CUMULATIVE INNOVATION IN PATENT LAW: MAKING SENSE OF INCENTIVES

OFER TUR-SINAI*

ABSTRACT

New innovation can be vastly dependent upon patented technologies. Despite growing awareness within the legal community of the chilling effect that the patent system may have on research and development, the United States patent law still does not provide adequate solutions to conflicts that may arise in a cumulative innovation setting. Against this background, this Article embarks on a comprehensive analysis of cumulative innovation. Examining the issue from the perspective of the well-versed incentive to invent theory—while accounting for certain important aspects that have been overlooked so far in legal scholarship—this Article suggests three main mechanisms that can work in tandem to ensure appropriate incentives in a cumulative innovation setting. The first mechanism, the Absolute Scope Principle, ensures the first inventor's incentive by including the exploitation of all follow-on inventions within the scope of the first patent. This includes products developed through use of patented research tools, and is subject only to a narrow exemption doctrine based on a reasonable expectations test. The Absolute Scope Principle is balanced by the second mechanism, a wide experimental use exception, allowing development of any follow-on inventions without receiving advance permission of the original patentee; and by the third mechanism, liability rule doctrines, allowing

* Faculty of Law, Ono Academic College. LL.B., , The Hebrew University of Jerusalem; LL.M., , Columbia University; LL.D., 2009, The Hebrew University of Jerusalem.

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non-consented exploitation of follow-on inventions in return for a reasonable royalty in case the inventors fail to reach a voluntary agreement. This Article concludes with a critical examination of the U.S. patent law, offering concrete suggestions for patent law reform necessary in order for the U.S. to provide a supportive environment to cumulative research and continue to lead the global innovation markets.

TABLE OF CONTENTS

I. INTRODUCTION

Technological research and development is often conducted in a cumulative manner—inventors must frequently rely on the discoveries and inventions of previous inventors in order to make their own contribution. When these discoveries and inventions lie within the public domain, this is a simple matter; however, when essential information is covered by a patent, potential conflict exists between the exclusive rights of the patent owner and the need to capitalize on her invention to continue developing the technology. As a result, the patent system may ultimately have a chilling effect on research and development.

While cumulative innovation is far from a new phenomenon,[1] until quite recently, this topic has not received adequate attention in academic literature.[2] Traditional thinking in patent law assumes that each patented invention stands alone and tends to ignore the possibility that an invention can also, or exclusively, serve as input in the development process of follow-on inventions.[3] Theoretical studies of the patent system have generally focused on the process leading to the development of a stand-alone invention and on the costs associated with granting exclusive rights in such invention.[4] Accordingly, various doctrines in

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1 As early as 1675, Sir Isaac Newton noted: "If I have seen further it is only by standing on the shoulders of giants." Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, J. ECON. PERSP., Winter 1991, at 29, 29 (quoting Letter from Isaac Newton to Robert Hooke (Feb. 5, 1675)).

2 *See id.* at 30; Howard F. Chang, *Patent Scope, Antitrust Policy, and Cumulative Innovation*, 26 RAND J. ECON. 34, 34 (1995); Ted O'Donoghue, *A Patentability Requirement for Sequential Innovation*, 29 RAND J. ECON. 654, 654 (1998); Pierre Régibeau & Katharine Rockett, *The Relationship Between Intellectual Property Law and Competition Law: An Economic Approach* 11 (Univ. of Essex and CEPR, Discussion Paper No. 581, June 2004), *available at* http://www.essex.ac.uk/economics/discussion-papers/papers-text/dp581.pdf.

3 *See, e.g.*, Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 868 (1990) (claiming that in most discussions of the patent system, emphasis is placed on the basic trade-off between incentives to the inventor and subuse of her invention as a result of monopolistic rights granted to her); Richard R. Nelson, *Intellectual Property Protection for Cumulative Systems Technology*, 94 COLUM. L. REV. 2674, 2676 (1994) (arguing that the problems associated with the grant of strong patent rights in cumulative technologies are not adequately dealt with in the standard isolated invention model).

4 See, for example, WILLIAM D. NORDHAUS, INVENTION, GROWTH AND WELFARE: A THEORETICAL TREATMENT OF TECHNOLOGICAL CHANGE (1969), for one of the most influential studies of the patent system, which discusses the basic trade-off between the desire to pro-

patent law are not equipped to solve conflicts that may arise in a cumulative innovation setting.[5] This is in contrast to copyright law, where the need to allow authors access to protected works is a fundamental factor.[6]

Only in the 1990s did a more dynamic perception of patent law begin to evolve, and scholarly discussions of cumulative innovation started to emerge—first, among economists,[7] and shortly thereafter in the legal community.[8] Since then, related legal literature has focused on ensuring that the exclusive rights granted to an inventor do not prevent the subsequent development of technological advances by follow-on inventors and has proposed to amend various arrangements in patent law in order to minimize this concern.[9] Scholars have fo-

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vide an incentive to invent and the social loss resulted from the monopolistic pricing by the patent owner, in an attempt to figure out optimal patent length. This article has served as the basis for many other studies of the patent system focusing on the above-mentioned trade-off. *See, e.g.*, Richard Gilbert & Carl Shapiro, *Optimum Patent Length and Breadth*, 21 RAND J. ECON. 106 (1990); Paul Klemperer, *How Broad Should the Scope of Patent Protection Be?*, 21 RAND J. ECON. 113 (1990) (attempting to find the combination of patent length and patent scope that would ensure a given amount of profit to the (singular) inventor while minimizing monopolistic cost).

5 *See, e.g.*, Madey v. Duke Univ., 307 F.3d 1351 (Fed. Cir. 2002); Embrex, Inc. v. Serv. Eng'g Corp., 216 F.3d 1343, 1349 (Fed. Cir. 2000); Roche Prods., Inc. v. Bolar Pharm. Co., 733 F.2d 858 (Fed. Cir. 1984); Ares-Serono, Inc. v. Organon Int'l B.V., 862 F.Supp. 603 (Mass. Dist. Ct. 1994); Pfizer, Inc. v. Int'l Rectifier Corp., No. 73–58, 1982 U.S. Dist. LEXIS 17411 (C.D. Cal. July 20, 1982) (constructing the experimental use exception in a narrow manner).

6 *See, e.g.*, WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 66–70 (2003); Wendy J. Gordon, *A Property Right in Self-Expression: Equality and Individualism in the Natural Law of Intellectual Property*, 102 YALE L.J. 1533, 1562 (1993).

7 In 1991, Scotchmer, *supra* note 1, was the first to author an article devoted to cumulative innovation.

8 *But see* Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017 (1989) [hereinafter Eisenberg, *Patents*]; Rebecca S. Eisenberg, *Proprietary Rights and the Norms of Science in Biotechnology Research*, 97 YALE L.J. 177 (1987) [hereinafter Eisenberg, *Rights*] (providing important earlier discussion of relevant matters). The topic may have attracted scholars' attention in the 1990s due to the expansion of the patent system into technological fields—such as biotechnology and software—typically characterized by cumulative innovation. It may also be related to the growth in scholarship addressing intellectual property issues, in general, or with the growing awareness of the need to preserve the public domain in an era of growing intellectual property rights, in particular. *See generally* Rochelle Dreyfuss, *Protecting the Public Domain of Science: Has the Time for an Experimental Use Defense Arrived?*, 46 ARIZ. L. REV. 457, 472 (2004); Jessica Litman, *The Public Domain*, 39 EMORY L.J. 965, 966–67 (1990).

9 Surprisingly, there has been hardly any integration of the economic studies on the topic with the legal writing. *Cf.* Rebecca S. Eisenberg, *Analyze This: A Law and Economics Agenda for*

cused mainly on the experimental use doctrine, which allows the performance of certain experimental activities during the patent term. The common argument in the literature supports its wide application, allowing for the development of follow-on inventions without the consent of the original patentee in a variety of circumstances.[10] The literature has also examined other doctrines and has suggested their employment in a manner that expands the freedom of follow-on inventors.[11]

Despite the legal community's growing awareness of the potential chilling effect of patents on follow-on research, no contemporary changes have been made in U.S. patent law to account for the cumulative nature of research and development. The experimental use exception, for example, is still narrowly construed by the courts in a fashion that negates its application if commercial motive exists, and its application has been denied even within the context of non-profit university research.[12]

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the Patent System, 53 VAND. L. REV. 2081, 2087–88 (2000) (noting the need for further integration between legal research and economic research in the field of patent law). *But see* John H. Barton, *Patents and Antitrust: A Rethinking in Light of Patent Breadth and Sequential Innovation*, 65 ANTITRUST L.J. 449, 452–53 (1996); Arti K. Rai, *Fostering Cumulative Innovation in the Biopharmaceutical Industry: The Role of Patents and Antitrust*, 16 BERKELEY TECH. L.J. 813, 819 n.24 (2001) (integrating economic research into their studies of cumulative innovation).

10 *See, e.g.*, Eisenberg, *Patents*, *supra* note 8, at 1078; Eisenberg, *Rights*, *supra* note 8, at 224–46; Irving N. Feit, *Biotechnology Research and the Experimental Use Exception to Patent Infringement*, 71 J. PAT. & TRADEMARK OFF. SOC'Y 819, 839–41 (1989); Janice M. Mueller, *No "Dilettante Affair": Rethinking the Experimental Use Exception to Patent Infringement for Biomedical Research Tools*, 76 WASH. L. REV. 1, 66 (2001); Tom Saunders, Comment, *Renting Space on the Shoulders of Giants: Madey and the Future of the Experimental Use Doctrine*, 113 YALE L.J. 261, 268 (2003); Katherine J. Strandburg, *What Does the Public Get?: Experimental Use and the Patent Bargain*, 2004 WIS. L. REV. 81, 119–52 (2004); Wendy Thai, *Toward Facilitating Access to Patented Research Tools*, 6 MINN. J.L. SCI. & TECH. 373, 390–97 (2004). *But see* Jordan P. Karp, Note, *Experimental Use as Patent Infringement: The Impropriety of a Broad Exception*, 100 YALE L.J. 2169, 2188 (1991) (arguing against a broad experimental use exception).

11 For example, some scholars have suggested various manners to narrow the scope of patentable subject matter, so that there are less basic patents that can potentially hold up follow-on research. *See, e.g.*, Rai, *supra* note 9, at 841. Others have proposed different mechanisms meant to reduce the number of patents registered in order to weed out patent thickets. *See, e.g.*, Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights*, 60 STAN. L. REV. 863, 893 (2007). Others have suggested to narrow down the patent scope, so that certain follow-on inventions would not be considered infringing upon the patent. *See, e.g.*, Merges & Nelson, *supra* note 3, at 916.

12 Madey v. Duke Univ., 307 F.3d 1351, 1362 (Fed. Cir. 2002) *See generally* Embrex, Inc. v. Serv. Eng'g Corp., 216 F.3d 1343, 1349 (Fed. Cir. 2000); Roche Prods., Inc. v. Bolar Pharm. Co., 733 F.2d 858 (Fed. Cir. 1984); Ares-Serono, Inc. v. Organon Int'l B.V., 862 F. Supp.

Against this seemingly dead end, reflected in the continuing gap between academic literature and the current legal regime in the U.S., lies the urgency to reexamine this issue. While some findings included in earlier works—most importantly, the basic recognition that cumulative innovation must be permitted and encouraged—are notable, certain important aspects have been overlooked in the legal literature. Most importantly, because the initial focus of scholars has been, naturally, on the need to ensure freedom to follow-on inventors, it seems that not enough attention has been devoted to ensuring the incentive of the first inventor in a cumulative innovation setting. Although a few scholars have discussed the need to compensate the original patentee,[13] certain important policy questions related to her rights and the means by which they should be secured have not yet been addressed.

Similarly lacking from the legal literature is the recognition of the two, distinct separate time periods in which the potential clash between inventors in a cumulative innovation setting may occur: the development period of the second invention and the time period that it is exploited. At the same time, while scholars have generally addressed problems associated with bargaining in this setting,[14] little attention has been drawn to the distinction between negotiating *ex ante* (i.e., before the development of the second invention) and *ex post* (i.e., after the development of the second invention). As a result, certain conclusions included in the literature may be incomplete and inaccurate.

This Article suggests a comprehensive analysis of cumulative innovation that accounts for these neglected aspects and provides new insights with respect to the optimal design of patent law.[15] In contrast to certain earlier discussions of the topic, the analysis is not limited to specific intellectual property

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603 (Mass. Dist. Ct. 1994); Pfizer, Inc. v. Int'l Rectifier Corp., No. 73–58, 1982 U.S. Dist. LEXIS 17411 (C.D. Cal. July 20, 1982).

13 *See, e.g.*, Eisenberg, *Patents*, *supra* note 8, at 1077–78; Donna M. Gitter, *International Conflicts over Patenting Human DNA Sequences in the United States and the European Union: An Argument for Compulsory Licensing and a Fair-Use Exemption*, 76 N.Y.U. L. REV. 1623, 1679, 1683 (2001); Mueller, *supra* note 10, at 9–10.

14 *See, e.g.*, Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 1052–65 (1997); Merges & Nelson, *supra* note 3, at 874–75; Maureen A. O'Rourke, *Toward a Doctrine of Fair Use in Patent Law*, 100 COLUM. L. REV. 1177, 1179 (2000).

15 This Article exclusively discusses patent law and does not address others fields of law, such as antitrust law, where relevant changes may supplement the suggested reform. For a discussion of cumulative innovation under antitrust law, see, for example, Barton, *supra* note 9, at 458–65; James B. Kobak, Jr., *Intellectual Property, Competition Law and Hidden Choices Between Original and Sequential Innovation*, 3 VA. J.L. & TECH. 6, ¶¶ 16–27, 29–36 (1998); Rai, *supra* note 9, at 844–53.

industries,[16] but rather aims at developing a general solution to the challenge of cumulative innovation.[17] The framework used for the analysis is the incentive to invent theory—a well known and instrumental theory, which constitutes the traditional economic justification for the patent system.[18]

The Article concludes, inter alia, that in order to ensure the first inventor's incentive to invent in a cumulative innovation setting, exploitation of a follow-on invention should always be considered within the scope of the origi-

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16 For articles discussing cumulative innovation in the context of a specific industry, see, for example, Gitter, *supra* note 13, at 1691 (focusing on the use of patented DNA sequences in follow-on research); Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 701 (1998) (analyzing cumulative innovation in the biomedical industry); Clarisa Long, *Patent Law and Policy Symposium: Re-Engineering Patent Law: The Challenge of New Technologies: Part II: Judicial Issues: Patents and Cumulative Innovation*, 2 WASH. U. J.L. & POL'Y 229, 233–46 (2000) (focusing on biomedical research); Robert P. Merges, *A Brief Note on Blocking Patents and Reverse Equivalents: Biotechnology as an Example*, 73 J. PAT. & TRADEMARK OFF. SOC'Y 878, 878, 883, 888 (1991) (discussing cumulative innovation in the biotechnology field); Nelson, *supra* note 3, at 2676 (discussing the cumulative development of software).

17 There are, certainly, broad differences between industries with respect to various relevant parameters, for example, the cost of research and development, the return on investment, and the ease by which agreements between inventors are concluded in the market. However, as the various technological industries are currently covered by our "one-size fits-all" patent system, it is important, first, to consider all industries together while searching for the optimal solution to the challenge of cumulative innovation. Based on such a general foundation, one could, then, examine various avenues to tailor the solution to the specific needs of certain industries. For that purpose, the general solution should include sufficient "policy levers." *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1696 (2003) (discussing the effectiveness of policy levers) [hereinafter Burk & Lemley, *Policy Levers*]; Dan L. Burk & Mark Lemley, *Don't Tailor Make Patent Act*, NAT'L L.J., May 11, 2009, at 18. For certain policy levers that may be used for this purpose within the regime suggested by this Article, see *infra* text accompanying note 94 (with respect to the appropriate standard to be applied in connection with the suggested reasonable expectations test), and *infra* text following note 182 (discussing the determination of royalty rates in connection with the suggested liability rule doctrines).

18 For other theories that offer a justification for the patent system based on economic efficiency considerations, see *infra* note 44. The patent system can also be justified by certain non-economic theories, including the Labor Theory, based on the work of the English philosopher John Locke, who argued that every man has a right to the fruits of his labor, see JOHN LOCKE, TWO TREATISES OF GOVERNMENT 290–91 (Peter Laslett ed., Cambridge Univ. Press 1988) (1690); and the Personality Theory, based on Hegel's writing, according to which the institution of personal property is essential, as it allows oneself to develop and fulfill her personality. *See* G.W.F. HEGEL, PHILOSOPHY OF RIGHT 4–12 (S.W. Dyde trans. 1996) (1821). For an analysis of cumulative innovation in light of such considerations, see Ofer Tur-Sinai, Cumulative Innovation in Patent Law (January 2009) (unpublished Ph.D. dissertation, The Hebrew University, in Hebrew) (on file with author).

nal patent. This rule, termed the "Absolute Scope Principle," should apply not only when the follow-on invention is an application or an improvement of the original technology. It should also apply when it does not embody the claims of the original patent at all, even though the original invention has served as a research tool in its development process. This argument serves as one of the central pillars of this Article's thesis. As the current rules governing patent scope center around the comparison between patent claims and the allegedly infringing product or process, a radical change in the law is needed in order to implement the Absolute Scope Principle. This principle should be subject only to a very narrow exemption doctrine, based primarily on a reasonable expectations test, which recognizes that the first inventor's incentive is influenced by opportunity to profit on a follow-on invention only if expectation for this was held during initial decision making.

