would be available.

Such an approach would encourage early commercialization and voluntary licensing. It would give the tool patentee an opportunity to maintain control of the tool-based research either by demonstrating her own research skills or by making socially beneficial bargains with more effective researchers so as to preserve the opportunity to capture at least some portion of the rewards of the eventual research. By reducing the opportunities for delay it would remove some of the opportunities for private rent-seeking.

The initial exclusivity period would also provide an opportunity for inventors who have sunk significant research and development investments into complex research tools with simple applications to perform the research their inventions have made possible. The inventor of a complex piece of laboratory equipment can publish the workings of the equipment in a patent while at the same time having a period of exclusivity to obtain the first research results employing it. Such a scheme preserves incentives both to develop complicated equipment and to place its workings into the public domain.\(^{231}\)

The initial exclusivity period would implicitly sort out whether there are close substitutes for the tool, whether the tool inventor can effectively manage the tool-based research, and whether the tool development was a trivial precursor for the tool-based research (distinguishing the dogs from the tails).\(^{231}\)

Only if the research facilitated by the tool cannot be accomplished or coordinated by the tool inventor during the initial exclusivity period and if the tool inventor has failed to commercialize the tool will there be much interest in the compulsory licenses when they become available. The compulsory license period will serve primarily as an incentive for the negotiation of voluntary licenses during the exclusive period. Because the compulsory license would be available only after a substantial delay, there would be incentives for both sides to come to an agreement rather than let the compulsory provisions kick in.

The exclusivity period would also provide some reference for the determination of a reasonable compulsory license.\(^{232}\) While royalty

\(^{231}\) See also Fed. Trade Comm’n, supra note 2, at 23–24 (discussing how enablement doctrines may facilitate a similar distinction in patent breadth between easy tools with complex applications and complex tools with simple applications).

\(^{232}\) It would be possible to simplify this proposal further by completely exempting research tool use after the exclusivity period. This simplification would remove some of the potential administrative difficulties of compulsory licenses but might pose the problem of too little incentive for tool development and could even conceivably delay the eventual research if third parties find it possible just to wait out the exclusivity period. On balance, and given the experience of other countries with compulsory license
determination is notoriously difficult, it may make sense to defer royalty determination to a compulsory licensing proceeding. By the time the compulsory licensing period kicks in, the experience with the tool during the exclusivity period should provide evidence of how much the tool invention contributes to the research process. Leaving this type of flexibility in the back-up compulsory license will help promote voluntary licensing since neither party will be able to count on a slam-dunk at the compulsory licensing stage. Experience elsewhere suggests that the potential complication and expense of administrative proceedings will be offset by the incentives to come to voluntary resolutions.

The approach suggested here is similar to the “working requirement” in the patent law of the United Kingdom, for example. It is also similar to the proposal made by Molly Holman and Stephen Munzer for the ESTs used in genetic research, though the approach suggested here differs from the Holman and Munzar proposal in that it does not incorporate a separate or weaker patentability requirement for research tools. This approach affects only infringement liability and not any patentability requirements.

There remains, of course, the question of the length of the initial exclusivity period. Here, of course, as for the patent term, there is no one right answer and one could argue for different periods for different areas of research. However, the patent law deals with average public benefit and we need not get the answer exactly right to make a significant

regimes, it seems better to require a royalty payment during the balance of the patent term. Another approach would be simply to make the injunctive remedy unavailable for research tool uses after the exclusivity period. This approach would also take care of potential administrative difficulties at the expense of a less predictable damages remedy. Again, on balance, it would seem that the more expert royalty determinations of an administrative body would be preferable to avoid overdeterrence of experimental use after the exclusivity period expires. However, the analysis in this Article does not strongly distinguish between these options.

