

ARTICLE

OPTIMAL REMEDIES FOR PATENT INFRINGEMENT: A TRANSACTIONAL MODEL

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I. INTRODUCTION

In order to appreciate the contours of a system of optimal patent remedies, one must first understand the relationship that transaction costs bear to invention. Imagine a simple scenario where one firm has inventive capacity and another requires an invention in order to market an innovative product for consumers:

Firm with Inventive Capacity→*Manufacturing Firm*→*Consumer*

In a world without transaction costs and perfect information (and a system of enforceable contracts), we would observe optimal invention even in the absence of property rights.¹ Firms needing inventions to reduce their cost of production, for example, would know which firms possessed the capacity to invent the necessary improvements. If transacting were costless, then a deal would be struck whereby the firms would enter into service contracts for the requisite invention. No property right in the invention would need to be assigned by law; the enforceable contract for invention would provide an adequate incentive to invent. This is true even in the case where social welfare demanded multiple parties be allowed to use the invention. If contracting were costless and information perfect, the inventive firm could enter into multiple agreements with all potential users and make efficient price adjustments.²

1. See Paul J. Heald, *Transaction Costs and Patent Reform*, 23 SANTA CLARA COMPUTER & HIGH TECH. L.J. 447, 448–52 (2007) (illustrating the point with contracts between seed inventors and farmers).

2. One could imagine a situation where it would be efficient for only a single user to exploit the invention. In such a case, the surplus generated by the use would be divided between the user and those who could credibly threaten to appropriate the invention themselves and reduce its value. There are no holdout or collective action problems in a world without transaction costs or property rights.

In fact, when transaction costs are especially low in the real world, we observe inventive behavior that does not require the creation of property rights.³ Large manufacturing firms with active R&D departments play all three roles delineated above: they have significant inventive capacity; they are innovators; and they can be consumers of their own inventions. In this situation, transacting is close to costless. The firm knows its own needs and the available alternatives, and it can communicate cheaply with its R&D department. Society does not need patent law in order to stimulate the General Motors (GM) R&D department to invent an improvement for GM cars (at least in the case where the improvement only works in GM cars).

Ronald Coase, whose famous thought experiment⁴ about liability rules informs this Article, realized that the cost of transacting in the real world is usually much higher than in the GM hypothetical.⁵ In fact, the specific costs that he identified in *The Problem of Social Cost* are especially relevant in the context of contracting over inventive activity. Following his analysis, transaction costs can be divided into three main groups:

(1) *Discovery Costs*: “[The cost] to discover who it is that one wishes to deal with [and] to inform people that one wishes to deal”;⁶

(2) *Negotiation Costs*: “[The cost to supply] terms, to conduct negotiations leading up to a bargain, [and] to draw up the contract”;⁷ and

(3) *Monitoring Costs*: “[The cost] to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on.”⁸

All of these costs are significant in the context of contracting for inventions: it is difficult to identify inventors and inventions;⁹

3. See Mark A. Lemley & Philip J. Weiser, *Should Property or Liability Rules Govern Information?*, 85 TEX. L. REV. 783, 786 (2007) (noting that low transaction costs will drive negotiation).

4. See R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960), reprinted in THE FIRM THE MARKET AND THE LAW 95–97, 102 (1988) (showing that in two-party nuisance scenarios the parties will contract for the efficient result regardless of the legal liability rule).

5. See *id.* at 114 (noting that a world without transaction costs “is, of course, a very unrealistic assumption”); *id.* at 117 (using airborne pollution as an example of a situation where the cost of transacting between the polluter and those affected would be very high).

6. *Id.* at 114.

7. *Id.*

8. *Id.*

9. See JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 70 (2008) (“[Because of identification problems] many technology firms . . . invest little in patent search and

pricing difficulties and lack of public information make licensing and sales agreements difficult to negotiate;¹⁰ and monitoring costs are significant, especially when the invention is still secret.¹¹

The primary means suggested by the framers of the Constitution¹² and chosen by Congress¹³ to lower costs is by encouraging transactions through the grant of an alienable property right to those who invent. Economists agree that “[r]educing transaction costs is the very *raison d’être* of property rights.”¹⁴ Patent law creates property rights in information and reduces transaction costs in several ways.