Ultimately, the adoption of an Absolute Scope Principle does not only express greater concern for the first inventor's rights, but also enables better options for ensuring independence for the second inventor while providing her with adequate incentive to invent.[19] Thus, this Article recommends, with respect to the development period of the second invention, a wide experimental use exception that applies in all scenarios of cumulative innovation. With respect to the exploitation stage, this Article calls for the adoption of liability rule doctrines allowing non-consented exploitation of follow-on inventions in return for reasonable royalties when negotiation for a voluntary agreement between the inventors fails.

The Article proceeds as follows: Part II provides background as to the cumulative innovation phenomenon and the incentive to invent theory. Part III analyses cumulative innovation in light of this theory. Part IV examines current U.S. patent law vis-à-vis the preceding theoretical analysis, and Part V concludes with recommendations for patent law reform that, if made, would increase the efficiency of the U.S. patent system by ensuring that it provides adequate incentive to invent throughout all stages of the inventive process.

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[19] Naturally, it is easier to protect the interests of the second inventor when simultaneous changes are being made that take into account the need to ensure the incentive of the first inventor. The existing literature, as previously stated, has not always done so, and this might be the reason why, with respect to the experimental use exception, most scholars have suggested qualifying it somehow rather than recommending its sweeping application in all cases of cumulative innovation. *See infra* note 130 and accompanying text.

II. BACKGROUND

A. Cumulative Innovation

The term "cumulative innovation," as used in this Article, encompasses any situation in which a second inventor uses a previous invention covered by a valid patent in order to develop her invention.[20] The term is limited to situations in which the second inventor does not own the first patent; as only in these instances do the unique questions discussed herein arise resulting from the need to balance between the rights granted to each of the inventors.

Cumulative innovation is evident in a few typical scenarios:[21] One is when the patented invention is a basic technology—such as laser technology—which forms the basis for a variety of applications in multiple technological fields.[22] Another is when the follow-on invention is an improvement of the original invention[23] or a spin-off of the original invention, catering to a different set

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[20] For the meaning of "use" in this context, see *infra* notes 84–86 and accompanying text. It is worth noting that under the strict liability regime employed by patent law, "use" may occur even if the second inventor acted without knowledge of the first invention. *See also infra* note 191.

[21] The following list is not meant to be exhaustive, and some cases may be hard to classify into one of these categories. For other attempts to divide cumulative innovation cases into various categories, see SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 132 (2006); Oren Bar-Gill & Gideon Parchomovsky, *The Value of Giving Away Secrets*, 89 VA. L. REV. 1857, 1868 (2003).

[22] *See* SCOTCHMER, *supra* note 21, at 127–29, 132 (with respect to the laser technology); Carmen Matutes et al., *Optimal Patent Design and the Diffusion of Innovations*, 27 RAND J. ECON. 60, 60–61 (1996) (surveying other examples of basic technologies with a variety of applications). A modern day example for a basic technology with a variety of applications in multiple fields is "Bluetooth," a technology providing wireless connectivity between devices in close proximity to each other. This ubiquitous technology is built into numerous electronic devices, from laptops to mobile phones to wireless headsets to remote controls. For a recent settlement of a lawsuit issued by the Washington Research Foundation, the owner of patents allegedly underlying the technology, against major producers of products incorporating the technology, see Richard Wilson, *CSR Pays $15m to Settle Bluetooth Patent Case*, ELECTRONICSWEEKLY.COM, Apr. 19, 2007, http://www.electronicsweekly.com/Articles/2007/04/19/41210/csr-pays-15m-to-settle-bluetooth-patent-case.htm.

[23] Improvements are common in many industries. See, for example, with respect to the computer industry, SCOTCHMER, *supra* note 21, at 129; Ayres & Parchomovsky, *supra* note 11, at 870–71; Nelson, *supra* note 3, at 2675–76; and see, with respect to the cellular phones industry, Michael R. Franzinger, *Latent Dangers in a Patent Pool: The European Commission's Approval of the 3G Wireless Technology Licensing Agreements*, 91 CAL. L. REV. 1693, 1698 (2003).

of consumers.[24] A follow-on invention may also involve the discovery of a new use of the original invention.[25] Finally, an invention may serve as a research tool in the development of follow-on inventions. In this scenario, the basic invention is not embedded in the final version of second-generation products, even though it has been used in the process of their development.[26] An invention may coincidently serve as a research tool in an individual case, but there are also inventions that their sole purpose is to serve as research tools. In biotechnology, for example, many patents have been issued for various technologies used in the course of laboratory research.[27] The same pattern characterizes the emerging field of nanotechnology, where patents cover the building blocks of the industry, such as atomic force microscopes that can manipulate individual molecules.[28]

Common to these scenarios is the concern that the patent of the first invention will delay, or even prohibit, the activity of the second inventor. This is not just a theoretical concern and there are numerous examples in which a patent had a chilling effect on follow-on research and development in the relevant

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[24] For example, the basic invention may be a method of treating humans, while the second invention is a variation designed to treat animals. See, with respect to the "spin-off" scenario, Jerry R. Green & Suzanne Scotchmer, *On the Division of Profit in Sequential Innovation*, 26 RAND J. ECON. 20, 22 (1995); Scotchmer, *supra* note 1, at 40.

[25] This scenario is mostly common in the pharmaceutical industry where new therapeutic uses to existing medical products are likely. *See, e.g.*, NUNO PIRES DE CARVALHO, THE TRIPS REGIME OF PATENT RIGHTS 199 (2d ed. 2005).

[26] This characteristic is essential in this Article's definition of the research tools scenario, as distinguished from other scenarios, such as the basic technology and applications scenario. *Cf.* Mueller, *supra* note 10, at 4, 14 (defining research tools (in the biomedical industry) in a seemingly broad manner, as "the many varied resources used by scientists to conduct research and development of new drugs, therapies, diagnostic methods, and other therapeutic products," yet limits the analysis of research tools to those used in the development of new products that do not themselves physically incorporate the tool). However, the above definition of "research tools" is only one of many possible definitions. *See, e.g.*, Joshua D. Sarnoff & Christopher M. Holman, *Recent Developments Affecting the Enforcement, Procurement, and Licensing of Research Tool Patents*, 23 BERKELEY TECH. L.J. 1299, 1302 (2008) (listing several possible definitions of the term research tools). In fact, in light of their unique characteristics—including, very importantly, the feature discussed above—research tools may be good candidates for a separate patent-like system designed in due consideration of such characteristics, in accordance with the guidelines developed in this Article.

[27] *See* Mueller, *supra* note 10, at 12–14.

[28] Mark A. Lemley, *Patenting Nanotechnology*, 58 STAN. L. REV. 601, 603–04 (2005). For examples of patented research tools in nanotechnology, see also Siva Vaidhyanathan, *Nanotechnology and the Law of Patents: A Collision Course*, *in* PATENTING OF NANOTECH INVENTIONS: A DEBATE 43, 44–45 (C. Sri Krishna ed., 2007), *available at* http://ssrn.com/abstract=740550.

field.[29] This has been documented since the early days of the radio industry, where key patents controlled by the Marconi Wireless Telegraph Company blocked the application of significant improvements developed by others using the patents.[30] This concern is also valid in modern days, where, for example, the Swiss pharmaceutical giant Hoffman-La Roche—the holder of the patent for the polymerase chain reaction ("PCR") technique, a revolutionary DNA amplification process—accused multiple research institutions and individual scientists of patent infringement in a manner that is counter-productive to "the advancement of knowledge for the public welfare."[31]

As these examples clearly illustrate, encouraging cumulative innovation is in society's best interest. If technological inventions are, in general, beneficial to society, then the same is true as well for follow-on inventions. The expeditious development of a follow-on invention—and not only following the expiration of the original patent—allows faster delivery of the product to the consumer.[32] Delaying the development of a follow-on invention creates a waste of potential interim uses, including its use as an input in the development process of yet further inventions.

Arguably, independent inventive activity may lead to the development of entirely different inventions than those developed while relying on previous inventions.[33] Yet, even if value exists in paving a completely new research line, existing lines should not be neglected prior to total exhaustion of their potential. In many cases, without the previous knowledge embodied in the original inven-

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29 For a thorough study of the history of science in this respect, see Merges & Nelson, *supra* note 3, at 884–908.

30 For a detailed historical account of this case, see Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, 84–87 (1994).

31 *See* Mueller, *supra* note 10, at 3. The recent expiration of the PCR patent has been said to offer growth opportunities in the research community. *See, e.g.*, Wai Lang Chu, *PCR Patent Expiry Offers NA Technology Growth*, DRUGRESEARCHER.COM, Jan. 5, 2006, http://www.drugresearcher.com/Tools-and-techniques/PCR-patent-expiry-offers-NA-technology-growth.

32 *Cf.* Merges & Nelson, *supra* note 3, at 878–79 (claiming that faster equals better when it comes to innovation).

33 *Cf.* Peter Lee, *Patents, Paradigm Shifts, and Progress in Biomedical Science*, 114 YALE L.J. 659, 663 (2004) (arguing that the existence of a patent on research tools increases the cost of research conducted within the framework of a known scientific paradigm, but also provides scientists an increased incentive to search for alternative theories, and thus, encourages paradigm shifts).

tion, it would be impossible to develop the follow-on invention.[34] Therefore, it is important to ensure the freedom to engage in cumulative research and development.

While the first inventor may possess the requisite incentive to develop a follow-on invention to her original one, this is not always the case. Several factors may keep the inventor from inventing follow-on inventions: other more promising research projects may exist with better potential commercial applications; new follow-on applications may not be within her field of expertise but commercially valuable in others;[35] or follow-on inventions might compete with the original invention in the same market.[36] The holder of a patent for a successful kitchen gadget, for example, may not feel motivated to search for improvements for such gadget, as she already enjoys a dominant position in the relevant market, and the improved version might not generate new demand but rather take sales away from the original product.[37]

The first inventor may also lack the ability to develop the second invention. While her position is advantageous to other inventors in terms of her knowledge and familiarity with the first invention,[38] she might nevertheless not be the best candidate to handle the task. First, ideas are scarce and not all ideas appear to all potential inventors. The emergence of an idea is a function not only of the amount of resources invested in the project but also of the inventor's

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34 *Cf.* Lemley, *supra* note 14, at 997 (arguing, with respect to copyright law, that the efficient creation of new works requires access to previous works and the ability to use them).

35 *Cf.* Suzanne Scotchmer, *Protecting Early Innovators: Should Second-Generation Products Be Patentable?*, 27 RAND J. ECON. 322, 322 (1996) (pointing out that the potential profit from certain inventions can attract other inventors, because of the nature of their activities). Scotchmer indicates, for example, that pharmaceutical materials developed through bioengineering technologies were rarely developed by the same research institutions holding patents over such technologies. *Id.*

36 *See* O'Donoghue, *supra* note 2, at 666 (explaining that one who controls the market may not want to invest in new inventions as she may replace herself; on the other hand, if she does invest in such inventions, she might prolong the period of her control of the market).

37 This may clearly change in the face of competition, but in order for such competition to exist, other potential inventors must be allowed to develop improvements based on the original invention. See, with respect to the correlation between competition and the existence of motivation to act, Merges & Nelson, *supra* note 3, at 872 (noting that "there are many instances when a firm that thought it had control over a broad technology rested on its laurels until jogged to action by an outside threat").

38 *Cf.* Merges, *supra* note 30, at 98–99 (mentioning that the first inventor can develop the improvement more cheaply since she "has less to learn given [her] familiarity with the technology"). On the other hand, the first inventor is arguably in an inferior position to others, as her previous familiarity with the technology might make her biased toward certain research directions.

skills, level of creativity, experience, prior knowledge in the relevant field, and, to an extent, sheer luck.[39] While the first inventor is only one, potential follow-on inventors are numerous, and it is more likely that a relevant idea could emerge to one of many than to a single one.[40] Second, development of the second invention may require different expertise than that needed for the basic invention.[41] For example, the expertise needed to develop a new type of fiber optic technology may be different than that needed to develop a new application of such technology in the telecommunications field. Third, even if the first inventor has both an idea for a follow-on invention and the requisite expertise to develop it, research projects are known to have uncertain results and completion of a successful invention is not always guaranteed. Where one inventor may fail—others may succeed.[42]

B. The Incentive to Invent Theory

According to the incentive to invent theory—the main economic theory used to justify the patent system[43]—the patent system's goal is to promote the progress of science and technology by providing economic incentive to invest in research and development.[44] Time, money, and other resources are often essen-

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39 *Cf.* SCOTCHMER, *supra* note 21, at 131 (discussing the notion that ideas are scarce); Scotchmer, *supra* note 1, at 32 (noting that creativity is largely serendipitous).

40 *See* SCOTCHMER, *supra* note 21, at 139 n.3; *see also* ADAM B. JAFFE & JOSH LERNER, INNOVATION AND ITS DISCONTENTS: HOW OUR BROKEN PATENT SYSTEM IS ENDANGERING INNOVATION AND PROGRESS, AND WHAT TO DO ABOUT IT 48–49 (2004); James Bessen & Eric Maskin, *Sequential Innovation, Patents, and Imitation*, 40 RAND J. ECON. 611, 612 (2009), *available at* http://www.researchoninnovation.org/patrev.pdf.

41 *See also supra* note 35 and accompanying text; James E. Bessen, *Holdup and Licensing of Cumulative Innovations with Private Information*, 82 ECON. LETTERS 321, 322 (2004); Scotchmer, *supra* note 1, at 31.

42 *See* Bessen & Maskin, *supra* note 40, at 614 (claiming that when various firms search to solve the same technological problem, the likelihood of success increases).

43 For use of the incentive to invent theory in academic literature, see, for example, Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 247 (1994); Wendy J. Gordon, *Intellectual Property*, *in* THE OXFORD HANDBOOK OF LEGAL STUDIES 617, 632 (Peter Cane & Mark Tushnet eds., 2003), *available at* http://www.ssrn.com/abstract=413001; Yusing Ko, *An Economic Analysis of Biotechnology Patent Protection*, 102 YALE L.J. 777, 791–92 (1992).

44 There are other theories purporting to explain the need for a patent system from an economic point of view, but a discussion of such theories is outside the scope of this Article. For an analysis of cumulative innovation under different theories, see Tur-Sinai, *supra* note 18. Among such theories, it is worth mentioning the prospect theory, suggested by Kitch, according to which the main justification for the patent system is that it increases the efficiency in

tial elements in the creation of an invention. No reasonable inventor will invest these resources without envisioning an opportunity to cover costs and make a reasonable profit through commercialization. Yet, commercialization can allow competitors an opportunity to become versed in the technology and imitate it rather quickly.[45] Competition from such free riders—who have neither taken part in the development process nor paid a fee for the use thereof—may lead to the decline of the invention's market price, even down to the marginal production costs level,[46] which does not allow the inventor to cover research costs nor gain profit.[47] Thus, despite the potentially high social value of an invention, an inventor may lack adequate incentive to develop it.[48] As market powers cannot

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allocation of resources for technological development, by granting ownership to the inventor in the technological prospect derived from her invention shortly after its development. *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 266 (1977). The prospect theory can be criticized from various angles. *See, e.g.*, *supra* Part II.A (discussing the inability to count on the original inventor to have the incentive and ability to develop the prospect). It has never gained support amongst scholars analyzing the patent system. *See, e.g.*, Merges & Nelson, *supra* note 3, at 871–78 (critically examining the prospect theory).

45 The ease of imitation varies from case to case. Not every invention can be easily discerned by examining the product embodying it and some inventions can be kept secret even post commercialization. Generally, the possibility of keeping an invention secret is greater with respect to process inventions than with respect to product inventions. *See* Julie S. Turner, *The Nonmanufacturing Patent Owner: Toward a Theory of Efficient Infringement*, 86 CAL. L. REV. 179, 189–90 (1998). In cases where the risk of imitation by competitors is relatively low and so is the likelihood of independent development of the invention, there is a lesser need to register a patent in order to secure incentive to invent.

46 There may be cases where the initial imitation costs are significant, so that competitors too need to charge a price that is higher than the marginal cost of production. The potential damage to the incentive to invent as a result of competition is, therefore, higher the larger the gap between research costs and imitation costs.

47 There is, in fact, inherent risk involved in research and development since success is hardly ever guaranteed. The typical inventor, thus, would not only need her proceeds to cover current R&D costs, but also to provide a certain premium for the risk associated with her activity, in general. *See* Chang, *supra* note 2, at 49 n.28 (1995); Scotchmer, *supra* note 1, at 30 n.4 (discussing the need for a risk premium to compensate inventors for failing projects).