233. See Mueller, supra note 37, at 58–66.
234. International obligations require that some other determinations be made at the time of application for compulsory licensing in any event. TRIPS article 31(b) permits compulsory licenses only if “prior to such use, the proposed user has made efforts to obtain authorization from the right holder on reasonable commercial terms and conditions and that such efforts have not been successful within a reasonable period of time.” Id. at 56 n.277 (internal quotations omitted). While this requirement may reintroduce some of the complexity of the commercialization requirement, it is specific to a particular licensee and thus more amenable to determination in a licensing proceeding. An evaluation of TRIPS-compliance is beyond the scope of this Article. For a more complete discussion of the implications of TRIPS in the context of an experimental use exemption, see Dinwoodie & Dreyfuss, supra note 30, at 17–18.
235. See generally Mueller, supra note 37, at 65–66; see also Dreyfuss, supra note 165, at 6–7.
improvement over the status quo. What is clear is that twenty years is too long a delay for any research field. One or two years is probably not enough time for the commercialization issues to shake out. Something somewhat longer—say four or five years—is probably about right.

In sum, while a nonprofit exemption of the type proposed by Dreyfuss and Nelson may have the important public benefit of restoring the ability for nonprofit researchers to perform research without significant commercial implications, a two-tiered compulsory licensing solution has broader application to the problem of delay in research into problems of commercial significance and better protects the investments of inventors of complex equipment used primarily in the nonprofit sector.

V. CONCLUSION

The goal of any experimental-use exemption should be to distinguish between a patentee’s reasonable efforts to recoup her investment in appropriable intellectual property and a patentee’s attempts to exert undue control over follow-on innovation. This distinction is already enshrined in many aspects of the patent law, including the disclosure requirement. 238 An analysis of the differing roles played by the incentive to invent and the incentive to disclose in the development of different inventions indicates that experimental use [should be hyphenated only when an adjective, right?] aimed at understanding, designing around, or improving a patented invention is merely an extension of disclosure. Such “experimenting on” has little direct effect on the free-rider problems that the patent system’s incentive to invent is designed to solve. “Experimenting on” a patented invention can, and should, be broadly permitted, regardless of commercial intent, as a means of ensuring that the public receives the benefit of its patent bargain with respect to follow-on innovation.

Experimentation “with” patented inventions—the case of research tools—poses more difficult questions because the patentee’s ability to recoup tool development investments is entangled with her ability to exert undue control over tool-based research. After considering proposals for research tool exemptions based on the nonprofit status of the researcher, I conclude that a more effective scheme for speeding the pace of commercially significant research while preserving incentives to invest in tool development is a two-tiered compulsory licensing scheme. In the proposed scheme, a research tool patentee would be entitled to a limited period of complete exclusivity during which she would have an opportunity to perform research or to commercialize or license the

238. *Integra*, 331 F.3d at 875 (Newman, J., concurring in part and dissenting in part). “[T]he patent system both contemplates and facilitates research into patented subject matter, whether the purpose is scientific understanding or evaluation or comparison or improvement. Such activities are integral to the advance of technology.” *Id.*
patented tool voluntarily. After the expiration of this period, compulsory licenses would be available through the remainder of the patent term, though the expectation would be that the availability of such licenses would serve primarily as an incentive to voluntary solutions. This two-tiered scheme would implicitly sort out situations in which the research tool is a mere “tail wagging a dog” of complicated research from situations in which developing a complex piece of research equipment is the major technological contribution.

As discussed above, the experimental-use exemption proposals in this Article have been designed as much as possible to rely on inherent differences between inventions rather than on explicit determinations by a court or administrative body. The self-disclosing versus non-self-disclosing distinction and the distinction between “hard” and “easy” research tools are exploited through their implicit effects and need never be considered explicitly in a particular case. However, there are two categorizations that must be made explicitly: uses must be characterized as “experimental” or “not experimental” and experimental uses must be characterized as “experimenting on” or “experimenting with.”

It is useful to point out what does not have to happen: there is no need to characterize patents or patent claims as “experimental” or as “research tool” patents or claims. Some patented inventions are dual-purpose, with uses, for example, both as clinical tests and in the laboratory for research. Under the proposed scheme of exemptions, determinations of experimental use will always be specific to the factual circumstances of a particular use. Thus, the fact that “it is often hard to tell the difference between things that are used only in the laboratory and things that might potentially be sold to non-research consumers” is not necessarily cause for concern because the proposed exemptions would apply only when the patented invention was being used for research and not when it was sold to nonresearch consumers.