Discovery Costs: Congress requires registration and disclosure of inventions in return for granting a patent.¹⁵ The patent office website, in theory, functions as a comprehensive bulletin board where both inventors and those seeking inventions can meet.¹⁶ To the extent that the inventive firm or innovative firm requires capital, published patents also lower the cost of obtaining financing.¹⁷

clearance.”); *id.* at 46 (“[I]nnovators . . . find it increasingly costly to find and negotiate the necessary patent licenses”); see also Mark A. Lemley, *Ignoring Patents*, 2008 MICH. ST. L. REV. 19, 21–22 (2008) (arguing that difficulties in identification have resulted in a non-searching culture).

10. See F. Russel Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 RUTGERS L. REV. 1175, 1181–1203 (2003) (applying the Black–Scholes equation to solve persistent problems in patent pricing); Mark A. Lemley & Nathan Myhrvold, *How to Make a Patent Market*, 36 HOFSTRA L. REV. (forthcoming 2008) (manuscript at 101–02), available at <http://ssrn.com/abstract=1012726> (noting that “[w]illing licensors and licensees can’t find each other” and arguing for a requirement that patent license terms be published).

11. See Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473, 487–89 (2005) (describing the extensive measures necessary to protect and exploit a secret invention).

12. See U.S. CONST. art. I, § 8 (“Congress shall have Power . . . [t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries”).

13. See 35 U.S.C. § 101 (2000).

14. WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 12–13 (2003).

15. See 35 U.S.C. § 112 (2000) (“The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same”).

16. United States Patent and Trademark Office Home Page, <http://www.uspto.gov> (last visited Oct. 18, 2008). The patent office has come under attack for doing a poor job of organizing patent registrations and applications, making it overly difficult to find inventions. See BESSEN & MEURER, *supra* note 9, at 235–37 (describing possible reforms including reducing backlog and creating clearer standards for patent acceptance).

17. See Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625, 627 (2002) (positing that patents lower the cost of communicating the strength of a firm’s human capital to outside sources of financing).

Negotiation Costs: Congress requires that patentees make specific public claims about the metes and bounds of their property right.¹⁸ Despite significant problems with the clarity of written claims, published patents help transacting firms overcome Arrow's Information Paradox¹⁹ and facilitate negotiations between parties.²⁰

Monitoring Costs: Much innovation requires the cooperation of a team of inventors, management, firm owners or boards of directors, licensors of complementary technology, and providers of outside capital. Clear property rights lower the cost of coordinating team production by lowering monitoring costs and the risk of opportunism.²¹ Patent law also facilitates long-term planning by firms by creating an affirmative asset partition that protects patent assets from the claims made by the creditors and heirs of an inventor who has transferred patents to the firm.²²

The alternative common law model, trade secrecy, suffers from much higher costs in all three areas. It is much more difficult to discover a trade secret than a patented invention.²³ And as Arrow pointed out, it is much more costly to negotiate over a trade secret.²⁴ Moreover, trade secrets are "leaky."²⁵ Once

18. See 35 U.S.C. § 112 (2000) ("The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."). *But see* BESSEN & MEURER, *supra* note 9, at 235–52 (arguing the notice function of patent law is badly in need of reform).

19. 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, 614–16 (1962); *see also* Robert G. Bone, *A New Look at Trade Secret Law: Doctrine in Search of Justification*, 86 CAL. L. REV. 241, 280 (1998) ("[T]here is a significant obstacle—known as 'Arrow's Information Paradox'—to bargaining over secret information. A trade secret owner generally is reluctant to reveal the secret unless the potential licensee first promises not to use it in the event a license is not negotiated. The licensee, on the other hand, is not likely to make such a promise without first learning the secret.").

20. See Heald, *supra* note 11, at 487–91.

21. *Id.* at 487–99 (illustrating how patent rights lower monitoring costs and promote efficiency between partners in bringing new ideas to the market).

22. *Id.* at 480–84 (explaining how patent law protects a transferee of a patent from termination of property rights where nonexclusive licensing agreements do not).

23. Jur Strobos, *Stalking the Elusive Patentable Software: Are There Still Diehr or Was it Just a Flook?*, 6 HARV. J.L. & TECH. 363, 418–19 (1993) (concluding that relying on trade secrets rather than patents makes early software-related intellectual property difficult to search).