48 This is, essentially, the "public goods problem," which exists with respect to inventions, as they are, in fact, a type of a public good: Once others have found out about an invention, it is difficult to prevent them from using it without paying—non-excludability—and its use by one does not prevent simultaneous use by others—non-rivalry. The combination of these characteristics causes the potential for sub-investment in the production of public goods, in general, and inventions, in particular. *See generally* Daphna Lewinsohn-Zamir, *Consumer Preferences, Citizen Preferences, and the Provision of Public Goods*, 108 YALE L.J. 377 (1998) (discussing the provision of public goods). For the public goods nature of inventions, see, for example, Burk & Lemley, *Policy Levers*, *supra* note 17, at 1580.

provide sufficient incentive to invent whenever it is efficient to do so, that is, when the marginal social utility of the invention exceeds its research costs, the state intervenes and provides the inventor with the incentive, by granting exclusive rights to her invention for a limited period of time.[49] This is, in essence, the incentive to invent theory.

Yet the patent system is not just beneficial to society, there are associated costs as well:

(1) the deadweight loss that results from non-competitive pricing of the patented invention;[50]

(2) the waste caused by the rent-seeking behavior of inventors engaging in a race to the patent office;[51]

(3) the potential distortion of efficient resource allocation in society by overly encouraging investment in specific research and development projects—the ones that may lead to a patent—at the expense of other activities;[52]

(4) the costs associated with the bureaucratic administration of the patent system and with patent litigation;[53] and

(5) the potential chilling effect of a patent on follow-on research.[54]

Over the years, a few critical arguments have been raised against the incentive to invent theory.[55] One questions the necessity of government interven-

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49 The patent system thus removes the natural characteristic of non-excludability by employing a legal rule prohibiting the use of an invention without permission of the patent owner. *See, e.g.*, Dam, *supra* note 43, at 247.

50 *See, e.g.*, Dam, *supra* note 43, at 249–51; Kitch, *supra* note 44, at 266–67; Merges & Nelson, *supra* note 3, at 871; Nelson, *supra* note 3, at 2676.

51 *See, e.g.*, Michelle Armond, *Introducing the Defense of Independent Invention to Motions for Preliminary Injunctions in Patent Infringement Lawsuits*, 91 CAL. L. REV. 117, 142–43 (2003); Dam, *supra* note 43, at 251–52; Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, 78 VA. L. REV. 305, 308 (1992).

52 *Cf.* Glynn S. Lunney, Jr., *Reexamining Copyright's Incentives-Access Paradigm*, 49 VAND. L. REV. 483, 487–88 (1996) (making a similar argument with respect to copyright law).

53 *See* O'Rourke, *supra* note 14, at 1217 n.160.

54 For a treatment of this effect as one of the costs of the patent system, see, for example, Dam, *supra* note 43, at 253.

tion in order to supply incentive: inventions are developed, with or without patents, when the state of the art and other relevant circumstances allow it.[56] Considering the costs associated with patents, surely society cannot justify granting a patent for an invention that would have been developed otherwise. A related argument notes that inventors are not necessarily driven by economic motives but rather by the prospect of gaining professional reputation and fame amongst their colleagues and peers or by sheer intellectual curiosity and personal satisfaction they derive from the process.[57] Those who invent for pure economic reasons can still be protected from competition, even in the absence of exclusive legal rights, by the existence of high production and imitation costs, which may be sufficient to deter free riders.[58] Even when competitors expose the invention's details, through reverse engineering or otherwise, the time the process takes may be sufficient to allow the inventor to profit and gain a head start in the market.[59] Another argument criticizes the incentive to invent theory for assuming that the patent system is the best suited mechanism to ensure incentive, while there are other alternatives to provide economic incentive for research and development that need to be considered, including direct grants of government subsidies to inventors.[60]

Ultimately, then, it is hard to reach a definitive conclusion regarding the need for patents to supply an incentive to invent.[61] Since, at least in certain in-

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55 For a recent empirical study showing that the "orthodox" assumption that patents spur technological innovation isn't necessarily true, see Andrew W. Torrance & Bill Tomlinson, *Patents and the Regress of Useful Arts*, 10 COLUM. SCI. & TECH. L. REV. 130, 166–67 (2009).

56 *See, e.g.*, Ko, *supra* note 43, at 792.

57 *Cf.* Gordon, *supra* note 43, at 632 (noting that the existence of reputational advantages might reduce the need for a patent system).

58 *See also supra* note 45; *cf.* Nancy T. Gallini, *Patent Policy and Costly Imitation*, 23 RAND J. ECON. 52, 52–53 (1992) (discussing imitation costs).

59 *See, e.g.*, Ko, *supra* note 43, at 794; Eisenberg, *Patents*, *supra* note 8, at 1026.

60 Needless to say, such alternative mechanisms are not free of problems (for example, difficulty in setting clear criteria for calculating the "price" of the invention and fear of censorship by the government). For discussion of various incentive mechanisms, see, for example, SCOTCHMER, *supra* note 21, at 41; Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POLICY AND THE ECONOMY 51, 55–56 (Adam Jaffe et al. eds., 2002), *available at* http://socrates.berkeley.edu/~scotch/G_and_S.pdf; Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 119 (2003); Steven Shavell & Tanguy van Ypersele, *Rewards versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 525 (2001).

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> If we did not have a patent system, it would be irresponsible, on the basis of our present knowledge of its economic consequences, to recommend institut-

dustries such as the biotechnology and pharmaceutical industries, inventors do rely on patents to provide incentive,[62] it appears that the above critical arguments cannot serve to completely negate justification for the patent system. As long as the social value of inventions that would not be developed absent patent protection exceeds costs associated with the patent system, the incentive to invent theory provides a valid rationalization for the patent system.

With that said, the patent system cannot always provide incentive for each inventor since it cannot always guarantee the inventor an award sufficient to cover research costs[63] and provide additional gains necessary to perfect her incentive.[64] The parameters needed to determine the size of the appropriate re-

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> ing one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abolishing it.

STUDY OF THE SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE S. COMM. ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM, STUDY NO. 15, at 80 (Comm. Print 1958) (written by Fritz Machlup); *see also* Barton, *supra* note 9, at 453.

62 For recent empirical evidence of the role that patents play in the biotechnology industry, see Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey* 2 (2009) (forthcoming publication, on file with the Berkeley Technology Law Journal), *available at* http://ssrn.com/abstract=1429049. For the importance of patents in the pharmaceutical industry, see, for example, Benjamin N. Roin, *Unpatentable Drugs and the Standards of Patentability*, 87 TEX. L. REV. 503, 569 (2009). For studies comparing the value of patents in different industries, see, generally, John R. Allison & Mark A. Lemley, *Who's Patenting What? An Empirical Exploration of Patent Prosecution*, 53 VAND. L. REV. 2099, 2125 (2000) (suggesting a possibility that patents are considered more important in the chemical, pharmaceutical and biotechnological fields than in other fields); John R. Allison et al., *Valuable Patents*, 92 GEO. L.J. 435, 471–76 (2004) (discussing differences in patent litigation patterns between various industries and concluding that patents in some industries are more likely to be valuable than patents in other industries); Burk & Lemley, *Policy Levers*, *supra* note 17, at 1580–95 (discussing the industry-specific nature of innovation and of the patent system).

63 As noted, inventors should also receive a premium for risk associated with research and development activity and compensation for failing research projects. *See supra* note 47. However, in order to simplify the discussion, these components are treated in this Article as if they are included in the research costs of the invention.

64 Arguably, in order to provide an adequate incentive to invent, it is enough to award the inventor a minimal amount of profits beyond what is necessary to cover the development cost of the invention. It seems that this is the approach laid in the basis of many economic researches dealing with the patent system. *See, e.g.*, Green & Scotchmer, *supra* note 24, at 22 (focusing on the need to ensure that each inventor covers her costs). However, in some cases there may be a need for a higher amount in order to supply an incentive to invent. *See, e.g.*, F. M. Scherer, *The Innovation Lottery*, *in* EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY 3, 20 (Rochelle Dreyfuss et al.

ward in each particular case are unknown to decision makers,[65] who cannot rely in this respect on information submitted by the inventor.[66] In fact, even if the exact amount needed to preserve incentive was known, designing patents that supply such an exact amount is impossible since the profits of the inventor depend, inter alia, on marketing efforts and on demand for the invention. Additionally, many rules and doctrines in patent law, for example, patent length, apply uniformly to all inventions.[67] As the cost of developing an invention and the amount of profit available in the market vary from one instant to another, a patent system can only reasonably determine an average for all cases. It could be suggested that in order to supply incentive in the maximum amount of cases, patents must be strengthened as much as possible: for example, by making the exclusivity period indefinite.[68] Yet, this solution also maximizes patent costs. The larger the economic reward, the more inventions will be developed, but the costs associated with patents will also increase unnecessarily with respect to inventions that would have been developed otherwise.[69] This is the basic trade-off that the patent system confronts: maximizing incentives while minimizing costs. It is difficult to say whether any current patent law actually achieves an optimal balance between these considerations.[70]

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eds., 2001) (arguing that there are investors who attribute great importance to the potential to earn particularly big awards, even if such possibility is rare).

65 The fact that the size of the award for a patent holder is determined in the market, without a need to rely on information, which decision makers do not own, with respect to the development cost of the invention or its social value, is actually one of the advantages ascribed to the patent system in the literature comparing it to alternative methods of supplying an incentive to invent. *See, e.g.*, Chang, *supra* note 2, at 50 n.31; Scotchmer, *supra* note 1, at 30.

66 The inventor would be motivated to present a high amount of costs, and it seems to be relatively easy to do so when it comes to research and development activities, for example, through an inflated report of work hours of an inventor who is engaged in experimental activity. Questions may also arise with respect to the right apportionment of overhead costs among various research projects.

67 As aforesaid, patent law employs a "one size fits all" approach, and generally does not differentiate between various technological fields, and certainly not between individual inventions. *See supra* note 17.

68 *Cf.* Scotchmer, *supra* note 1, at 31 ("[T]he only way to ensure that firms undertake every research project that is efficient is to let the firms collect as revenue all the social value they create."). *But see* Gordon, *supra* note 43, at 622 ("[N]o one would suggest that IP should internalize *all* the benefits that flow from an intangible.").

69 *See* SCOTCHMER, *supra* note 21, at 98; Gordon, *supra* note 43, at 632; Scotchmer, *supra* note 1, at 31.

70 *See*, e.g., Eisenberg, *Patents*, *supra* note 8, at 1031–32 (noting the difficulty in determining whether the current level of incentives supplied by the patent system is too high or too low); *see also supra* note 61.

III. THEORETICAL ANALYSIS OF CUMULATIVE INNOVATION

In a cumulative innovation setting, the need to ensure incentive applies to each of the inventors. Since the basic premise of the incentive to invent theory is that the patent provides this motive, each inventor in a cumulative innovation setting should be provided a patent for her invention.[71] For such patents to provide appropriate incentives, they should be designed so that each inventor can earn a large enough reward to allow her to cover costs and make a minimal profit. Thus, cumulative innovation creates the special challenge of dividing profits among inventors in a manner ensuring appropriate incentives at each stage of the invention process.[72] The question that needs to be answered then is how to divide the social value of the follow-on invention between the

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[71] Patent registration of the second invention also allows the second inventor to bargain with the first inventor, without fear of impermissible use by the first inventor if negotiation fails. See, with respect to such concern, *infra* notes 122–123 and accompanying text. Additionally, as the patent for the second invention blocks the first inventor from exploiting the second invention, which often has a higher profitability potential than the original invention, see, for example, Kitch, *supra* note 44, at 271, it increases her motivation to reach an agreement with the second inventor. Therefore, registration of a blocking patent, for a follow-on invention, should not be conditioned on the consent of the original patentee. See, with respect to the term "blocking patent," *infra* note 106. This is essentially not a controversial issue and depriving such ability with respect to an invention that meets the regular criteria for patentability is unthought-of.

Current U.S. patent law allows for registration of a patent for an improvement of an existing product or process. *See* 35 U.S.C. § 101 (2006) ("Whoever invents or discovers . . . any new and useful improvement . . . may obtain a patent therefor."). In fact, one can explicitly designate a patent application as claiming such an improvement. With respect to such claims, entitled "Jepson claims," see MARTIN J. ADELMAN ET AL., CASES AND MATERIALS ON PATENT LAW 677 (1998); DONALD S. CHISUM ET AL., UNDERSTANDING INTELLECTUAL PROPERTY LAW 2-165 (1996). Yet, apart from improvements, the law does not refer to other scenarios of cumulative innovation. The law also does not explicitly address the possibility that the existing product or process is covered by a valid patent. Cf. § 32 of the Canadian Patent Act, R.S.C., ch. P-4 (1985), *available at* http://laws.justice.gc.ca/PDF/Statute/P/P-4.pdf, which states that: "Any person who has invented any improvement on any patented invention may obtain a patent for the improvement, but he does not thereby obtain the right of making, vending or using the original invention, nor does the patent for the original invention confer the right of making, vending or using the patented improvement." It is advisable, then, to clarify that a patent may be obtained even when the invention is an improvement of, or otherwise a follow-on invention with respect to, another patented invention.

[72] *Cf.* SCOTCHMER, *supra* note 21, at 135; Scotchmer, *supra* note 35, at 322. In fact, an optimal division of profit between inventors should not only guarantee that each party receives the necessary amount to serve as incentive, but should also ensure that neither of them earns too large a prize, which may overly increase rent seeking. *Cf.* Scotchmer, *supra* note 1, at 33.

inventors to ensure such a result.[73] In order to answer this question, the analysis now focuses on each inventor, the original and the follow-on, separately.[74]

A. Incentive to Invent the First Invention: The Absolute Scope Principle and the Reasonable Expectations Test

1. The Absolute Scope Principle

It is important to acknowledge that the social value of the first invention in a cumulative innovation setting is comprised not only of its stand-alone value, but also of its contribution to subsequent inventions, which can occur in at least three ways:[75]

(1) the first invention is essential to the development of the second invention, a "but-for-cause";

(2) the first invention lowers the cost of developing the second invention; and

(3) the first invention allows for faster development of the second invention.[76]

The social value of the first invention in a cumulative innovation setting thus includes at least part of the marginal social value of the second invention, the decrease in its development cost, or the value associated with its more rapid development.[77]

Yet, the mere existence of a positive externality created by the first inventor does not necessarily mean that allocating her the respective market profits from the second invention would be efficient: It depends on the extent to which such profits are necessary in order to ensure the first inventor's incentive to invent.[78] In some cases, profits in the direct market for her invention may

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73 More accurately, it is the portion of value appropriable by the inventors that is to be divided. See, with respect to the gap between the social value of an invention and the portion thereof appropriable by the patent owner, *supra* notes 68–70 and accompanying text.

74 For simplicity reasons, the analysis in this Article uses a two-generational model. However, as showed elsewhere, the principal conclusions remain valid in a multi-generational situation as well. *See* Tur-Sinai, *supra* note 18, at 81–83.

75 *See* SCOTCHMER, *supra* note 21, at 127; Scotchmer, *supra* note 1, at 31.

76 Scotchmer, *supra* note 1, at 31.

77 *Id.*

78 *See supra* notes 68–70 and accompanying text (concluding generally that not all benefits flowing from an invention should necessarily be allocated to the inventor).

suffice to provide the first inventor with incentive to invent. However, in other cases, proceeds from the immediate market may not be sufficient to cover the development cost of the first invention. This may be the case, notwithstanding that the social value of the invention, including its contribution to subsequent inventions, is higher than the development cost, so that its development is nevertheless socially efficient. In these instances, the first inventor must be allowed to receive a portion of the social value of subsequent inventions, since without it, she lacks incentive to invent the first invention, and as a result the entire research line may not be developed.

Ideally, the first inventor would be allowed to profit from the second invention only when this profit is integral in supplying incentive to develop the first invention; however, in all other cases, market profits from the second invention should be allocated in full to the second inventor. Nonetheless, decision makers must have access to reliable information regarding the development cost of the first invention and its stand-alone value in order to distinguish between these two scenarios. In fact, the invention's development cost is private information held by the inventor alone,[79] while the social value of an invention, and the portion of it that is appropriable by the inventor, is a parameter that even the inventor herself cannot have accurate knowledge of.[80] Therefore, it is impossible to design rules that would ensure that the first inventor only gets a portion of the profits in the secondary markets in cases where the development cost of the first invention is higher than its stand-alone value.

To ensure her incentive, then, the first inventor must always be allocated a portion of the market profits from the second invention. The exploitation of each follow-on invention thus needs to be included in the scope of the original patent (hereinafter, the "Absolute Scope Principle"), forcing the second inventor to request a license to market her invention in order to avoid infringement liability. The license fees, or the compensation the second inventor would be required to pay if she acts without permission, act as the means to pass profits back to the hands of the first inventor.

The Absolute Scope Principle must apply not only when the follow-on invention is an application of the technology covered in the original patent or an improvement of the original invention, but also in the research tools scenario. In such a scenario, the second invention does not embody claims of the original patent and does not even constitute its variation. Since the original invention in

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79 *See supra* notes 65–66 and accompanying text.