The threshold question whether a use is “experimental” is an unavoidable part of any experimental-use inquiry that must be confronted however the exemption is structured. Specifically relevant to the proposals made in this Article is the need to distinguish “experimenting on” from “experimenting with.” In many cases, of course, the distinction


240. It is part of the inquiry under the current experimental-use exemption, but it might rise in importance under a more robust exception. The current exception is so narrow that it can generally be dismissed based on the legitimate business inquiry without any need to quibble over whether the use was experimental. Under the proposal advanced here, the issue whether a use is experimental can arise either in an administrative compulsory licensing proceeding (for experimenting with) or in infringement litigation (for experimenting on). Often, of course, close cases will be resolved a priori by bargaining “in the shadow” of the research exemption.
is clear. The use of a patented laser to study the optical properties of materials is clearly “experimenting with” the laser while research aimed at improving the power of the same laser is clearly “experimenting on” the laser. More generally, research on subjects far removed from the technical field of the patented invention is easily determined to be “experimenting with.” Many cases of “experimenting on” a patented invention to produce an improved product will be equally clear. Particularly when the improved product or process incorporates the original patented invention, such experimentation raises few concerns about incentives for producing the original invention since the original inventor can collect royalties on the improved product.

But more difficult cases seem certain to arise, particularly in areas, such as biotechnology and software, in which the “tools” of the trade are often of the same technological nature as the subject of the research. In fact, disagreement on the issue has already cropped up in the Federal Circuit. In *Integra Lifesciences I v. Merck KGaA*, which dealt with the applicability of a statutory exemption for research aimed at FDA approval, the majority and dissenting opinions disagreed not only about the relevance of the common law experimental-use exemption but also about whether the patented invention was a research tool.\(^\text{241}\) So how is this issue to be resolved?

While it is probably impossible to produce a bright-line rule to distinguish the two types of experimentation, it is possible to use the analysis in this Article to refine the inquiry. To deal with more difficult cases, we return to the distinction between use of the inventive idea as a basis for follow-on innovation and use of the invention for its intended purposes. “Experimenting on” is aimed at using the inventive idea, whereas “experimenting with” is aimed at using the invention. One way to get at this distinction is to ask whether, in a world of perfect communication, the experimental use of the invention could be replaced by a perfect disclosure. In other words, could the infringing experimentation have been avoided in principle by more information about the patented invention? If so, we are dealing with “experimenting on.” If not, we are dealing with “experimenting with” and the two-term compulsory licensing approach should apply. This test may be applied to some examples for purposes of illustration.\(^\text{242}\)

\(^{241}\) Compare 331 F.3d at 872 n.4 (“The dissent asserts that Integra’s patented RGD peptides are not research tools, ‘but simply new compositions having certain uses.’ . . . The dissent does not explain why one of those ‘certain uses’ cannot embrace use of an RGD peptide as a laboratory tool to facilitate the identification of a new therapeutic.”), with id. at 878 (Newman, J., concurring in part and dissenting in part) (“The RGD-containing peptides of the Integra patents are not a ‘tool’ used in research, but simply new compositions having certain biological properties.”).

\(^{242}\) I am grateful to Rochelle Dreyfuss for bringing two of these specific examples to my attention.
Let us begin by applying this analysis to the prototypical Madey\textsuperscript{243} and Embrex\textsuperscript{244} cases that motivated this work. The Madey case is a clear example of “experimenting with.” The infringement involved use of the free electron laser to perform its intended function. No amount of information about the laser components could substitute for the use of the laser itself. In Embrex, on the other hand, complete information would have avoided the infringement. Had the infringing researchers understood the patented vaccination process completely, they could have predicted that their attempt to design around it would result in infringement and avoided the unsuccessful experiments.