24. See Arrow, *supra* note 19.

25. Geraldine Szott Moohr, *The Problematic Role of Criminal Law in Regulating Use of Information: The Case of the Economic Espionage Act*, 80 N.C. L. REV. 853, 868 (2002) ("The 'leaky' nature of trade secrets means that secret information often eventually enters the public domain . . .").

they are made public, they are free for all to use, which greatly raises monitoring costs at all levels of production and transfer.²⁶

The creation of a properly administered property right lowers the cost of transacting for inventions, but the patent system cannot reduce all transaction costs to zero. In fact, property rights can sometimes create transaction costs.²⁷ Congress is therefore sensitive to the shape of patent law in order to reduce the cost of the artificially created right.²⁸ For example, consider the GM hypothetical above that suggested GM needs no property right to innovate for its own cars. If Congress creates a patent right, however, GM might worry that someone would reverse engineer or independently invent its improvement, obtain a patent on it, and charge GM a licensing fee for using its own creation. Present novelty rules prevent this inefficient scenario from occurring as long as GM is the first to invent or make a commercial use of the invention before someone else invents.²⁹

Patent law, it appears, serves two functions. Its primary function is to create a property right that reduces the cost of contracting between inventive firms and firms needing inventions. Its secondary function is to police inefficiencies and maximize the social value of the new property right, including monitoring the cost of administering the patent system. Current controversies over the shape of the patent system implicate both its primary and secondary functions.

First, many suggestions for reforming the patent system revolve around improving the certainty of the boundaries of the property right, patent law's notice function.³⁰ The primary function of patent law is ill-served if the property right embodied in the patent has poorly defined boundaries and therefore does a poor job of reducing transaction costs. Jim Bessen and Mike Meurer devote much of their recent book to notice problems in

26. *Id.*

27. RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 35 (4th ed. 1992) (“[T]he costs of effecting a transfer of rights—transaction costs—are often prohibitive, and when this is so, giving someone the exclusive right to a resource may reduce rather than increase efficiency.”).

28. *See* RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 36–37 (3d ed. 1986) (providing four examples of cost-reducing in patent law: patents expire after a limited time, obvious inventions are not patentable, patents are granted before commercialization, and fundamental ideas are not patentable).

29. 35 U.S.C. § 102 (2000).

30. *See, e.g.*, Dan L. Burk & Mark A. Lemley, *Quantum Patent Mechanics*, 9 *LEWIS & CLARK L. REV.* 29, 54 (2005) (suggesting a narrow view of patents in order to provide clear patent rights).

the patent system.³¹ As they note pithily: “If you can’t tell the boundaries, it ain’t property.”³² They suggest changes in claim drafting rules to improve the clarity of patent boundary rights, changes in rules that allow patent applications to remain hidden from public view, and other changes that would make inventions easier to find.³³ Mark Lemley and his co-authors approach the problem from a different angle, proposing an optional intensive examination procedure (available to inventors at an increased cost) that would improve predictability by allowing inventors to “gold plate” their patents,³⁴ which would then enjoy greater deference from courts.³⁴ Others, like Jeanne Fromer, argue more generally for “invigorating the patent system’s disclosure function.”³⁵ The primary function of patent law, therefore, looks much like property law.

But even if patent law produces a crystal clear property right, important issues remain, including how to define what acts should constitute infringement of the right and what sort of remedies should be available to the aggrieved property owner. Such issues implicate the secondary function of patent law, which looks and feels more like tort law. To analogize to estates in land, property law establishes the borders of a piece of land and who owns it; tort law (trespass) determines remedies for unauthorized uses of the land; and tort law (nuisance) regulates the relationship between the owner of the land and her neighbors. In defining boundaries and alerting the world to what is owned by whom, patent law’s primary function looks like property law. In establishing what constitutes infringement and what remedies apply, patent law’s secondary function looks like tort law.

At first glance, the issue of proper remedies for patent infringement implicates the same issues of over- and under-deterrence addressed by tort law. The law, for example, does not impose excessive penalties for tortious behavior.³⁶ If the penalty for negligent driving were capital punishment, people would make too high an investment in taking care or would cease to

31. See generally BESSEN & MEURER, *supra* note 9.

32. *Id.* at 8.

33. *Id.* at 235–53.