80 The inventor's profits depend primarily on the market demand for her invention, which is a parameter that cannot be accurately measured and is also subject to possible changes as a result of future developments.

this scenario contributes to the development of the second invention, there is no reason to treat it differently and deprive the first inventor of an opportunity to benefit from a positive situation she enabled. In fact, because in the research tools scenario the first invention often has no, or very little, stand-alone commercial value—consider, for example, a new method of DNA sequencing, which does not have any uses other than for research purposes—it may be particularly important to ensure the first inventor's right to profit from follow-on products.[81] Therefore, a follow-on invention, for purposes of implementing the Absolute Scope Principle, should include any invention that has been developed while using the patented invention and not only inventions that embody claims of the original patent.[82] The Absolute Scope Principle is not reflected in current U.S. patent law and its implementation may pose a challenge, particularly in the context of the research tools scenario.[83]

Does the second inventor need to physically use the first invention or is it sufficient that the first invention inspired the development of the second invention to trigger the Absolute Scope Principle?[84] The marginal addition to the incentive of the first inventor as a result of the chance to profit from inventions that were merely inspired by her invention is likely to be negligible.[85] At the same time, the potential chilling effect that inclusion of inspired inventions, in the scope of the original patent, may have on follow-on research could be overwhelming, considering that inventors are very often inspired by their colleagues' previous work. Cases of mere inspiration thus should remain outside the patent scope.[86]

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81 For an economic study supporting this argument, *see* Chang, *supra* note 2, at 34, 49.

82 For comparison, in copyright law a "derivative work"—which the copyright owner has an exclusive right to prepare—is defined as any "work *based upon* one or more preexisting works . . . ." 17 U.S.C. § 101 (2006) (emphasis added).

83 *See* discussion *infra* Part IV.A.1.

84 Another question that needs to be answered is whether direct usage of the original invention in the development process of the second invention is necessary or is indirect contribution of the original invention sufficient. This question may arise, for example, if the original invention is used in developing an intermediary product that then serves in the development process of the second invention. It may also arise when use of a patented invention does not immediately lead to the successful development of a follow-on invention but constitutes an integral part of a research and development process that eventually does, for example, by identifying an unproductive dead-end. Discussion of these interesting questions is deferred for future research.

85 *See also* discussion *infra* note 98. Additionally, in most cases inspiration is also likely to be difficult to prove.

86 A different scenario that may also need to be excluded from patent scope is the use of the invention in order to design around the patent by searching for non-infringing substitute

2. The Reasonable Expectations Test

The Absolute Scope Principle can be qualified by a reasonable expectations test, which is based on the understanding that the first inventor's incentive to invent is influenced by the opportunity to profit from follow-on inventions only if she held such expectation *ex ante*. Thus, under the reasonable expectations test, if, at the time her investment decision was made, the first inventor could not have reasonably expected the development of a specific follow-on invention and thus could not have considered any financial gains from such follow-on invention, she shall not be entitled to such gains.[87]

In principle, it seems reasonable that a typical inventor, with experience and expertise in the relevant technological field, can predict the type of follow-on inventions that could stem from her discovery. She may even be able to roughly estimate the value and probability of such inventions and take this information into account in her prediction. With that said, there are different levels of likelihood of such expectations. If it can be ascertained, with a high degree of assurance, that an inventor could not have reasonably foreseen the development of a follow-on invention, then it is arguably unnecessary to include this invention in the scope of her patent, since she had no reasonable expectation of associated potential profits.[88] Accordingly, the *ex ante* incentive of other po-

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technologies. *See* Westvaco Corp. v. Int'l Paper Co., 991 F.2d 735, 745 (Fed. Cir. 1993); Texas Instruments, Inc. v. U.S. Int'l Trade Comm'n, 805 F.2d 1558, 1572 (Fed. Cir. 1986); Yarway Corp. v. Eur-Control USA, Inc., 775 F.2d 268, 277 (Fed. Cir. 1985) (emphasizing the importance of supplying an incentive to design around patents).

87 In a recent article, a similar argument was advanced in connection with copyright law. *See* Shyamkrishna Balganesh, *Foreseeability and Copyright Incentives*, 122 HARV. L. REV. 1569 (2009) (arguing that adopting a foreseeability requirement in copyright law, whereby a creator is denied control over uses of her work that could not have reasonably been foreseen at the time the work was created, would serve to align copyright law with its underlying theory of incentives).

88 It may be argued that some inventors hold a general expectation that unexpected follow-on inventions will be developed based on their inventions and factor such expectation for an occasional windfall into their decision. *Cf.* Balganesh, *supra* note 87, at 1590 (describing "windfall" as representing "unincentivized gains and losses"); Justin Hughes, *Copyright and Its Rewards, Foreseen and Unforeseen*, 122 HARV. L. REV. F. 81, 82 (2009) (noting that many sectors of intellectual property are "gamble economies" in which investments are made in portfolios with the expectation that "occasional blockbuster successes" would occur); Scherer, *supra* note 64. However, to the extent that such vague expectations exist and are factored into the investment calculation, it is likely that they only enter the equation with a very low probability attached thereto, so the diminishing effect of the suggested test on the incentive to invent in such cases, if any, is likely to be marginal. *Cf.* Balganesh, *supra* note 87, at 1620. *See also* Ian Ayres & Paul Klemperer, *Limiting Patentees' Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-*

tential inventors would not be affected by the exclusion of such a follow-on invention from the scope of her patent.[89] The absence of reasonable expectations can thus assist in delineating cases in which follow-on inventions may be excluded from the scope of the original patent without unduly diminishing the first inventor's incentive.[90] Reasonable expectations can serve as a criterion in future legislation that creates pre-determined exemptions from the patent scope, or as a tool used by courts in creating ad-hoc exemptions.[91] In cases where such an exemption applies, all profits from the follow-on invention shall remain in the hands of the follow-on inventor.

Injunctive Remedies, 97 MICH. L. REV. 985 (1999) (arguing that increasing patent law's overall uncertainty does not necessarily substantially reduce incentives to invent); Michael J. Meurer & Craig Allen Nard, *Invention, Refinement and Patent Claim Scope: A New Perspective on the Doctrine of Equivalents*, 93 GEO. L.J. 1947 (2005) (arguing that incentive is not greatly harmed when an inventor is denied rights *ex post* over technology that she did not foresee *ex ante*).

89 To be sure, legal rules have their own impact on expectations. A rule that allows inventors to profit in secondary markets contributes to the formation of expectations to make such profits, while the opposite rule may result in eliminating these expectations. For this very reason, an argument seeking to use the existence of expectations in order to justify legal rights is a circular argument. However, this is not the argument made here. The justification for allowing an inventor to profit in secondary markets is based, as explained above, on the need for such profits in order to secure incentives to invent, and not on the existence of expectations to make such profits, which could indeed be changed by legal rules, if not justified by other reasons. Yet, in the absence of reasonable expectations for the development of a particular follow-on invention, even if an inventor is given a legal right to profit from such invention, it is very unlikely that she, and others in her position, would take it into account in her decisions. Therefore, in such cases, this Article opines that the exclusion of such markets from the scope of the patent should not affect inventors' expectations, and hence, incentives.

90 *Cf.* Balganesh, *supra* note 87, at 1624 (noting that a requirement of foreseeability is unlikely to interfere significantly with the creator's original incentive); Meurer & Nard, *supra* note 88 (arguing that incentive is not greatly harmed when an inventor is denied rights *ex post* over technology that she did not foresee *ex ante*). Even if the application of the suggested foreseeability test reduces the predictability of the patent system for inventors that do rely on the occasional windfall (*see supra* note 88), it is unlikely to have a significant impact on their incentive. *See generally* Ayres & Klemperer, *supra* note 88 (arguing that increasing patent law's overall uncertainty does not necessarily substantially reduce incentives to invent).

91 Contrary to Balganesh, *supra* note 87, who suggests using the foreseeability test as an integral part of any copyright infringement analysis, with the burden of proof that the use complained of could have been reasonably foreseen on the plaintiff, *id.* at 1574–75, the proposal made herein is limited to the cumulative innovation scenario, that is, to cases where the alleged infringer is also an inventor herself, and the reasonable expectations test is suggested as an exception, rather than as part of the entitlement delineation process. Accordingly, the burden of proof that the relevant follow-on invention falls outside the realm of reasonable foreseeability is placed, under this proposal, on the defendant.

It is important to emphasize that the proposed reasonable expectations test is objective, and hence, a test of reasonable expectations,[92] and not a test of actual expectations.[93] This is so, not only because of evidentiary problems that would result from having to prove the inventor's prior subjective expectations in a particular case, but also because subjective expectations of the inventor at hand are less relevant to the incentives of future inventors. An objective test must rely on concrete and agreed-upon measures. Reasonable expectations must be measured from the perspective of a typical inventor holding knowledge of the existing prior art in the relevant technological field at the time the decision to embark on the project was made.[94] Another matter to be considered is how specific does the expectation of the development of a follow-on invention need to be.[95] It seems appropriate to apply a rather low level of specificity in this context. The fact that an inventor could not have reasonably anticipated a particular follow-on invention—for example, a specific medicine to treat a certain disease—to be developed based on her invention—for example, an innovative laboratory technique—does not mean that she could not have factored into her decision the prospect that follow-on inventions of that general type—for example, medicines—would be developed. The test would thus only filter out cases where a follow-on invention is clearly outside the realm of all reasonable expectations.

Courts are well advised to adopt guidelines for use of the test. For example, it may be useful to distinguish between first inventions that, by nature, do not have a stand-alone commercial value and first inventions that do have a commercial value. If the first invention does not have a commercial value on its own, it is inherently expected that profits would be made from follow-on inventions. The inventor of a basic technology expects to profit on applications of the technology, and the inventor of a research tool expects to profit on products

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92 The use of the term "reasonable" does not mean to indicate a normative judgment. The relevant inquiry under the proposed test is not whether an expectation is legitimate but whether it is probable.

93 *Cf.* Balganesh, *supra* note 87, at 1605, 1611.

94 *Cf.* Balganesh, *supra* note 87, at 1624. Note that the person having ordinary skill in the art ("PHOSITA") standard, which is used in the context of the non-obviousness inquiry, cannot be used herein, as the targeted crowd consists of inventors. With respect to the PHOSITA standard, *see generally* Daniel L. Burk & Mark A. Lemley, *Is Patent Law Technology-Specific?*, 17 BERKELEY TECH. L.J. 1155, 1185–96 (2002); Jeanne C. Fromer, *The Layers of Obviousness in Patent Law*, 22 HARV. J.L. & TECH. 75, 83 (2008).

95 *Cf.* Hughes, *supra* note 88, at 89, 92 (noting that an occurrence can be foreseen at a general level while being unforeseen at a more specific level).

developed while using the tool.[96] In contrast, the inventor of a stand-alone commercially valuable invention typically focuses on the immediate market for her invention and may not consider the possibility that follow-on inventions will be based upon it.[97]

Another potential guideline is the magnitude of the contribution of the first invention to the development of the second invention.[98] The greater the contribution is, it is presumably more likely that the first inventor could expect the development of the second invention. Surely, when contribution is minimal, there would be generally no such expectation. The reasonable expectations test may thus also serve as a type of a de minimis exception.

The reasonable expectations test can account for characteristics of the second invention as well and may be used, for example, to exempt follow-on inventions characterized by a particularly high degree of non-obviousness, to the extent it can be identified. Arguably, it is unreasonable that the typical inventor would expect such inventions to be developed based on her invention. An exception in these cases is also justified in light of the strong interest society has in preserving the incentive to invent such inventions.[99]

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96 While classification to this group can be a meaningful consideration supporting a ruling that reasonable expectation exists, clearly, such a ruling cannot be made with respect to all cases belonging to this group. For example, if a technique developed originally to assist laboratory research in animals is surprisingly found to be useful in the course of research in plants and such research results in the development of a certain homeopathic medicine, such result is arguably not reasonably foreseeable. Thus, it is still necessary to examine each case on its own merits.

97 Here, too, it is clear that this is not always the case. If the follow-on invention improves on the first, both inventions might compete in the same market. Even if the typical inventor of a commercial product does not expect to profit in additional markets, she might reasonably expect to continue gaining from her own invention and not loose its value as a result of competition with a follow-on invention. *But cf.* Balganesh, *supra* note 87, at 1609 (refusing to accord any independent weight to "concern with substitutability" within his foreseeability test). For criticism of Balganesh's thesis in this context, see Wendy J. Gordon, *Trespass-Copyright Parallels and the Harm-Benefit Distinction*, 122 HARV. L. REV. F. 62, 77 (2009) (noting that Balganesh is wrong for refusing to accord independent weight to destruction of expected markets); Hughes, *supra* note 88, at 91 (emphasizing that individuals can foresee that unforeseeable events will disrupt existing markets).

98 The nature and type of contribution may also serve as an important factor. Thus, if the first invention merely inspired the development of the second invention, the expectation of its development is arguably unreasonable. *See supra* notes 84–85 and accompanying text.

99 Such interest exists not because inventions characterized by a high degree of non-obviousness are necessarily more valuable than other inventions, but because there are likely fewer opportunities to develop them, assuming that ideas for such inventions emerge less frequently.

The reasonable expectation test, in the context of cumulative innovation,[100] has never been suggested in academic writing, and there is currently no rule corresponding to it in U.S. or other patent systems. However, using a criterion of reasonable expectations as a limiting basis for liability or entitlement is certainly not uncommon in law,[101] and examples can be found in many other legal fields. For example, foreseeability plays a pivotal role in tort law in limiting liability for a negligent act to consequences that could have been reasonably foreseen.[102] In contract law, as well, expectations-based criteria play an important role, for example, in assessing damages for a breach of a contract.[103] Finally, in copyright law, the author's expectations play a part in determining the scope of her rights.[104]

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100 The only context in patent law where foreseeability is actually used is in connection with the rule of prosecution history estoppel, which bars an applicant who has surrendered or narrowed a claim during the prosecution process, from later invoking the doctrine of equivalents to recapture lost ground. *See* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17, 30–31 (1997); Douglas Lichtman, *Rethinking Prosecution History Estoppel*, 71 U. CHI. L. REV. 151, 153 (2004). The Supreme Court has recently clarified that patentees are not barred from using the doctrine of equivalents with respect to equivalents that were unforeseeable at the time of the application. *See* Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki, 535 U.S. 722, 738 (2002). The reasoning is that when an equivalent was unforeseeable, it cannot be concluded that the patentee abandoned it. For an analysis of the Federal Circuit's decision in this matter (prior to its appeal to the Supreme Court), see Matthew J. Conigliaro, et al., *Foreseeability in Patent Law*, 16 BERKELEY TECH. L.J. 1045 (2001).

101 *Cf.* Balganesh, *supra* note 87, at 1574, 1591 (noting that foreseeability enables courts, in various contexts, to mark the outer boundaries of liability or entitlement, by differentiating between events that are likely to have formed a part of an actor's *ex ante* incentives for action and those that are unlikely to have done so).

102 *See generally* Palsgraf v. Long Island R.R. Co., 162 N.E. 99 (N.Y. 1928) (a landmark case establishing the principle in tort law that liability for negligence is limited to injury that could be reasonably foreseen).

103 RESTATEMENT (SECOND) OF CONTRACTS § 351(1) (1981) ("Damages are not recoverable for loss that the party in breach did not have reason to foresee as a probable result of the breach when the contract was made.").

104 Berne Convention for the Protection of Literary and Artistic Works art. 9(2), Sept. 9, 1886, as amended on Sept. 28, 1979, 25 U.S.T. 1341, 828 U.N.T.S. 221, *available at* http://www.wipo.int/treaties/en/ip/berne/index.html, and General Agreement on Tariffs and Trade: Multilateral Trade Negotiations Final Act Embodying the Results of the Uruguay Round of Trade Negotiations, Annex 1C, Agreement on Trade Related Aspects of Intellectual Property Rights art. 13, Apr. 15, 1994, 33 I.L.M. 1197 (1994) [hereinafter the TRIPS Agreement] allow member states to apply certain exceptions to the exclusive rights granted to the copyright owner, provided, inter alia, that such exceptions do not conflict with a normal exploitation of the work. It has been argued that in order to determine what qualifies as normal exploitation of a work, certain expectations of the copyright owner need to be considered. *See* SAM RICKETSON, THE BERNE CONVENTION FOR THE PROTECTION OF LITERARY AND

B. Incentive to Invent the Second Invention: Experimental Use Exception at the Ex Ante *Stage*

Financial gain from the second invention—an amount sufficient to cover research costs and provide a minimal profit—is a necessary element in supplying the second inventor with incentive to invent. Yet, patent registration of the follow-on invention cannot ensure the inventor such a stake in the profits.[105] While a patent provides its owner with a shield against competition, it does not permit her to use the invention if it infringes upon other rights or is otherwise prohibited by law. As established above, follow-on inventions should be included within the scope of the original patent. However, if this is the case, then the ability of the second inventor to exploit her invention is restricted. Albeit she may hold the patent, yet she is blocked from using it.[106] Thus, there is a need for a mechanism that allows the second inventor to exploit her invention, despite the fact that such activity falls within the scope of the original patent, while ensuring a division of profit between the inventors in a manner preserving each incentive to invent.