The Integra case involved experiments on particular cyclical peptide compounds believed potentially useful for various medical treatments, including treatment of cancer, diabetic retinopathy, and rheumatoid arthritis. Research was performed on several candidates “to evaluate the specificity, efficacy, and toxicity . . . to explain the mechanism by which these drug candidates work, and to determine which candidates were effective and safe . . . .”\textsuperscript{245} These drug candidates were later found to infringe a patent on a particular peptide sequence. The majority opinion characterized the research as “use of an RGD peptide as a laboratory tool to facilitate the identification of a new therapeutic.”\textsuperscript{246} The dissent, on the other hand, opined that “[t]he Scripps/Merck syntheses and evaluations of new RGD peptides were not use of the Integra products as a research tool.”\textsuperscript{247}

The analysis presented in this Article leads us to side with Judge Newman’s partial dissent on the research tool question in Integra.\textsuperscript{248} The purpose of the experiments in that case was to learn more about the new cyclic peptide compounds. If these new compounds were within the scope of the more generic peptide compound patent, then this research was aimed at understanding the patented invention. A perfect disclosure of the patented invention would have obviated the need for such experiments. Thus, the experiments were in the “experimenting-on” category.

Next, consider a patented software program, such as, for example, a program for an operating system. To produce applications that are compatible with the patented operating system it may be necessary to reverse engineer the program and to use the patented invention during process of debugging the compatible application. Copyright law generally permits reverse engineering for purposes of producing

\textsuperscript{243} 307 F.3d 1351.
\textsuperscript{244} 216 F.3d 1343.
\textsuperscript{245} Id. at 863 (internal quotations omitted).
\textsuperscript{246} Id. at 872 n.4.
\textsuperscript{247} Id. at 878 (Newman, J., concurring and dissenting).
\textsuperscript{248} 331 F.3d at 872.
interoperable code but to date, patent law does not recognize an interoperability exception. Should the use of patented software to produce interoperable applications be treated as “experimenting on” because its purpose is to understand the patented software well enough to make complementary innovation possible or should it be treated as “experimenting with” because it does not produce an improved version of the patented invention but is a “tool” to produce a different sort of product?

The reverse engineering of software to produce an interoperable product is a relatively straightforward case of “experimenting on” under this analysis. Interoperability requires an understanding of the patented operating system or other software. The patented software is not being used to obtain information about some other topic.

BRCA1 and BRCA2 kits are used clinically to detect specific genetic markers that signify an increased risk of breast cancer. Not all breast cancers are associated with these specific genetic markers, however. Suppose that, in an attempt to discover other possible breast cancer markers, researchers use the BRCA 1 and BRCA 2 kits to exclude cancers that are explainable by the known markers so that they can study the remaining unexplained cancers. If this research produces a new breast cancer test, is the research use of the BRCA 1 and BRCA 2 kits “experimenting on” because it produces an improved breast cancer test or is it “experimenting with” because the original kits are used as tools to produce the samples used in the search for a new marker?

The distinction between use of information about the patented invention and use of the invention leads to a different result when applied to this example. It appears that no amount of further information about BRCA1 or BRCA2 would substitute for the use of the kits to identify the unexplained tumors. In this case, researchers are “experimenting with”

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250. Up to the present time, software has been protected primarily by copyright and trade secret law, both of which permit reverse engineering, at least for interoperability purposes. The issue of reverse engineering of patented software has yet to be addressed by the courts, though it has been considered by commentators. See, e.g., Burk & Lemley, supra note 109, at 8–13 (discussing the relationship between reverse engineering of patented software and the patent disclosure requirements); Cohen & Lemley, supra note 99, at 17–21.

251. There is a slight complication in the software reverse engineering context because the reverse engineering uncovers not only (and perhaps not even primarily) information about the patented invention but also copyrighted or trade secret “know-how” that is not protected by patent. This type of use also serves the “experimenting on” function, however, because it is aimed at uncovering information about the patented software that should be available to the public under copyright or trade secret law.
the kits and using them for their intended function—the identification of the BRCA1 and BRCA2 genetic markers.

As a final example, *Scripps Clinic & Research Foundation v. Genentech* involved a patented purified human blood-clotting agent factor VIII:C. Genentech isolated the gene that encoded factor VIII:C from the purified material, then cloned the gene to produce recombinant factor VIII:C. Experimental use was not at issue in the case, most likely because Genentech’s intent to commercialize the recombinant factor VIII:C would have precluded application of the exception under current law. However, as pointed out by Phillipe Ducor, the facts provide an interesting hypothetical for considering research exemption proposals.