34. Mark Lemley, Doug Lichtman & Bhaven Sampat, *What to Do About Bad Patents?*, 28 REGULATION 8, 12–13 (2005).

35. Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. (forthcoming 2009) (manuscript at 50, on file with the Houston Law Review), available at <http://ssrn.com/abstract=1116020>.

36. *BMW of N. Am., Inc. v. Gore*, 517 U.S. 559, 568 (1996) (explaining that grossly excessive awards in tort cases violate the Due Process Clause).

drive altogether. Productive activity would be deterred. In patent law, a regime of strict liability rules where the penalty for patent infringement is fifty years in prison would have the same effect. Draconian penalties would most likely stimulate excessive searching for rights holders by potential users and would induce users to enter into unnecessary precautionary licenses or not innovate at all.³⁷ If patent damages were set too high, excessive transaction costs would be incurred and innovation would be stunted. On the other hand, if damages were set too low, inventions would be misappropriated excessively, and both transacting and innovating would likely be deterred. Parts II and III keep transaction costs and the tort law analogy firmly in mind.

II. FOCUSING ON TRANSACTIONS INSTEAD OF R&D

Most remedial models of patent infringement focus directly on maintaining incentives to invent,³⁸ rather than optimizing incentives to transact. In the standard model, the creation of the patent right is presumed to encourage rent seeking in the form of capital flows into R&D,³⁹ which suggests that remedies for patent infringement should be calibrated to optimize the amount of R&D in which firms invest. There are two problems with this starting point. First, outside of the pharmaceutical context, research economists have serious doubts about the tightness of the causal connection between patent law and R&D

37. Stewart Sterk has made this point forcefully. See Stewart E. Sterk, *Property Rules, Liability Rules, and Uncertainty About Property Rights*, 106 MICH. L. REV. 1285, 1285 (2008) (“In some instances, the cost of acquiring information about the scope of property rights will exceed the social value of that information. In those circumstances, further search for information about the scope of rights is inefficient; the social harm avoided by further search does not justify the costs of the search.”).

38. See ROGER D. BLAIR & THOMAS F. COTTER, *INTELLECTUAL PROPERTY: ECONOMIC AND LEGAL DIMENSIONS OF RIGHTS AND REMEDIES* 42 (2005) (“We begin by presenting a stylized model of a firm’s decision to invest in creating and marketing a new invention.”); Ian Ayres & Paul Klemperer, *Limiting Patentees’ Market Power Without Reducing Innovation Incentives: The Perverse Benefits of Uncertainty and Non-Injunctive Remedies*, 97 MICH. L. REV. 985, 988 (1999) (“[T]he nature of patents should be to offer sufficient rewards to stimulate innovation.”); Matthew D. Henry & John L. Turner, *Patent Damages and Spatial Competition* 31 (July 2007) (unpublished manuscript, on file with the Houston Law Review), available at <http://www.terry.uga.edu/~jltturner/PatentDamagesSpatialJuly07.pdf> (asserting that ideal remedies regimes “maximize incentives to innovate”).

39. See sources cited *Heald*, *supra* note 11, at 473 nn.1–2; see also Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry 1979–1995*, 32 RAND J. ECON. 101, 105 (2001) (“[T]he patent system aims to encourage inventors to direct more of their resources toward R&D than would otherwise be the case.”).

expenditures.⁴⁰ If the link between patent law and R&D incentives is weak or, more likely, indirect, then calibrating remedies to optimize R&D is a clumsy and unwieldy proposition. Second, and more importantly, no one has any idea how to calculate the optimal amount of R&D a firm should conduct.⁴¹ Even if the link between patent law and R&D expenditures were tight and direct, drawing the line between rules that stimulate too little or too much R&D is a formidable task.⁴²

A court can, of course, engage in an *ex post* analysis of a patentee's R&D expenditures and award an amount sufficient to ensure adequate incentives for an inventor in a particular case. Blair and Cotter, among others, suggest this as the baseline damage award in their model.⁴³ Incentive-based models, however, provide no help in calculating an upper-bound for patent remedies. Given that most current debates in patent law involve claims of overcompensation to patentees, the lack of means to measure whether damages are excessive is glaring.⁴⁴ It is no surprise that the conventional incentive theory of patent law has proven to be of little use in resolving present debates over the scope of patent remedies.