Yet, patent law appears too imprecise an instrument to handle this task. If, as it is with respect to singular inventions, it is difficult to design each patent to provide the accurate reward necessary to ensure incentive,[107] then how can patents be "saddled" with the difficult task of dividing profit among two or more inventors? Can the solution be found in voluntary agreements between the inventors?

In fact, as has been noted by various scholars, licensing transactions between cumulative inventors are characterized by particularly high transaction costs and other factors that make it difficult for the parties to reach an agree-

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ARTISTIC WORKS: 1886–1986 483 (1987). This is actually reflected in the way the fair use defense in U.S. copyright law is structured. One of the four factors that courts are instructed to consider as part of the fair use analysis is the impact of the allegedly infringing use on the actual and potential market for the protected work. *See* 17 U.S.C. § 107 (2006). Courts have observed that the inquiry under this factor should be limited to markets of the work that are "traditional, reasonable, or likely to be developed," see, for example, *American Geophysical Union v. Texaco Inc.*, 60 F.3d 913 (2d Cir. 1994), or in other words—foreseeable markets. *See* Hughes, *supra* note 88, at 90.

105 For the initial conclusion that the second inventor should be granted a patent on her invention, see *supra* note 71 and accompanying text.

106 The first inventor is also blocked from using the second invention because of the second patent. Thus, each patent blocks the other. For the use of the term "blocking patents" in this context, see SCOTCHMER, *supra* note 21, at 129; Lemley, *supra* note 14, at 1008–10; Merges, *supra* note 30; Merges & Nelson, *supra* note 3, at 860–62.

107 *See* discussion *supra* notes 63–70 and accompanying text.

ment.[108] One such factor is the lack of information of relevant parameters, such as the expected value of the second invention.[109] Additionally, relative contributions to the development of the second invention may be difficult to agree upon, as each inventor may have an inflated idea of their own contribution or not understand the other's contribution.[110] Anti-competitive motives might cause the first inventor to block licensing even when the deal is efficient.[111] Finally, in some cases, the second inventor may need to rely on multiple patents in order to develop her invention and a tragedy of the anticommons might emerge.[112]

Certain recent empirical studies suggest that reality is actually not as bad as patent scholars predict, including, inter alia, with respect to the ability to

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108 *See, e.g.*, sources cited *supra* note 14. Clearly, the ease by which agreements between inventors are concluded in the market varies among industries. For example, in some industries, such as the automobile, aircraft manufacturing, and synthetic rubber industries, patent pools were established to facilitate market transactions and ease access to patented technologies. *See* Heller & Eisenberg, *supra* note 16, at 700. *See generally* Robert P. Merges, *Institutions for Intellectual Property Transactions: The Case of Patent Pools*, *in* EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY 123 (Rochelle Dreyfuss et al. eds., 2001); Barton, *supra* note 9, at 462–65; Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. U. L. REV. 77, 129–33 (1999). Yet, patent pools are not prevalent in all industries and their existence cannot be taken for granted. *See, e.g.*, *id.* at 129. *See also* Richard Li-dar Wang, *Biomedical Upstream Patenting and Scientific Research: The Case for Compulsory Licenses Bearing Reach-Through Royalties*, 10 YALE J.L. & TECH. 251, 307 (2008) (arguing that the preconditions required for patent pools or other license-facilitating institutions to emerge rarely exist in the biomedical sector).

109 *See, e.g.*, Eisenberg, *Patents*, *supra* note 8, at 1073; Lemley, *supra* note 14, at 1055; Merges, *supra* note 30, at 75, 99–100.

110 *See, e.g.*, Heller & Eisenberg, *supra* note 16, at 701; Merges, *supra* note 30, at 89–91; Turner, *supra* note 45, at 183. *See generally* Linda Babcock & George Loewenstein, *Explaining Bargaining Impasse: The Role of Self-Serving Biases*, 11 J. ECON. PERSP. 109 (1997) (discussing the tendency of parties to arrive at judgments that reflect a self-serving bias: to conflate what is fair with what benefits oneself).

111 For example, the first inventor may refuse to grant license for the development of an improvement in order to retain sole control of the market.

112 *See* Heller & Eisenberg, *supra* note 16. *See also* Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting*, *in* 1 INNOVATION POLICY AND THE ECONOMY 119 (Adam B. Jaffe et al. eds, 2001) (discussing the problem of "patent thickets," which occurs when an overlapping set of patent rights requires that those seeking to commercialize new technology obtain licenses from multiple patentees). For a recent economic study, see Gaston Llanes & Stefano Trento, *Anticommons and Optimal Patent Policy in a Model of Sequential Innovation* (Harvard Business School Entrepreneurial Management, Working Paper No. 09-148, 2009), *available at* http://ssrn.com/abstract=1424498 (concluding that the probability of introducing an invention decreases (increases) as the number of inventive inputs increases when inputs are complements (substitutes)).

receive licenses to use upstream patents.[113] However, such studies are limited in their scope,[114] non-conclusive,[115] and there are other empirical studies and additional evidence that lend strong support to the theoretical concerns outlined above.[116] In any case, even if there are indeed cases where the parties can manage to conclude an agreement despite the difficulties described above, there still remain other cases where a voluntary agreement cannot be counted on.

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113 *See, e.g.*, John P. Walsh et al., *Effects of Research Tool Patents and Licensing on Biomedical Innovation*, *in* PATENTS IN THE KNOWLEDGE-BASED ECONOMY 285 (Wesley M. Cohen & Stephen A. Merrill eds., 2003) (providing survey results indicating that the patenting of research tools in the biomedical industry has generally not been viewed as having a substantial negative effect on further research in the field). The main explanation for the results, supplied in the study, is that firms and universities have been able to develop "working solutions" that allow their research to proceed, which one of them is, simply, "taking licenses." *Id.* at 286. The authors opine that "it is typically not that difficult to contract" and state that licensing is routine in the drug industry. *Id.* at 322. For descriptions of other studies suggesting, in general, that scholars may have been overly concerned with the results of proprietarizing upstream research results, see Sarnoff & Holman, *supra* note 26, at 1325–31; Katherine J. Strandburg, *User Innovator Community Norms: At the Boundary Between Academic and Industry Research*, 77 FORDHAM L. REV. 2237, 2239 n.8 (2009).

114 The study of Walsh, *supra* note 113, for example, focused entirely on research tools and was based on seventy interviews with individuals involved in biomedical research exclusively. *See also* Rebecca S. Eisenberg, *Noncompliance, Nonenforcement, Nonproblem? Rethinking the Anticommons in Biomedical Research*, 45 HOUS. L. REV. 1059, 1076, 1098 (2008) (noting that these studies have focused primarily on the effects of patents on the research science community itself while paying relatively little attention to downstream product development, what limits their value as a test of the hypothesis that too many upstream patent claims could impede downstream product development).

115 *See, e.g.*, Walsh, *supra* note 113, at 286 (admitting that there is nevertheless "some evidence of delays associated with negotiating access to patented research tools, and there are areas . . . where access to foundational discoveries can be restricted").

116 *See infra* notes 29–31 and accompanying text. *See also* Ron A. Bouchard, *Balancing Public and Private Interests in the Commercialization of Publicly Funded Medical Research: Is There a Role for Compulsory Government Royalty Fees?*, 13 B.U. J. SCI. & TECH. L. 120, 144 (2007) (noting that "there is significant evidence to suggest that the scientific commons is eroding and that there is at least the potential for development of an anticommons"); Eisenberg, *supra note* 114, at 1098 (describing studies suggesting that product development firms face a growing burden of transaction costs to identify and clear rights); Jay P. Kesan, *Transferring Innovation*, 77 FORDHAM L. REV. 2169 (2009) (describing empirical studies indicating, among other things, the slowdown of development in industry as university patenting has increased); Sarnoff & Holman, *supra* note 26, at 1331 (summarizing studies that indicate an increasing trend towards restriction of access and some delays in or changes to research); Peter Yun-hyoung Lee, *Inverting the Logic of Scientific Discovery: Applying Common Law Patentable Subject Matter Doctrine to Constrain Patents on Biotechnology Research Tools*, 19 HARV. J.L. & TECH. 79, 85 (2005) (describing studies suggesting that "patents on research tools undermine scientific exchange, and ultimately, progress").

1. *Ex Ante* Agreements

One point that has not received enough attention in legal literature is the distinction between an *ex ante* agreement, executed prior to the development of the second invention, and an *ex post* agreement, concluded after its development.[117] It appears that for various reasons, the chances of concluding an *ex ante* agreement are particularly low.[118] First, prior to investing in research and development, most inventors have only a minimal knowledge of the course of research they intend to pursue, and do not have anything to "sell" at this stage.[119] From the viewpoint of the original patentee, considering that her invention can potentially serve as the basis for a variety of follow-on projects, the development stage of a project may serve as an important screening factor—the more advanced the development stage of the second invention, the greater the chances of its successful completion, thereby encouraging the original patentee to grant a license.

Second, at this early stage, there is typically not enough information about development costs, the risks involved in the project, and the potential profits in order for the parties to be able to reach an agreement.[120] Some parameters may be estimated in advance; however, if the second inventor merely holds a vague research agenda at this stage, it is unlikely that enough factors are known at this time or that the parties can agree upon their anticipated value. Lack of information can add a burden on the transaction and increase its costs.[121]

Third, at this stage, the second inventor is not likely to secure a patent and is thus without legal protection to defend against the use or exposure of confidential information disclosed during negotiations. According to Kenneth J.

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117 For the distinction between *ex ante* agreements and *ex post* agreements, *see* SCOTCHMER, *supra* note 21, at 137; Green & Scotchmer, *supra* note 24, at 21; Scotchmer, *supra* note 1, at 32.

118 For empirical support of this argument, *see* Bessen, *supra* note 41, at 3 (concluding that *ex ante* licensing is not a prevalent practice in industries characterized by cumulative research and development).

119 *Cf*. Barton, *supra* note 9, at 453; O'Donoghue, *supra* note 2, at 672.

120 *See* Eisenberg, *Rights*, *supra* note 8, at 217 (noting that the serendipitous nature of research discoveries may make it difficult to value the right to use a patented invention before the research project is completed); Timothy J. Engling, *Improvements in Patent Licensing*, 78 J. PAT. & TRADEMARK OFF. SOC'Y 739, 741–42, 746 (1996) (explaining that the value of a future improvement is hard to measure in advance); Wang, *supra* note 108, at 326 (pointing at the lower information costs existing at the *ex post* stage).

121 *See* Merges & Nelson, *supra* note 3, at 895 n.251 (pointing out that valuation problems in licensing transactions are difficult enough after an invention has been developed and are seemingly even more difficult prior to its development).

Arrow, the quandary of disclosing information without legal rights to the invention is one of the justifications for the patent system.[122] Within the context of cumulative innovation, it poses yet another significant hurdle that may thwart the possibility of concluding *ex ante* agreements.[123]

2. Experimental Use Exception

Since the chances for concluding an *ex ante* agreement are minimal, the second inventor must be allowed to use the original invention for research and development purposes without obtaining advance permission. This would enable the second inventor to complete the project, register a patent, and approach the first inventor to try negotiating an *ex post* agreement that would allow exploitation of the invention while dividing profit between the inventors.

There are many legal systems that employ arrangements allowing certain experimental activity during the life of the patent.[124] The experimental use doctrine has also benefitted from much attention in legal literature.[125] Yet, the direct link that exists between the low probability of concluding an *ex ante* agreement in a cumulative innovative setting and the need for an experimental use exception that allows the development of follow-on inventions must be em-

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122 *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609 (Richard R. Nelson ed., 1962). *See also* Jerome H. Reichman, *Of Green Tulips and Legal Kudzu: Repackaging Rights in Subpatentable Innovation*, *in* EXPANDING THE BOUNDARIES OF INTELLECTUAL PROPERTY: INNOVATION POLICY FOR THE KNOWLEDGE SOCIETY 23, 35 n.30 (Rochelle Cooper Dreyfuss et al. eds., 2001); Gordon, *supra* note 43, at 633; Robert P. Merges, *Of Property Rules, Coase, and Intellectual Property*, 94 COLUM. L. REV. 2655, 2657–58 (1994). Arguably, this problem can be solved by using confidentiality agreements. However, it is likely that the party who is about to be exposed to the information will hesitate to execute such agreement before knowing what is the subject of the agreement. Also, a confidentiality agreement provides contractual protection only and cannot be of assistance if confidential information has leaked, spread, and reached third parties.

123 *Cf.* Chang, *supra* note 2, at 38 n.6; Donald G. McFetridge et al., *Patents, Prospects, and Economic Surplus: A Comment*, 23 J.L. & ECON. 197, 202–03 (1980) (noting the impossibility of reaching an *ex ante* agreement, since prior to the registration of a patent the future legal right is still not defined).

124 *See infra* Part IV.B.

125 *See, e.g.*, AMIRAM BENYAMINI, PATENT INFRINGEMENT IN THE EUROPEAN COMMUNITY 266–80 (13 IIC STUDIES, 1993); DAVID GILAT, EXPERIMENTAL USE AND PATENTS (16 IIC STUDIES, 1995); Richard E. Bee, *Experimental Use as an Act of Patent Infringement*, 39 J. PAT. OFF. SOC'Y 357 (1957); Eisenberg, *Patents*, *supra* note 8; Eisenberg, *Rights*, *supra* note 8; Feit, *supra* note 10; Ronald D. Hantman, *Experimental Use as an Exception to Patent Infringement*, 67 J. PAT. & TRADEMARK OFF. SOC'Y 617 (1985); Mueller, *supra* note 10; Saunders, *supra* note 10; Strandburg, *supra* note 10; Thai, *supra* note 10.

phasized.[126] A direct implication of this link is that the experimental use exception must be wide and apply to all scenarios of cumulative innovation, as the analysis conducted above is not dependent upon the existence of characteristics associated with only a sub-group of those scenarios.

As mentioned, the experimental use exception currently embodied in U.S. law is extremely narrow.[127] Other countries, notably European, have employed wider exceptions in their patent systems, though not necessarily as wide as the exception suggested herein.[128] While scholars discussing the U.S. experimental use exception have generally expressed the necessity for adopting a wider exception,[129] the vast majority of them have nevertheless suggested qualifying the exception in various manners to distinguish between permissible and non-permissible experiments.[130] Yet, as the discussion above indicates, the experimental use exception should not be limited, but rather applied in a sweeping manner. This would also provide certainty for research users of patented inventions.

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126 Needless to say, even if *ex ante* agreements were easy to conclude, entrusting control over research uses at the hands of the patent owner may not be efficient, as she may choose her licensees and design licenses' terms in a manner that optimizes her own private interests—for example, with respect to competition with other products sold by her—but does not necessarily match society's interests. *Cf.* Rai, *supra* note 108, at 124.

127 *See supra* note 12 and accompanying text.

128 *See infra* notes 204–209 and accompanying text.

129 *Contra* Karp, *supra* note 10, at 2185.

130 For example, one parameter that has been suggested in the literature is to apply the exception only in cases where the likelihood for agreement between the parties is low. *See* GILAT, *supra* note 125, at 39–42. As explained above, there are various reasons why negotiation between parties may fail, which may exist in any possible scenario of cumulative innovation. Another suggested distinction is between users motivated by profit and users with other motivations. *See, e.g.*, Bee, *supra* note 125, at 377; *cf.* Gitter, *supra* note 13, at 1628, 1679 (suggesting to apply different rules with respect to commercially driven research and other research). This distinction is also inappropriate, as most of inventors are driven, at least partially, by a desire to make a profit, and society can benefit from the development of a follow-on invention even if the motive is commercial; while at the same time, commercially driven research does not necessarily inflict more harm on the economic interests of the original patent owner, as the main market for her invention may actually be amongst researchers that are not driven by such goals. *See* Eisenberg, *Patents*, *supra* note 8, at 1023–24, 1035. Another distinction suggested in the literature is between research users who compete with the patent owner in the same market and research users who are "regular consumers" of the invention. *See, e.g.*, Eisenberg, *Patents*, *supra* note 8, at 1074–78; Eisenberg, *Rights*, *supra* note 8, at 225; GILAT, *supra* note 125, at 44; Hantman, *supra* note 125, at 638–41. This is another problematic distinction, because difficulties to reach an agreement can exist not only when the inventors compete in the same market.

Adoption of a wide experimental use exception will admittedly result in preventing compensation of the original patentee for the mere use of her invention during the development stage of the second invention. However, if the second inventor is ultimately successful in developing and commercializing her invention, the proper application of the Absolute Scope Principle guarantees, at least, that the exploitation of such invention shall be included in the scope of the original patent, ensuring its owner a portion of the profits. The original patentee would indeed not be compensated if the follow-on researcher does not end up developing or marketing her invention.[131] Providing compensation in such instances would increase the risk associated with research and development activity, while it is not clear whether it is actually needed in order to provide incentive to the first inventor.[132] In fact, in such cases, it is likely that the use of the basic invention, not evidenced by a marketed product, would not even be traceable by the patent owner,[133] and even if traced, such "low value infringement" may not be enforced because of the high litigation cost relative to the expected low payoff.[134]

One special case worthy of attention in this context is the research tools scenario.[135] Two main arguments have been made against application of the experimental use exception with respect to research tools. One argument is that when the invention serves as a means for conducting experiments that are not related to the subject matter of the invention, so that the inventors do not compete with each other, no reason exists for the patent owner to refuse granting a license to the research user who, after all, is a regular consumer of the inven-

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131 *Contra* Mueller, *supra* note 10, at 62 (supporting compensation even when the research use does not result in a commercial product).