In a case such as this one, the final product is an improvement over the original patented invention, which may itself still infringe the claims of the original patent. Yet, one could argue that in the research the purified factor was used as a tool to retrieve the encoding gene. If so, the recombinant product was obtained by “experimenting with” the patented invention.

This example poses difficult line-drawing questions. First, we must distinguish between potential claims to the process for purifying factor VIII:C and claims to the purified factor VIII:C itself. Infringement of claims to the purification process while producing purified factor VIII:C to be used in further research is the easy case. More detailed information about the purification process would not substitute for use of the process, which is thus squarely in the “experimenting with” category. But what about the extraction of the gene needed to produce the recombinant version of factor VIII:C from the purified factor VIII:C itself? Again, the disclosure-based analysis suggests that this use is “experimenting with” the patented material as a research tool. The extraction of the gene from the purified factor VIII:C may provide new information about the patented factor VIII:C itself. Research aimed merely at producing this new information would constitute “experimenting on.”

However, as

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254. *Id.*
256. One might at first wonder whether information about the patented invention that the patentee did not have at the time of patenting should be deemed part of the “disclosure” that is available for “experimenting on.” The doctrine of inherent anticipation suggests that the answer to this question is “yes.” When an invention is patented, all information about that invention—even if in fact unknown to the patentee—is deemed to be part of the prior art and within the purview of the patentee’s claims to the invention. *See* Schering Corp. v. Geneva Pharms., Inc., 339 F.3d 1373, 1377 (Fed. Cir. 2003).

Moreover, a prior art reference may anticipate without disclosing a feature of the claimed invention if that missing characteristic is necessarily present, or inherent, in the single anticipating reference. . . . [I]nherent anticipation does not require that a person of ordinary skill in the art at the time would have
long as the research aimed at producing the recombinant factor VIII:C could not have been completed using the information alone but required the extracted genetic material, it should be classified as “experimenting with” the patented factor.

Though there will undoubtedly be hard cases, these examples illustrate how the analysis here can provide a framework that is capable of categorizing experimental uses as “experimenting with” versus “experimenting on” the patented invention. This framework is closely tied to the underlying theoretical reasons for the distinction between the two types of experimental use.

Finally, the proposals here may illustrate the possibility of a middle ground in the broader dispute between those who believe that the heterogeneity of subject matter covered by the patent laws demands specialized treatment for different types of inventions and those who advocate an “all-or-nothing” approach. The proposals here demonstrate that it may be possible in some instances to have the best of both worlds by designing rules of uniform applicability that inherently

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recognized the inherent disclosure. . . . [I]nherency places subject matter in the public domain as well as an express disclosure.

Id. 257. See Gallini & Scotchmer, supra note 42, at 71–72 (discussing the need to design IP regimes to deal with economic heterogeneity and arguing that “each intellectual property regime should cover subject matter with similar needs for protection”); Samuelson & Scotchmer, supra note 249, at 1663 (providing an economic analysis suggesting that “[r]estrictions on reverse engineering ought to be imposed only if justified in terms of the specific characteristics of the industry, a specific threat to that industry, and the economic effects of the restriction”).

258. See Epstein, supra note 151, at 2–3 (discussing the advantages of “all-or-nothing” rules).
discriminate between types of inventions, thus providing desirably heterogeneous results from “one-size-fits-all” rules.259

259. For a proposal with a similar spirit, see Burk & Lemley, supra note 109, at 1648, 1672–73 (arguing that modifications to the PHOSITA standard will differentiate between technologies in a useful way and discussing the way in which various patent law doctrines, including the experimental-use exemption, can make implicit distinctions between technologies).
Experimental Use and the Patent Bargain

Fig. 1

Invention

No Invention

Fig. 2a

Invention

No Invention

Fig. 2b

Invention

No Invention
Invention w/ Patent

Invention w/ or w/o Patent

Self-Disclosing Patent

Non-Self-Disclosing Trade Secret

Non-Self-Disclosing Trade Secret or Patent

Self-Disclosing Patent

Fig. 3a

Fig. 3b

Fig. 4

Non-Self-Disclosing Trade Secret