40. See BESSEN & MEURER, *supra* note 9, at 216 ("Our empirical analysis indicates that the patent system provides little innovation incentive to most public firms; these are the firms that perform the lion's share of R&D."); Hall & Ziedonis, *supra* note 39, at 106 ("[E]mpirical studies have failed to find evidence that the strengthening of U.S. patent rights during the 1980s stimulated industrial spending in R&D."); Heald, *supra* note 11, at 499–503 (summarizing empirical research that is skeptical of the effect of patent law on R&D expenditures).

41. See, e.g., Charles I. Jones & John C. Williams, *Too Much of a Good Thing? The Economics of Investment in R&D*, 5 J. ECON. GROWTH 65, 79–80 (2000) (explaining that optimal R&D investment involves a great deal of uncertainty). Siebrasse makes a similar argument about copyright law, stating: "While there is indeed a level of copyright protection that strikes the optimal balance between incentives to create and restrictions on dissemination . . . [d]etermining the optimal level of protection requires far more information than is available to courts or, for the most part, to the legislature . . .". Norman Siebrasse, *A Property Rights Theory of the Limits of Copyright*, 51 U. TORONTO L.J. 1, 3 (2001).

42. The incentive theory of patent law assumes that capital flowing to develop patented inventions is going to its most highly valued use. Heald, *supra* note 1, at 450–51 & n.7. The hope of obtaining a patent, for example, may stimulate the flow of \$10 million to develop a hair loss remedy. In the absence of patent protection, the \$10 million might be spent on plant renovation, worker training, or some nonpatent driven capital investment. In real markets, it will frequently vary where the \$10 million is optimally spent. In other words, patent law might inefficiently direct capital away from more efficient uses. See POSNER, *supra* note 28, at 37 ("The costs of the patent system include . . . inducing potentially excessive investment in inventing.").

43. See BLAIR & COTTER, *supra* note 38, at 42–45 (advocating damages that match original R&D expenditures).

44. John M. Golden, *Commentary: "Patent Trolls" and Patent Remedies*, 85 TEX. L. REV. 2111, 2145 (2007) (noting the lack of a standard for excessive damages in Lemley and Shapiro's model).

Alternatively, a model of patent remedies might instead choose to optimize the number of transactions between firms with inventive capacity and firms requiring inventions. Such an approach would have several advantages. First, economists are quite certain that patent law robustly stimulates transactions.⁴⁵ As noted above, patents help solve the problem of negotiating over secret information.⁴⁶ Clear property rights increase trust when parties bargain over inventions.⁴⁷ As studies conducted on the effect of the Bayh–Dole Act⁴⁸ suggest, when patents become available, technology transfer is stimulated.⁴⁹ Second, as noted above, Coasean analysis suggests that in a world without transaction costs, one would observe the optimal level of inventive activity.⁵⁰ The transactions occurring in this state can be predicted with a high degree of accuracy, permitting the exposition of a model that need not rely on *ex ante* assumptions about optimal R&D expenditures.⁵¹ In other words, a model that optimizes transactional activity should be more precise than a model that optimizes for the amount of R&D.

Most importantly, transactional analysis can be used to set an upper bound for remedies, not just a baseline. The primary contribution of this Article lies in exploring the contours of these upper bounds. For example, if remedies are too generous, then patent owners may prefer to be victims of infringement rather

45. See Heald, *supra* note 11, at 488–91.

46. See Robert W. Hahn, The Economics of Patent Protection: Policy Implications from the Literature 30 (Oct. 30, 2003) (unpublished manuscript, on file with the Houston Law Review), available at <http://ssrn.com/abstract=467489> (“[D]rafting an enforceable contract is virtually impossible without some additional means to ensure compliance. That is where patents come in.”).

47. See Ashish Arora & Robert P. Merges, Property Rights, Firm Boundaries, and R&D Inputs 1 (Jan. 11, 2001) (unpublished manuscript, on file with the Houston Law Review), available at <http://ssrn.com/abstract=255869> (“Property rights . . . reduce the risk of buyer firm opportunism.”).

48. 35 U.S.C. §§ 200–212 (2000).