132 Empirical studies may provide an answer to this question. For other suggestions to limit compensation to cases in which the experimental use has resulted in the successful development of a commercial product, see Eisenberg, *Patents*, *supra* note 8, at 1077–78; Feit, *supra* note 10, at 840.

133 *Cf.* Eisenberg, *Patents*, *supra* note 8, at 1071–72 (noting that making and using a patented invention within a research laboratory is not very conspicuous and thus may never come to the attention of the patent holder); Walsh, *supra* note 113, at 324 (noting that infringement of research tool patents is often hard to detect).

134 *See* Walsh, *supra* note 113, at 334.

135 As noted above, various scholars have suggested limiting experimental use to cases involving research users who compete with the patent owner in the same market. *See supra* note 130. *But see* Gitter, *supra* note 13, at 1684–85 (proposing the application of the experimental use exception with respect to noncommercial research in DNA sequences); Thai, *supra* note 10, at 393–97 (suggesting the exemption of certain uses of research tools in university research).

tion.[136] The other argument is that in most cases, a research tool cannot be used for non-research purposes, and therefore, exempting research uses can significantly diminish the ability of patent owners to profit from commercialization of their invention.[137]

These arguments are not convincing. Similar to other scenarios of cumulative innovation, licensing of research tools bear high transaction costs—especially when a particular follow-on inventor must use more than one research tool—and the parties to such licensing transactions may encounter barriers in negotiating an agreement, even though they are not direct competitors of each other.[138] For example, inventors may disagree about the division of profits from the follow-on invention and the payment that the follow-on inventor must deliver to the original patentee if the research project fails. Moreover, the risk involved in disclosing information that is yet not protected by a patent, may deter the second inventor from even attempting to receive the patentee's consent.[139] Such risk exists even if the patent owner is not directly involved in the same research field as the second inventor since she may pass along the information to others. As to the second argument, which doubts the ability of the patent owner to profit from the research tool invented by her, it is likely that any damage caused as a result of adopting an experimental use exception can be remedied by ensuring appropriate compensation through the strict application of the Absolute Scope Principle.[140] Therefore, even if differences exist between the various scenarios, such differences do not justify the non-application of the experimental use exception with respect to research tools.

Yet, the experimental use exception should not be applicable to research tools that are readily available in the market, that is, tools that can be purchased through an anonymous transaction, as in the case of patented chemical reagents

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136 *See* GILAT, supra note 125, at 44; Eisenberg, *Patents*, *supra* note 8, at 1074, 1078; Eisenberg, *Rights*, *supra* note 8, at 225.

137 *See* Eisenberg, *Patents*, *supra* note 8, at 1035.

138 S*ee* Mueller, *supra* note 10, at 40 (arguing that because of these difficulties it is a mistake to call research users "ordinary consumers" of the invention).

139 *See* discussion *supra* notes 122–123 and accompanying text.

140 As explained above, the research tools scenario has a unique characteristic that must be accounted for: the second invention in its final form, which was developed with the aid of the research tool, does not embody the claims of the original patent. Thus, exploitation of the second invention does not involve simultaneous use of the original invention, and patent scope rules need to be designed in a manner ensuring that it is nevertheless captured in the scope of the original patent. *See* discussion *infra* Part IV.A.1.

sold via catalogues.[141] In such a case, all obstacles that could prevent the follow-on inventor from using the research tool no longer exist: There is no need to negotiate a deal with the patent owner, and there are no transaction costs other than payment of the market price for the tool itself. Therefore, a follow-on inventor should not be allowed to manufacture the research tool on her own, an action that would be considered an infringement of the patent; rather, the tool must be purchased from the patent owner.[142] The use of a purchased research tool will generally be permissible under the exhaustion doctrine or the implied license doctrine, if not explicitly by the contract between the parties.[143] Follow-on inventions developed while using these research tools should be considered outside the scope of the original patent, subject to the provisions of the contract governing the sale of the tool, since the price of the tool likely accounts for the possibility that the tool would be used to develop profitable follow-on inventions.[144]

C. Incentive to Invent the Second Invention: Liability Rule Doctrines at the Ex Post *Stage*

1. *Ex Post* Agreements

While the experimental use doctrine allows for the development of a follow-on invention, in order for the second inventor to exploit it, she still needs

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141 *See* Barton, *supra* note 9, at 457; Mueller, *supra* note 10, at 15. For the existence of such research tools, see also SCOTCHMER, *supra* note 21, at 142; Eisenberg, *Patents*, *supra* note 8, at 1072. The burden of proof should clearly rest on the patent owner to show that at the time the research use of her invention took place, the invention was readily available in the market.

142 Certainly, when the invention is a product not readily available in the market, the experimental use exception should apply to the manufacturing of the patented device and not only to its use. Otherwise, the exception would not serve its goal as the original patentee would still need to consent.

143 The longstanding doctrine of patent exhaustion provides that the initial authorized sale of a patented item terminates all patent rights to that item. *See* Quanta Computer, Inc. v. LG Elecs., Inc., 128 S.Ct. 2109, 2115 (2008). At the same time, the authorized sale of a patented product carries with it an implied license to use the product. *See* Eisenberg, *Patents*, *supra* note 8, at 1072.

144 This is surely not the case with respect to ordinary consumption products, as opposed to research tools, purchased in the market. Thus, the buyer of a cellular phone who wishes to develop an improvement thereof is not protected by the exhaustion or implied license doctrines. She may certainly rely on the suggested experimental use exception, but the resulted improvement will then be included in the scope of the original patent under the Absolute Scope Principle.

permission from the original patentee. Although *ex post* agreements are easier to negotiate than *ex ante* agreements, the second inventor still must overcome many obstacles in order to execute an *ex post* agreement.[145] The conclusion of an *ex post* agreement, thus, cannot be taken for granted.

Additionally, it appears that the division of profits determined in an *ex post* agreement may not be efficient. Specifically, the second inventor might not receive a sufficient portion of the profits, since, in the *ex post* scenario, the second inventor already invested the development costs of the second invention and the first inventor might not agree to share such costs with the second inventor.[146] In fact, at this point the first inventor can, if she wants to, extort the second inventor, who can lose her entire investment without the first inventor's consent. Even if royalties demanded by the first inventor are high, the second inventor is in a bind and likely to pay.[147] The knowledge that she may need to pay overly high royalties in order to secure the original patentee's permission *ex post*, can have an adverse effect, *ex ante*, on the second inventor's incentive.

In light of the above, a mechanism that levels the playing field and increases the chances of concluding a voluntary transaction—whereby the second inventor earns a sufficient portion of the negotiation surplus—needs to be found. Such a mechanism should also serve as a second-order solution for cases in which parties do not reach an agreement, where it would allow the exploitation of the second invention while minimizing the adverse effect on the incentive of the original inventor.

Adoption of a limited exemption doctrine that would release the second inventor, when it is applied, from liability for the non-permitted exploitation of the follow-on invention, could be useful. Such doctrine would also strengthen, in general, the bargaining power of follow-on inventors in *ex post* agreement negotiations. But, in light of potential damage to the first inventor's incentive as

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145 *See* discussion *supra* notes 108–112 and accompanying text.

146 For this reason, Green and Scotchmer, *supra* note 24, at 21, point out that *ex ante* agreements are preferable because they may lead to the development of follow-on inventions that would not happen otherwise. *See also* SCOTCHMER, *supra* note 21, at 138 (noting that "[r]esolving the blocking patents *ex ante* can expand the circumstances in which the second product is developed"). Yet, as explained above, *ex ante* agreements are not often a feasible option.

147 *See* Barton, *supra* note 9, at 453 (discussing the risk of a hold-up in *ex post* agreements); Chang, *supra* note 2, at 35 (elucidating on the potential for extortive behavior by the first inventor); Molly A. Holman & Stephen R. Munzer, *Intellectual Property Rights in Genes and Gene Fragments: A Registration Solution for Expressed Sequence Tags*, 85 IOWA L. REV. 735, 779 (2000) (noting that a firm that already made specific investments is more susceptible to opportunistic behavior from the patent holder); Scotchmer, *supra* note 1, at 32 (noting the weak negotiation stance of the second inventor). Nevertheless, this concern may be exaggerated when the original inventor is a repeat player in the market.

a result of the application of such doctrine—other than pursuant to the reasonable expectations test discussed above—such limited doctrine must be applied very carefully.[148] Thus, creation of a complementary mechanism, examined in the following section, is necessary.

2. Liability Rule Doctrines

Liability rule doctrines would allow the second inventor to exploit her invention, even without the consent of the patent owner, in return for an appropriate royalty determined by an external entity such as the U.S. Patent and Trademark Office or the courts.[149] The adoption of such doctrines is particularly important when exploitation of nearly every follow-on invention is considered within the scope of the original patent—by nature of the proposed Absolute Scope Principle. Liability rule doctrines can be applied in two forms: prospectively, following a request by the second inventor for a compulsory license, or retrospectively, as part of the remedy determination in a patent infringement suit brought by the original patentee. The liability rule mechanism serves the goals set forth above: it strengthens the negotiation position of the second inventor, and thus improves the chances for an efficient *ex post* deal between the parties, whereby the second inventor earns a sufficient stake of the profits. However, if the parties cannot reach an agreement, activating a liability rule doctrine ensures that the second inventor can nevertheless exploit her invention in return for royalties. This may also increase the second inventor's *ex ante* incentive to de-

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[148] Some scholars suggested guidelines to identify cases in which an exemption should be granted to a follow-on inventor. *See* Chang, *supra* note 2, at 42–49 (arguing that fewer exemptions should be granted when the standalone value of the original invention is particularly low or particularly high); Merges & Nelson, *supra* note 3, at 865–67 (arguing that such an exemption is warranted particularly when the marginal value of the second invention is higher than the standalone value of the original invention).

[149] *Cf.* Gitter, *supra* note 13, at 1628, 1679, 1685 (suggesting a similar regime in the context of DNA fragments patents used for commercially oriented research); Mueller, *supra* note 10, at 9–10, 54–55 (suggesting, with respect to biomedical research tools, employing a liability rule regime in the development stage rather than a full-on experimental use exception); O'Rourke, *supra* note 14, at 1209–10 (proposing a general fair use exception in patent law, with royalties imposed on the user in a sub-group of cases); Reichman, *supra* note 122, at 39–48 (proposing a liability rule regime with respect to sub-patentable developments); Strandburg, *supra* note 10, at 142–46 (supporting a compulsory licenses regime with respect to research tools that would be triggered a few years after the registration of the patent); Wang, *supra* note 108, at 319 (suggesting a regime whereby users of biomedical research tools "bear an obligation to submit royalties, as if the law automatically and compulsively granted a license").

velop her invention, as she knows that her bargaining position is stronger and that liability rules would serve as default in case negotiations fail.

This Article suggests that liability rule doctrines should be activated in each and every case negotiations fail, not only in a sub-group of such cases.[150] Otherwise, the failure of parties to reach an agreement will prevent the exploitation of an already developed follow-on invention, the invention's potential social utility will never materialize, and the invention's development costs will be wasted.[151] Obviously, these circumstances are best avoided whenever possible. Moreover, the suggested "sweeping" regime is optimal from the viewpoint of the incentive to invent follow-on inventions: a potential second inventor knows that her worst scenario—inability to exploit her completed invention—can never happen.

The main potential criticism against applying liability rule doctrines in favor of a "dependent patent,"[152] rather than adhering to the property rule regime established by the patent system in general, is that it may diminish the incentive to develop research tools or other inventions that are more likely to serve as inputs for cumulative research. However, if the inventor of such invention knows in advance that she is entitled to receive a reasonable royalty every time a follow-on invention is developed and can factor this into her investment decision, her incentive should not be significantly diminished. In fact, inasmuch as more follow-on inventions may develop in the presence of liability rule doctrines, as this Article predicts, the first inventor may also benefit from it, as she would ultimately have more opportunities to gain profits in markets for follow-on inventions. Hence, this is not necessarily a zero-sum game.

There are a few other purported disadvantages of the suggested regime. First, liability rules are costly due to the need to determine their applicability and the royalty rate on a case-by-case basis.[153] Yet, under the suggested sweep-

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150 *Cf.* Reichman, *supra* note 122, at 39–48 (raising a similar argument with respect to sub-patentable developments).

151 It may be argued that in cases where a liability rule is not applied, the parties have an incentive to reach an agreement, even if they are not pleased with its outcome, in order to avoid wasting the invention. However, in many cases irrational considerations may keep the parties from executing an agreement even if it is the rational choice for them. In particular, pride may prevent the second inventor from agreeing to a deal where she retains only a very small portion of the profits.

152 The term "dependent patent" reflects the fact that in order to exploit the invention covered by it, its owner needs the original patentee's consent. For use of this term, see, for example, J. Straus, *The Principle of "Dependence" Under Patents and Plant Breeders' Rights*, 26 INDUS. PROP. 433, 438 (1987).

153 *See infra* note 169 and accompanying text (discussing the assessment costs associated with the application of liability rules).

ing regime there would actually be no need to determine whether a liability rule is applicable or not, which simplifies the decision-making process significantly. Therefore, this regime may actually lead to reduced costs compared to regimes in which liability rules are applied only under certain conditions. As will be discussed later, the application of liability rules can be further simplified in order to reduce costs by ensuring that the determination of royalty rates does not involve a long evidentiary process.

Another potential criticism of the suggested regime is that if liability rules are applicable whenever negotiations fail, then it may make parties less motivated to reach an agreement.[154] Yet, it seems that even under such a regime, the uncertainty associated with determining royalty rates may push the parties to negotiate with each other rather than rely on the tribunal's decision. The second inventor may believe that she can retain a larger portion of the profits through a voluntary transaction. At the same time, the first inventor may be enticed to agree on a certain rate in order to avoid the risk of being awarded a lower rate by the tribunal. Therefore, with some degree of uncertainty about the expected decision of the court, it seems that incentives to negotiate are preserved. Also, motivation to reach a voluntary agreement stems from the potential to save time, effort, and other resources involved in the legal procedure. Furthermore, by reaching a voluntary agreement, parties can be certain about their respective rights and obligations at an earlier stage. Hence, the concern of lost motivation to negotiate seems exaggerated. In fact, empirical evidence shows that in legal systems where a liability rule in the form of a compulsory license exists, it is hardly ever used.[155] This may indicate that the main effect of liability rules, after all, is to influence the negotiation positions of the parties in order to increase the

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154 Supposedly, a voluntary agreement is preferable to other solutions because it generally corresponds most precisely to the needs of the parties, as they have better information about the relevant parameters than any external decision maker.

155 *See* ADELMAN ET AL., *supra* note 71, at 1235 (noting that compulsory licensing schemes "are more often discussed than invoked in practice"); WILLIAM CORNISH & DAVID LLEWELYN, INTELLECTUAL PROPERTY: PATENTS, COPYRIGHT, TRADE MARKS AND ALLIED RIGHTS 296, 301 (6th ed. 2007) (arguing that compulsory license systems are not used); Merges, *supra* note 30, at 104–05 (arguing that compulsory "dependency license" provisions in various statutes are hardly ever adjudicated); Mueller, *supra* note 10, at 65–66 (pointing out that few applications for compulsory licenses have actually been made under laws that allow it); Straus, *supra* note 152, at 442. Admittedly, a possible reason compulsory licenses are rarely used is because the applicant must meet rigid requirements under the current regimes in such legal systems. *See* discussion *infra* Part IV.C.

likelihood of closing an efficient voluntary agreement.[156] In any event, when applying for a compulsory license the second inventor should be required to show a prior good faith effort to secure the original patentee's consent; this will encourage the conclusion of voluntary agreements in more cases.[157]

Adopting liability rule doctrines within the context of cumulative innovation[158] is in line with the principles developed in academic literature for choosing between property rules and liability rules.[159] An entitlement is protected by a property rule if no one can appropriate it without the consent of its owner at a price determined by her.[160] A liability rule, on the other hand, allows for the transfer of the entitlement even without the consent of its owner, as long as she receives monetary damages determined by an organ of the state.[161] Calabresi and Melamed laid out the basic model to choose between property rules and liability rules in order to maximize economic efficiency. They suggested that property rules should be used when transaction costs are low and the parties can negotiate with each other,[162] while liability rules should be used when transaction costs are high and negotiation is impossible or difficult; in such cases, the damages determined by the state should attempt to mimic the expected market outcome.[163] Following Calabresi and Melamed's seminal article, a vast body of literature addressed the topic. Scholars presented various arguments to support, refine, elaborate, or question Calabresi and Melamed's model.[164] Some criti-

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156 *Cf.* Straus, *supra* note 152, at 442 (noting that compulsory dependency licenses, as well as other compulsory licenses under the patent system, already seem to produce positive effects by their mere existence).

157 *See* Reichman, *supra* note 122, at 43 (noting that the combination of such requirement and the potential application of a liability rule in each and every case where negotiation fails creates, de facto, mandatory arbitration with respect to royalty rates).

158 Surely, in any other context, against any person imitating the invention or using it under any circumstances other than the one discussed herein, the patent would continue granting its owner an entitlement protected by a property rule.

159 This distinction between these two forms of legal entitlement protection was first presented by Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972) (discussing also a third type of protection, inalienability, which is irrelevant in the context discussed herein).

160 *Id.* at 1092, 1105.

161 *Id.* at 1092, 1106–10.

162 *See id.* at 1106–10.

163 *See id.*

164 *See generally* Richard Craswell, *Property Rules and Liability Rules in Unconscionability and Related Doctrines*, 60 U. CHI. L. REV. 1 (1993); Merges, *supra* note 122; A. Mitchell Polinsky, *Resolving Nuisance Disputes: The Simple Economics of Injunctive and Damage Remedies*, 32 STAN. L. REV. 1075 (1980).

cisms focused on the fact that even when transaction costs are low, liability rules may be superior to property rules, because they induce owners to reveal their true valuation of the entitlement and thus facilitate more efficient bargaining.[165] However, other scholars emphasized the shortcomings of bargaining under liability rules and the advantages of property rules in cases where negotiation is a realistic option, while criticizing the assumption that sellers necessarily act in an extortive manner under such regimes.[166] In light of the high transaction costs and other factors that make bargaining particularly difficult in the cumulative innovation scenario,[167] both the basic model suggested by Calabresi and Melamed and the other approaches described above justify the choice of liability rules.[168]

A different criticism is that even when high transaction costs exist, liability rules might not be superior to property rules in light of the high assessment costs associated with their application.[169] This argument strengthens the need to ensure that the determination of royalty rates is not overly complicated. The configuration of royalty rates can indeed be difficult. Some may argue that in order to ensure adequate incentives, royalties should be calculated so that

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165 *See* Ian Ayres & Eric Talley, *Solomonic Bargaining: Dividing a Legal Entitlement to Facilitate Coasean Trade*, 104 YALE L.J. 1027, 1059–60 (1995) (noting that "[b]y effectively forcing the plaintiffs to reveal information about their valuations, liability rules mitigate the inefficiencies of bargaining under private information"). *See generally* Louis Kaplow & Steven Shavell, *Property Rules Versus Liability Rules: An Economic Analysis*, 109 HARV. L. REV. 713 (1996) (offering a criticism from a different angle that leads to the conclusion that liability rules should be applied more frequently).

166 *See* Daphna Lewinsohn-Zamir, *The Choice Between Property Rules and Liability Rules Revisited: Critical Observations from Behavioral Studies*, 80 TEX. L. REV. 219, 221 (2001) (drawing on insights from behavioral and psychological studies of bargaining behavior to support a return to the wisdom of the original Calabresi and Melamed thesis).

167 *See* discussion *supra* notes 108–112 and accompanying text.

168 *See* Ayres & Talley, *supra* note 165, at 1093–94 (presenting a concrete support of liability rules in a cumulative innovation setting and arguing that in most cases the parties themselves will reach an agreement with such rules in the background, so that there will be no need to actually use them). As explained above, this Article suggests applying liability rules with respect to follow-on inventors, while preserving the protection of the patentee through a property rule with respect to any other third parties. The suggested regime may, in fact, be characterized as a simultaneous pliability rules regime, meaning, a regime combining property rule protection with respect to certain users and a liability rule protection with respect to other users. *See* Abraham Bell & Gideon Parchomovsky, *Pliability Rules*, 101 MICH. L. REV. 1, 30, 49–53 (2002) (defining pliability rules).

169 *See* James E. Krier & Stewart J. Schwab, *Property Rules and Liability Rules: The Cathedral in Another Light*, 70 N.Y.U. L. REV. 440, 453 (1995) (pointing out that problems in obtaining and processing information might impede efficient decision making by the judge in liability rule cases).

each inventor gets a sufficient portion of the profits to allow her to cover costs and gain a minimal profit. However, this option is not practical because there is little information concerning the relevant parameters for such a calculation, including the costs associated with the development of each invention.[170] Thus, this Article suggests foregoing mathematical formulas. Rather, decision makers should be authorized to determine royalty rates through a rough estimation within a stated range of percentages of the second invention's value.[171]

As previously explained, patents—even within the context of a stand-alone invention—are difficult to design in an accurate manner. Even if this Article accepts the central role that expectations to receive profits play under the incentive to invent theory, it is clear that the typical inventor does not base her investment decisions on precise mathematical calculations. Needless to say, the suggested approach for determining royalty rates promotes simplicity and significantly reduces assessment costs because it requires no complicated evidentiary proceedings.[172] Additionally, the uncertainty associated with this approach to determining royalty rates would preserve incentives to bargain.[173] Still, setting boundaries on potential royalty rates provides a framework for negotiation, gives the parties a basis for evaluating their risks and opportunities and serves as a factor in their initial investment decisions.[174]

While decision makers should enjoy wide discretion to determine royalty rates within the stated range, certain guidelines may be useful.[175] For example, the higher the value of the first invention, on a stand-alone basis, and/or the more such basic invention serves—or has a potential to serve—as the basis for multiple follow-on inventions, the lower the rate should be set—since the first inventor is less likely to need a high royalty in order to perfect her incentive in such cases. Another possible guideline is that the higher the inventive step represented by the second invention, the lower the rate should be set in order to

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170 *See supra* notes 65–66 and accompanying text.

171 *Cf.* Reichman, *supra* note 122, at 44 (discussing why a "uncomplicated scale of percentage royalties" is preferable); Mueller, *supra* note 10, at 64–65 (surveying methods to simplify royalty rate determination). To determine an acceptable range of rates, the decision-maker can look to empirical studies of agreed upon rates across relevant industries.

172 *See supra* note 169.

173 *See* discussion *supra* notes 154–157 and accompanying text.

174 This is true particularly with respect to the second inventor, who can receive, *ex ante*, an idea of the maximum percentage of profits that she may be obligated to pay the first inventor.

175 *Cf.* Georgia-Pacific Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (providing a list of factors to be considered in determining reasonable royalties as damages for patent infringement).

ensure incentive to develop such a rare invention.[176] In an improvement scenario, the first inventor must be compensated for the loss of revenue resulting from competition with the follow-on invention.[177] On the other hand, in the research tools scenario the decision-maker must pay attention to the potential for a tragedy of the anticommons,[178] as multiple tools are often required for the development of one follow-on invention.[179] In that case, it may be appropriate to set lower royalty rates in order to avoid unduly burdening the follow-on inventor.[180] In addition to various efficiency-related factors,[181] fairness considerations may be taken into account as well. For example, a relevant factor to determine royalty rates should be the comparative contributions of the parties to the development of the second invention.[182] The type and extent of use of the first invention in the development process of the second invention may also be a factor. Finally, within this context, it is also appropriate to take into account customary rates in the relevant industry, to the extent they exist, and other unique characteristics thereof. It is likely that with time and experience, authorized tribunals will develop the additional guidelines and expertise that would allow them to decide in these matters with growing efficiency.

IV. CRITICAL EXAMINATION OF CURRENT U.S. PATENT LAW

In order to evaluate the need to reform patent law, this part examines current U.S. patent law in light of the recommendations made above. For this purpose, U.S. patent law is compared to the patent laws of other countries. Additionally, this part examines compliance with relevant provisions in interna-

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176 *See supra* note 99 and accompanying text.

177 *See* SCOTCHMER, *supra* note 21, at 134 (discussing the profit-eroding effect of competition between an improvement and an original invention); *see also infra* text accompanying note 36.

178 *See supra* note 112 and accompanying text.

179 *See, e.g.*, SCOTCHMER, *supra* note 21, at 132 (noting that the need to use multiple inventive inputs characterizes the research tools scenario).

180 *Cf.* Wang, *supra* note 108, at 320 (suggesting an interpleader mechanism to deal with a multi-patents situation).

181 On top of the factors noted above, when reliable information about development costs exists, it should be accounted for by setting lower royalty rates when development costs of the second invention are higher and/or development costs of the first invention are lower.

182 This conclusion can be supported by an analysis of cumulative innovation in light of the labor theory. *See supra* note 18 and accompanying text. Under the theory, each inventor is entitled to the fruits of her labor. As both inventors' labor contribute to the development of a follow-on invention in a cumulative innovation setting, the theory supports a profit distribution that ensures each inventor just reward for her contribution.

tional agreements. Discussion follows the order of the previous part. First, this section examines the rules defining patent scope in order to evaluate the extent the Absolute Scope Principle and the reasonable expectations test are reflected in legal doctrine. Second, this section examines the current experimental use exception against the similarly termed exception proposed above.[183] Third, this section discusses the possibility of applying the proposed liability rule doctrines.[184]

A. Patent Scope

1. The Absolute Scope Principle

In order to give effect to the Absolute Scope Principle, exploitation of a follow-on invention should always be considered an infringement of the original patent. Based on the type of relation existing between the first invention and the follow-on invention, various scenarios of cumulative innovation can be distinguished. There are settings in which the follow-on invention typically embodies the claims of the original invention, as in applications for a basic technology or in new uses of an existing product. With respect to these scenarios, current law does not need to be amended because it already defines any use of an invention as infringement of the patent.[185] For example, if laser technology is the original

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183 Needless to say, the experimental use exception is also a topic related to patent scope. However, it is discussed separately for convenience purposes.

184 It is worth noting that the theoretical framework developed in this Article can be used to evaluate other patent law doctrines and rules as well. For example, the doctrine of exhaustion and the doctrine of implied license doctrine must be examined to ensure their proper functioning with respect to research tools purchased in the market. As explained above, see *supra* note 143 and accompanying text, the use of such tools for research purposes should be permitted under these doctrines. Another doctrine that may be used to supplement the suggested reform is the patent misuse doctrine, which allows a court to withhold patent enforcement if its owner behaves in an anti-competitive manner that amounts to misuse of the patent. *See generally* Byron A. Bilicki, *Standard Antitrust Analysis and the Doctrine of Patent Misuse: A Unification Under the Rule of Reason*, 46 U. PITT. L. REV. 209 (1984); Kenneth J. Burchfiel, *Patent Misuse and Antitrust Reform: "Blessed Be the Tie?,"* 4 HARV. J.L. & TECH. 1 (1991); James B. Kobak Jr., *The Misuse Defense and Intellectual Property Litigation*, 1 B.U. J. SCI. & TECH. L. 2 (1995); Mark A. Lemley, *The Economic Irrationality of the Patent Misuse Doctrine*, 78 CAL. L. REV. 1599 (1990); William B. Miller, *Giving the Patent Owner His Due: Recent Developments in the Antitrust/Patent Misuse Interface*, 12 DEL. J. CORP. L. 135 (1987); Note, *Is the Patent Misuse Doctrine Obsolete?*, 110 HARV. L. REV. 1922 (1997). The patent misuse doctrine may prove useful in cumulative innovation settings to deal with certain refusals to grant a license to use a patent or in response to certain licensing practices.

185 35 U.S.C. § 271(a) (2006).

invention and an application in the cosmetic field is the follow-on invention, then the original invention is inevitably embodied in the follow-on invention. Thus, any use of the latter is also simultaneously a use of the former. Similarly, if the first invention is a new drug for treating anxiety disorder, and the follow-on invention is based on the discovery that the same drug can be used to treat attention deficit disorder, then exploitation of the drug for such new purpose obviously constitutes a use thereof.

In another scenario, the second invention can be an improvement or another variation of the first invention. In such cases, the first invention's claims are not always literally embodied in the follow-on invention.[186] Under U.S. law, the scope of a patent includes not only cases of literal infringement but also certain other cases where something very close to it has been made or practiced by the alleged infringer. The doctrine of equivalents plays a central role in this respect:[187] a finding of infringement is possible, even in the absence of a literal infringement, as long as the competing product or process is substantially equivalent to the claimed product or process.[188] While the doctrine of equivalents may be helpful in some cases, it is certainly not a sufficient instrument in the context of cumulative innovation.[189] The doctrine was not developed to deal with cumulative innovation. The perimeter it establishes around patent claims is rather narrow and does not capture all improvements of the invention. Thus it is

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186 The original claim is embodied in the second invention only if the improvement adds new elements but keeps the original claimed elements intact.

187 *See* Lee Petherbridge, *Patent Law Uniformity?*, 22 HARV. J.L. & TECH. 421, 432 (2009) (describing the doctrine of equivalents as determining whether an accused infringer's conduct is "close enough to the letter of a patent").

188 *See generally* Warner-Jenkinson Co. v. Hilton Davis Chem. Co., 520 U.S. 17 (1997) (a leading case on the doctrine of equivalents); John R. Allison & Mark A. Lemley, *The (Unnoticed) Demise of the Doctrine of Equivalents*, 59 STAN. L. REV. 955 (2007).

189 An interesting question is whether the nonobviousness of a follow-on invention, evidenced by the registration of a patent for it, necessarily indicates substantial differences between the inventions, and thus negates a finding of equivalency. Pursuant to case law, patentability of an allegedly infringing device does not necessitate a finding of non-infringement. *See* Hoechst Celanese Corp. v. BP Chems. Ltd., 78 F.3d 1575, 1582 (Fed. Cir. 1996); Nat'l Presto Indus., Inc. v. West Bend Co., 76 F.3d 1185, 1191–92 (Fed. Cir. 1996); Atlas Powder Co. v. E.I. du Pont de Nemours & Co., 750 F.2d 1569, 1580 (Fed. Cir. 1984). Some judges opined that this is, nevertheless, a relevant parameter in determining equivalency. *See* Roton Barrier, Inc. v. Stanley Works, 79 F.3d 1112, 1128 (Fed. Cir. 1996) (Nies, J., concurring) (noting that the existence of a second patent may be relevant to the issue of whether the changes are substantial); *Presto*, 76 F.3d at 1192 (noting that "[t]he fact of separate patentability is relevant, and is entitled to due weight"); Hoganas AB v. Dresser Indus., Inc., 9 F.3d 948, 954 (Fed. Cir. 1993) (concluding that the issuance of a follow-on patent is relevant to the equivalence issue).

important to adopt a clear rule under which improvements of an invention, including those that involve a material change in one—or more—of its elements, are considered within the patent scope.

Finally, in the research tools scenario there is no similarity between the first invention and the second invention although the first invention was used in the development process of the second invention.[190] This makes the existing patent scope rules of no use. By definition, the first and second inventions are not equivalent; thus, the use of the second invention does not involve a simultaneous use of the research tool. Therefore, there is a need to adopt an arrangement supplementing the existing patent scope rules, whereby exploitation of an invention developed by using a patented invention shall be considered an infringement.[191] Conceptually, this is a radical change in the law of patent infringement, which has always been based on a comparison between the claims of the patent and the allegedly infringing device or process.[192] Establishing that the allegedly infringing device was developed through use of the patented in-

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190 *See supra* note 26 and accompanying text.

191 This type of rule can also be useful with the previous scenarios discussed herein, including the improvement scenario. However, its adoption does not make the previous suggested rule, with respect to improvements, superfluous. While an improvement may be caught in the scope of the original patent under both rules, there may also be cases where an independent inventor who is not even aware of the previous invention develops an improvement. In such cases, the rule based on the actual use of the patented invention is not helpful. Patent law employs a strict liability regime; there is no exemption for independent inventors. *See supra* note 20. This core principle has been criticized from various angles. *See generally* Armond, *supra* note 51; John S. Leibovitz, *Inventing a Nonexclusive Patent System*, 111 YALE L.J. 2251 (2002); Stephen M. Maurer & Suzanne Scotchmer, *The Independent Invention Defense in Intellectual Property*, 69 ECONOMICA 535 (2002); Symposium, *Patent System Reform: Strict Liability and Its Alternatives in Patent Law*, 17 BERKELEY TECH. L.J. 799 (2002); Samson Vermont, *Independent Inventions as a Defense to Patent Infringement*, 105 MICH. L. REV. 475 (2006). It may be appropriate to abolish this principle, in general or in specific contexts, including the context discussed herein. For example, one can argue that in an independent development of an improvement case, there is no positive externality of the first inventor that needs to be internalized through the inclusion of the second invention in the scope of her patent. On the other hand, non-inclusion of the second invention in the scope of the original patent may still diminish the first inventor's incentive to invent, especially if the inventions compete in the same market. The question of whether it is appropriate to exempt improvements developed without conscious reliance on the basic invention has not been addressed in the literature, but see Reichman, *supra* note 122, at 35, with respect to subpatentable developments. It is left for future research. Assuming that the strict liability regime stays intact, it must be ensured that improvements are included in the scope of the original patent, regardless of how they were developed.