49. See Rebecca Henderson, Adam B. Jaffe & Manuel Trajtenberg, *Universities As a Source of Commercial Technology: A Detailed Analysis of University Patenting, 1965–1988*, 80 REV. ECON. & STAT. 119, 119 (1998) (“[T]he observed increase in university patenting [after Bayh–Dole] may [possibly] reflect . . . an associated increase in the rate of knowledge transfer to the private sector”); see also Adam B. Jaffe & Josh Lerner, *Reinventing Public R&D: Patent Policy and the Commercialization of National Laboratory Technologies*, 32 RAND J. ECON. 167, 171, 194 (2001) (discussing the effect of congressional authorization of Cooperative Research and Development Agreements on national laboratories).

50. See *supra* Part I.

51. Cf. Shubha Ghosh, *Turning Gray into Green: Some Comments on Napster*, 23 HASTINGS COMM. & ENT. L.J. 563, 578 (2001) (explaining that, in the case of Napster’s liability, low transaction costs lead to a predictable conclusion that a merger was imminent).

than to negotiate licenses.⁵² Because patent owners write patents and have the primary responsibility for publicizing the contours of their property rights, they may prefer to obscure their position by writing vague patent claims, engaging in patent office practices that hide inventions, or otherwise laying low if the rewards of going undiscovered and winning an infringement suit are too tempting. An efficient system of remedies would provide all parties with incentives to negotiate when that is the optimal strategy from the standpoint of social welfare. Incentive-based theories focusing solely on R&D expenditures tell us nothing about the upper boundaries of infringement remedies.

Tort law provides a good analogy. In theory, negligence law incentivizes actors to take efficient precautions (as does strict liability law which may be preferable in cases where overall activity levels by careful actors may be inefficient). Yet, justifying optimal damage rules for negligence or strict liability does not require an *ex ante* calculation of how many accidents should occur.⁵³ Applying the proper standard of care to both tortfeasors and victims, coupled with the proper damage rule (usually compensatory, but with upward adjustments possible in case of willful acts), provides adequate incentives for behavior without the need to predict or even model the optimal amount of accidents.⁵⁴ The patent remedy model set forth below similarly seeks to deter infringement efficiently without directly stating the optimal amount of R&D expenditures.

Before formalizing a model for infringement remedies that optimizes transacting, an important point must be made: the model does not assume that all transactions should be voluntary. Imagine Firm A invents a widget for Firm B, an ice cream manufacturer, and Firm A obtains a patent on the widget. It grants Firm B a license and promises not to license the widget to any of Firm B's competitors. A year later, Firm C invents the same widget, which makes its lawnmowers run better, leading Firm A to sue for patent infringement. Before Firm C was sued, it had no knowledge of Firm A, the earlier invention, or the patent. Under 35 U.S.C. § 154(a)(1), Firm C wrongly used Firm A's property when it incorporated the widget into its new line of

52. See Dov Greenbaum, *In re Seagate: Did it Really Fix the Waiver Issue? A Short Review and Analysis of Waiver Resulting from the Use of a Counsel's Opinion Letter as a Defense to Willful Infringement*, 12 MARQ. INTELL. PROP. L. REV. 155, 184 (2008) (noting treble damages as a motivation for patent trolls).

53. See WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF TORT LAW* 87 (1987) (explaining that marginal costs can measure the amount of due care required; a total cost calculation is not necessary).

54. *Id.*

lawnmowers.⁵⁵ Assuming the widget improves the lawnmowers—and therefore society is marginally better off if Firm C uses it—then we want Firm C to use the widget. The question from an efficiency standpoint is whether we want Firm C to engage in a voluntary transaction and obtain a license from Firm A first, or do we want Firm C to use Firm A's property without obtaining permission and then pay damages?

It all depends on the facts. If the gain to society of Firm C's planned use is X and the cost to Firm C and Firm A of discovering each other beforehand and negotiating an agreement is greater than X , then it might be inefficient to encourage the voluntary transaction in this case.⁵⁶ The model, therefore, does not assume the voluntariness of transactions. Rather, one of its central functions is to identify those transactions that should be allowed to occur involuntarily and what remedies, if any, should be available.