192 As explained above, this seemingly wide rule is balanced by other parts of the suggested regime such as a broad experimental use exception and liability rule doctrines.

vention may prove difficult. It is advisable to adopt a legal presumption, which can be triggered in certain cases where circumstances indicate a strong likelihood for such use.[193]

2. An Exemption Doctrine

The discussion above supports qualifying the Absolute Scope Principle with an exemption doctrine, which would allow courts to release second inventors from infringement liability, based primarily on a reasonable expectations test.[194] The courts in the United States have developed over the years the "reverse doctrine of equivalents,"[195] which exempts the defendant from a finding of literal infringement if she can show that the product exploited by her is nevertheless "so far changed in principle from [the] patented article that it performs the same or a similar function in a substantially different way."[196] This doctrine may be used to exempt certain improvements from the scope of the original patent. But because this doctrine is limited to cases of literal infringement, where its application is conditioned upon the existence of substantial differences between the products, it cannot fully assume the role of the exemption doctrine suggested herein with respect to all scenarios of cumulative innovation. Therefore, the doctrine should be revised to incorporate criteria developed above, particularly the reasonable expectations test, rather than being dependent solely on the level of non-similarity between the inventions.

B. Experimental Use Exception

While patent laws in various countries typically allow certain experimental activity during the patent term, the scope of the experimental use exception in the United States is particularly narrow.[197] Courts have clearly noted that

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193 *Cf.* 35 U.S.C. § 295 (2006) (a presumption to prove that a product was made by a patented process).

194 *See* text accompanying *supra* note 87.

195 *See generally* Karl Bozicevic, *The "Reverse Doctrine of Equivalents" in the World of Reverse Transcriptase*, 71 J. PAT. & TRADEMARK OFF. SOC'Y 353 (1989); Merges, *supra* note 30; Merges, *supra* note 16.

196 Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 608–09 (1950).

197 The origin of the exception is commonly traced to *Whittemore v. Cutter*, No. 17,600, 1813 U.S. App. LEXIS 371, at *3 (Mass. Ct. App. May 1813). Alongside the common law exception, a separate statutory exception exempts uses reasonably related to the development and submission of information needed for a regulatory approval to manufacture, use, or sell generic drugs or veterinary biological products after the expiration of the patent. This exception was enacted as part of the Drug Price Competition and Patent Term Restoration Act of

commercial motivation at the basis of the experimental use negates application of the exception, even if the commercial activity is meant to commence only after the patent is expired.[198] The narrow construction of the experimental use exception makes it irrelevant for most cases of cumulative innovation because inventors can be assumed to be typically commercially motivated.

Moreover, in *Madey v. Duke University*,[199] the U.S. Court of Appeals for the Federal Circuit refused to apply the exception in the context of non-profit university research, stating that:

> [R]egardless of whether a particular institution or entity is engaged in an endeavor for commercial gain, so long as the act is in furtherance of the alleged infringer's legitimate business and is not solely for amusement, to satisfy idle curiosity, or for strictly philosophical inquiry, the act does not qualify for the very narrow and strictly limited experimental use defense.[200]

Thus even university research does not generally enjoy the exception under current law.[201]

Over the years, many criticized the narrow construction of the experimental use exception in patent law.[202] From the perspective discussed in this Article, it is clear that the current exception is not sufficient. In order to bring

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1984, Pub. L. No. 98-417, 98 Stat. 1585 (codified as amended in scattered sections of 21 U.S.C. and 35 U.S.C. (1984)). *See* Merck KGaA v. Integra Lifesciences I, Ltd., 545 U.S. 193, 202 (2005), *vacating* Integra Lifesciences I, Ltd. v. Merck KGaA, 331 F.3d 860 (Fed. Cir. 2003) (an important recent decision providing a broad interpretation of the statutory exception).

198 *See* Embrex, Inc. v. Serv. Eng'g Corp., 216 F.3d 1343, 1349 (Fed. Cir. 2000) (stating the narrow construction of the experimental use exception); Roche Prods., Inc. v. Bolar Pharm. Co., 733 F.2d 858, 863 (Fed. Cir. 1984), *superseded by statute* 35 U.S.C. § 271(e) (1994) (holding the experimental use exception to be truly narrow and not applicable when the allegedly infringing use has "definite, cognizable, and not insubstantial commercial purposes"); Ares-Serono, Inc. v. Organon Int'l B.V., 862 F. Supp. 603, 608 (D. Mass. 1994) (clarifying that "[t]he experimental use exception does not protect experiments or tests which have a commercial purpose"); Pfizer, Inc. v. Int'l Rectifier Corp., No. 73–58, 1982 U.S. Dist. LEXIS 17411, at *12 (C.D. Cal. July 20, 1982) (holding that experimental use "cannot be invoked for the protection of one who uses a patented invention commercially").

199 307 F.3d 1351 (Fed. Cir. 2002).

200 *Id.* at 1362.

201 However, the 11th Amendment of the U.S. Constitution provides state universities immunity from lawsuits. *See* Fla. Prepaid Postsecondary Educ. Expense Bd. v. Coll. Sav. Bank, 527 U.S. 627, 630 (1999) (holding Congress's 1992 abrogation of immunity from patent infringement liability unconstitutional). *See generally* Gary Pulsinelli, *Freedom to Explore: Using the 11th Amendment to Liberate Researchers at State Universities from Liability for Intellectual Property Infringements*, 82 WASH. L. REV. 275 (2007).

202 *See* sources cited *supra* note 10.

the recommendations raised in this Article into effect, the experimental use exception should be expanded to apply to all cases of cumulative innovation, regardless of the commercial, or other business-furthering, motive of the user.[203]

In fact, certain other countries already employ a wider experimental use exception. In Europe, Article Twenty-Seven of the Community Patent Convention[204] includes an exception for acts "done for experimental purposes relating to the subject-matter of the patented invention."[205] Many European countries adopted similar language in their national laws,[206] which allows for the exception's application even when commercial motivation exists.[207] However, the exception is limited to experiments related to the subject matter of the patented invention and cannot be applied with respect to experiments relating to a different subject matter.[208] This limitation precludes the use of the exception in vari-

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203 The suggested exception is presumably compatible with the TRIPS Agreement, *supra* note 104, art. 30, which allows members to provide limited exceptions to patent rights, "provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties." *See, e.g.*, Carlos M. Correa, *Patent Rights*, *in* INTELLECTUAL PROPERTY AND INTERNATIONAL TRADE: THE TRIPS AGREEMENT 208 (Carlos M. Correa & Abdulqawi A. Yusuf eds., 1998) (noting that members are allowed to create exceptions related to research uses of an invention). *But see* DE CARVALHO, *supra* note 25, at 311 (opining that an experimental use exception can only be allowed under art. 30 if it is limited to non-commercial uses); Wang, *supra* note 108, at 328–29 (doubting whether a similar regime, suggested by the author, is compatible with art. 30).

204 Luxembourg Convention for the European Patent for the Common Market, Dec. 15, 1975, as amended by the Agreement Relating to Community Patents, Dec. 15, 1989, www.wipo.int/clea/en/text_html.jsp?lang=EN&id=1411.

205 *Id.*

206 This is despite the fact that the Community Patent Convention has not yet taken effect. *See* Patents Act, 1977, c. 37, § 60(5)(b) (Eng.), www.ipo.gov.uk/patentsact1977.pdf (last visited Feb. 26, 2010); Intellectual Property Code, CODE DE LA PROPRIÉTÉ INTELLECTUELLE, Aug. 1, 2003, art. L613–5(b) (Fr.), *available at* www.jpo.go.jp/shiryou_e/s_sonota_e/fips_e/pdf/france_e/e_chiteki_zaisan.pdf (last visited Feb. 26, 2010); Patents Act, 1992 (Act No. 1/1992) § 42(b) (Ir.), *available at* http://www.irishstatutebook.ie/1992/en/act/pub/0001/index.html (last visited Feb. 26, 2010); Patents Act, Dec. 15, 1967, § 3 (Nor.), *available at* http://www.patentstyret.no/upload/Filarkiv/regelverk/Norwegian_Patents_Act.pdf (last visited Feb. 26, 2010).

207 This is the prevailing interpretation in various European countries. *See, e.g.*, CORNISH & LLEWLYN, *supra* note 155, at 254 (noting that "[r]ecent developments in the EPC countries show that the exception may also apply to commercial research").

208 ANDREW GOWERS, GOWERS REVIEW OF INTELLECTUAL PROPERTY 45 (2006), http://ec.europa.eu/internal_market/copyright/docs/links/gowers_report_en.pdf (noting that "[i]t is not entirely clear what uses fall within the scope of the experimental use exception").

ous cases, most importantly, in the context of research tools.[209] As explained above, this Article recommends constructing the U.S. experimental use exception in a broader manner so that it can apply to research tools as well.[210] Following this path would ensure that the United States takes the lead in providing a supporting environment for cumulative research.

C. Liability Rule Doctrines

For many years, the United States has been the most vigorous opponent of compulsory licenses in patent law.[211] The United States does not have a compulsory licenses regime with respect to dependent patents.[212] Adopting such a regime would allow the exploitation of an already developed follow-on invention despite the failure of the parties to conclude a voluntary agreement, while dividing the profit between the parties in a manner ensuring their respective incentives.[213]

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209 *See* CORNISH & LLEWELYN, *supra* note 155, at 254 (noting, for example, that a patented medium cannot be used to grow a particular micro-organism under the exception); Wang, *supra* note 108, at 315 (noting that the exception "excludes pure research tools from its purview").

210 *Cf.* Patents Act, 1967, S.H. 148 § 1 (Isr.) (an example of a legal system with a broad experimental use exception). The Israel Patents Act excludes from the list of acts constituting patent infringement, inter alia, experimental acts conducted in order to improve the invention or develop another invention. Admittedly though, the amendment leading to this broad experimental use exception was not based on an elaborate weighing of all the relevant considerations, but rather was a side product of another amendment that created an exception similar to the U.S. statutory exception, see *supra* note 197 and accompanying text. As a result, no corresponding changes were made in the rules governing patent scope to ensure that the exploitation of products developed through use of patented research tools is considered within the scope of such patents.

211 *See* Dawson Chem. Co. v. Rohm & Haas Co., 448 U.S. 176, 215 n.21 (1980) (noting that "[c]ompulsory licensing of patents often has been proposed, but it has never been enacted on a broad scale"); CORNISH & LLEWELYN, *supra* note 155, at 296 (noting the hostility of the U.S. with respect to compulsory licensing); Barton, *supra* note 9, at 458 (noting that the idea of compulsory licensing is strongly opposed in the U.S.); Chang, *supra* note 2, at 43 n.18 (noting that compulsory licensing "remains disfavored in patent law"); Gitter, *supra* note 13, at 1681 (describing the "traditional antipathy in U.S. law toward any incursions on a patentholder's monopoly"); Mueller, *supra* note 10, at 51–52 (describing the traditional rejection in the U.S. of any derogation of the patentee's right to exclude, including compulsory licenses); Straus, *supra* note 152, at 442.

212 There are a few concrete compulsory license arrangements in various other contexts, for example, with respect to the exploitation of certain inventions in the field of atomic energy, see 42 U.S.C. § 2183 (2006).

213 *See supra* notes 171–182 and accompanying text for the suggested method of determining royalty rates.

In fact, many countries already employ such a regime.[214] All of them comply with the TRIPS Agreement,[215] which sets up a particularly rigid framework in this context. A compulsory license in favor of a dependent patentee can be granted only, inter alia, if "the invention claimed in the second patent shall involve an important technical advance of considerable economic significance in relation to the invention claimed in the first patent."[216] This restriction, which was adopted through compromise between countries,[217] does not correspond to this Article's recommendation to apply liability rules in every case of negotiation failure. With that said, it may be possible to interpret this restriction broadly.[218]

Until a compulsory license arrangement pursuant to the above recommendations is legislated—and maybe even subsequently, as a complementary mechanism necessary in light of the limitation posed by the language of the TRIPS Agreement—courts should use their discretion to avoid granting injunctions in infringement suits against follow-on inventors.[219] The U.S. Supreme

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214 *See* Patents Act, 1997, Belgium, § 31.1(2), *available at* http://www.jpo.go.jp/shiryou_e/s_sonota_e/fips_e/pdf/belgium/patents_law.pdf (last visited Feb. 26, 2010); Patents Act, 1977, c. 37, § 48(3)(d)(ii) (Eng.), *available at* www.ipo.gov.uk/patentsact1977.pdf (last visited Feb. 26, 2010); Intellectual Property Code, CODE DE LA PROPRIÉTÉ INTELLECTUELLE, Aug. 1, 2003, art. L613–15 (Fr.), *available at* www.jpo.go.jp/shiryou_e/s_sonota_e/fips_e/pdf/france_e/e_chiteki_zaisan.pdf (last visited Feb. 26, 2010); Patents Act, 1967, S.H. 148 § 121 (Isr.).

215 The TRIPS Agreement, *supra* note 104.

216 *Id.* art. 31(l)(i), 33 I.L.M at 1210.

217 *See* DE CARVALHO, *supra* note 25, at 316, 370; DANIEL GERVAIS, THE TRIPS AGREEMENT: DRAFTING HISTORY AND ANALYSIS 236, 246, 248, 253 (2d ed. 2003) (describing the evolution of the arrangement and its negotiation history).

218 The main barrier to a broad interpretation is that the ability to apply for a compulsory license is provided, to begin with, only to the owner of a second patented invention. Hence, the requirement for an important technical advance cannot simply be interpreted as the standard nonobviousness. The suggested "sweeping" regime may also fall short of the general requirement stated in the TRIPS Agreement, *supra* note 104, art. 31(a) (mandating that compulsory licenses be considered and granted on a case-by-case basis).

219 While a refusal to issue an injunction can be viewed as a de facto compulsory license, it is an entirely different mechanism and as such, not governed by the TRIPS Agreement, *supra* note 104, art. 31. Rather it is governed by art. 44, which deals with injunctions in intellectual property cases. Art. 44.1 requires all member states to provide their judiciaries the "authority to order a party to desist from an infringement" but it does not mandate an injunction in each and every infringement case. *Id.* art. 44.1. In fact, art. 44.2 explicitly allows member states to award "declaratory judgments and adequate compensation" as an alternative remedy in certain cases. *Id.* art. 44.2; *see* Christopher A. Cotropia, *Compulsory Licensing Under TRIPS and the Supreme Court of the United States' Decision in* eBay v. MercExchange, *in* PATENT LAW AND THEORY: A HANDBOOK OF CONTEMPORARY RESEARCH (Toshiko Takenaka & Rain-

Court's recent ruling in *eBay, Inc. v. MercExchange L.L.C.*,[220]—emphasizing the discretionary nature of injunctions in patent infringement suits[221]—can be a stepping stone in this direction.

In infringement cases in which the court avoids issuing an injunction, an ongoing royalty rate must be determined. The royalty rate may be calculated according to the same principles suggested above with respect to the compulsory license arrangement. However, it may be appropriate to award punitive damages if the parties did not attempt to bargain one with the other, or negotiations were held but failed and the follow-on inventor chose to exploit the invention rather than apply for a compulsory license, provided that a provision allowing to apply for a compulsory license in such case exists.

V. SUMMARY AND CONCLUSIONS

This Article conducts a comprehensive analysis of cumulative innovation in patent law in light of the incentive to invent theory. Conclusions arising out of the discussion can be divided into two distinct chronological stages: the development of the second invention and its exploitation.

With respect to the development stage, a wide experimental use exception should be embraced that allows for the development of follow-on inventions without the advance permission of the original patentee. The exception needs to apply in all scenarios of cumulative innovation, including the research tools scenario.

With respect to the exploitation stage, an Absolute Scope Principle should be adopted: the exploitation of a follow-on invention would always be considered within the scope of the original patent, even when the follow-on invention does not embody the first invention's claims but was developed while using it. This principle should be subject to an exemption doctrine based primarily on a reasonable expectations test. In light of the obstacles to reaching a voluntary agreement, even *ex post*, this Article proposes that the U.S. should adopt liability rule doctrines, either in the form of compulsory licenses or as part of the remedy determination in a patent infringement suit. These doctrines should be applicable in every case negotiations fail between the parties. The royalty rates should be determined within a preset range of percentages of the

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er Moufang eds., 2009) (forthcoming), *available at* ssrn.com/abstract=1086142 (arguing that a discretionary approach to injunctions can be sanctioned under art. 44 of the TRIPS Agreement).

220 547 U.S. 388 (2006).

221 *Id.* at 391–92.

second invention's value through a rough estimation subject to a few concrete guidelines. The main effect of such liability rule doctrines would likely be to promote market transactions by affecting the parties' negotiation positions rather than direct regulation of the market through the imposition of an external solution on the parties.

Current U.S. patent law does not conform to these recommendations, while some other countries, notably, in Europe, enacted laws that head in the correct direction.[222] In order for the United States to maintain a leading position in the innovative markets, changes are necessary—better sooner than later—in order to give effect to the above recommendations.

While each of these recommendations may seem extreme when viewed separately, and the adoption of any one on its own is certainly not advisable, the suggested mechanisms can work in tandem to balance between the incentives of inventors in a cumulative innovation setting. The rules recommended are easy to apply and do not require complicated weighing of various considerations on a case-by-case basis. As such, the proposed recommendations promote certainty and efficient decision-making.

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[222] *See supra* notes 204–207 and accompanying text (describing the experimental use exception adopted by many European countries); *supra* note 214 (listing countries that employ a compulsory licensing regime with respect to dependent patents).