III. THE TRANSACTIONAL MODEL

Although one would observe optimal inventive activity in a world without transaction costs, the remedial model proposed below must provide proper incentives for firms under more realistic conditions. Therefore, a key variable is S , the cost of searching for the invention and negotiating a license. The goal of remedies for patent infringement should be to provide incentives for efficient transactions to occur while accounting for the cost of transacting. The model assumes a two-party transaction, keeping in mind that a transaction can be voluntary or involuntary. An efficient transaction occurs between a party with inventive capacity ("inventing firm") and a party needing an invention ("exploiting firm") when:

$$VI - \min\{S, SI\} - VS > C$$

where:

VI = gross *value* of the *invention* to the exploiting firm in terms of profits earned from additional sales or manufacturing costs saved;

S = cost of *searching* for the invention and negotiating a license;

55. 35 U.S.C. § 154(a)(1) (2000) (granting a right to exclude with no mention of independent invention).

56. If the search and negotiation costs were only slightly greater than X , a voluntary transaction might still be most efficient when the costs of adjudication are taken into account.

SI = cost to the exploiting firm of *self-inventing*;
 VS = *value* to the exploiting firm of the known best
substitute for the invention;
 C = *cost* to the firm of inventing (C_{inv}) + the *cost* of
 transferring the invention—including anticipated
 lost profits (C_{trans}).

In other words, an efficient transfer occurs when the net expected gain to the exploiting firm of using the new invention is greater than the inventing firm's cost of inventing. The exploiting firm's net gain, importantly, is not merely the gross extra profits that the exploiting firm would earn by using the new invention. The net gain must account for the fact that the exploiting firm will either incur costs to search for an invention possessed by someone else or to invent the improvement itself. It must also account for the possibility that switching to the next-best technology might be more efficient. So, the net gain is the gross value of the invention minus the lesser of the costs of searching or self-inventing, represented as $\min\{S, SI\}$, minus the value of the next-best substitute.

Looking at the other side of the inequality, it's clear that assigning a value to C must be done with some precision if one is to identify whether a transfer is efficient. Note that, from an *ex ante* perspective, the invention would not have been produced in the absence of a reward of at least C_{inv} to the inventive firm. As Elhauge notes, unless the inventor anticipates a reward greater than its investment, it will not invent and there will be nothing to transfer.⁵⁷ Furthermore, where the inventive firm and the exploiting firm are competitors, the inventive firm may anticipate losing profits if the invention is transferred. In such a case, the full cost of inventing, C , equals the sum of C_{inv} and C_{trans} .

Assuming that all the private gains identified have corresponding public ones and there are no negative externalities, society should want a transfer of technology to occur whenever $VI - \min\{S, SI\} - VS > C$. Efficient remedies for patent infringement, therefore, should encourage transactions meeting this condition and should deter transactions where $VI - \min\{S, SI\} - VS < C$. Because remedial models need only address situations where the inventive firm has already chosen to incur the cost of invention (without invention there can be no infringement), no variable is included to account for the

57. Einer Elhauge, *Do Patent Holdup and Royalty Stacking Lead to Systematically Excessive Royalties?* 7 (Harvard John M. Olin Discussion Paper Series, Discussion Paper No. 614, 2008), available at <http://ssrn.com/abstract=1139133>.

possibility that the inventive firm might have more profitably expended its resources on a different project.

Finally, the remedial model below assumes that the inventive firm obtains priority to patent its invention either because it is the first-to-invent or because it is the first-to-apply for a patent.⁵⁸ In other words, the model assumes a property right is available to the inventive firm. As noted above, making a property right available to inventive firms reduces public costs in various important ways.⁵⁹ Although the patent right may raise costs in some individual cases, the overall savings generated by firmly established boundary rights are likely to dwarf those costs. In addition, at least some incentives to invent would be diminished by assuming no liability.⁶⁰ Of course, patent law presently establishes a property rule imposing strict liability for the unauthorized appropriation of patented inventions.⁶¹

It is the assumption of a property right that makes the remedial question salient. How should the law react to an unauthorized invasion of that property right? The typical response in tort law has been to distinguish between intentional and unintentional infringements of rights. Borrowing from that remedial template, four primary patent infringement scenarios describe the field of potential infringement. They encompass infringements that are intentional or unintentional in contexts where a transaction is efficient and when it is not. The four scenarios are:

- (1) Intentional infringement/efficient transaction (where $VI - \min\{S, SI\} - VS - C > 0$);
- (2) Infringement by self-invention/efficient transaction;
- (3) Intentional infringement/inefficient transaction (where $VI - \min\{S, SI\} - VS - C < 0$); and
- (4) Infringement by self-invention/inefficient transaction.

58. The present U.S. rule rewards the first-to-invent, but a rational group of inventive and exploiting firms might agree *ex ante* to a property right regime that rewards the first to register the invention in the patent office, as opposed to rewarding the first to actually invent. 35 U.S.C. § 102(g) (2000). Rewarding the first to make a public disclosure, and thereby reduce search costs, has a significant appeal. For the purposes of this Article, the choice between first-to-invent and first-to-apply is immaterial. What is important is the establishment of a clear rule for assigning the property right.

59. See *supra* notes 15–22 and accompanying text.

60. See Paul J. Heald & James Charles Smith, *The Problem of Social Cost in a Genetically Modified Age*, 58 HASTINGS L.J. 87, 105–07 (2006) (discussing the effect of liability rules on invention).

61. See 35 U.S.C. § 154(a)(1) (2000).

The goal is to identify remedies for each scenario that provide incentives for firms to engage in efficient behavior. In a world without transaction costs, the parties would contract for the efficient result, and it would be unnecessary to establish a regime of liability rules.⁶² But as Coase himself noted, once transaction costs are accounted for, the choice of rules may affect public welfare.⁶³ In fact, the second half of *The Problem of Social Cost* is primarily concerned with what sort of tort rules provide the proper incentives for efficient behavior where transaction costs are significant.⁶⁴ The remedies set forth below similarly attempt to channel behavior into efficient transactions and away from inefficient ones. Methodologically, this means defining efficiency in terms of perfect information about the value of each variable: *VI*, *S*, *SI*, *VS*, and *C*. A transaction is placed in one of the four categories defined above based on what would happen in a world with perfect information. Determining the proper remedy requires examining actual expenditures in order to effectively channel exploitative behavior.

A. Intentional Infringement / Efficient Transaction

A recent study by Cotropia and Lemley suggests that intentional infringement is implicated in only a small percentage of patent litigation.⁶⁵ They found that only 31.1% of cases involved an allegation that the defendant knew about the patent before the lawsuit was filed.⁶⁶ Moreover, only 10.9% alleged that the infringer copied the patent owner's invention,⁶⁷ and copying was only established in 1.76% of the cases in their sample.⁶⁸ This suggests that intentional infringement may not be much of a problem. Nonetheless, despite the paucity of litigation, no model is complete without a discussion of intentional infringement, and negligent infringement is analytically easier to address once the

62. See Coase, *supra* note 4, at 114 (explaining that when transaction costs are zero firms will always negotiate an efficient result).

63. *Id.* at 115 ("Once the costs of carrying out market transactions are taken into account . . . the initial delimitation of legal rights does have an effect on the efficiency with which the economic system operates.").

64. Heald & Smith, *supra* note 60, at 97–98.

65. See Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law* 38–39 (Stanford Pub. Law Working Paper Group, Working Paper No. 1270160, 2008), available at <http://ssrn.com/abstract=1270160>.

66. *Id.* at 23.

67. *Id.* at 24.

68. *Id.* at 21–22, 36 (studying 200 patent infringement complaints filed in Delaware and Texas from 2000 to 2007).

questions raised by intentional wrongdoing have been answered. So we begin here.

Consider first the context of a transaction that would have been efficient for the parties to enter into *ex ante*, but the infringing firm chose to pirate the invention instead. When a transaction is efficient, then wealth is created equal to $VI - \min\{S, SI\} - VS - C$. This represents the net value of the invention, the value that the parties would have bargained over. Let L denominate the licensing fee that the infringing firm would have paid for the privilege of using the invention had there been a negotiation. The maximum fee the exploiting firm would be willing to pay is something less than its net gain. As explained below, the minimum fee the inventive firm will be willing to accept is C_{trans} , so the licensing fee can be approximated as $VI - \min\{S, SI\} - VS > L > C_{\text{trans}}$. Simply put, depending on the relative bargaining power of the parties,⁶⁹ they will each share a portion of the net return, $VI - \min\{S, SI\} - VS - C$.⁷⁰

The model makes four assumptions about L . First, L may sometimes be smaller than C , the full cost of inventing, but never smaller than C_{trans} , the cost to the inventive firm of transferring the invention (primarily its lost profits, if any). A simple example illustrates the point. Firm A expends \$1 million to invent a widget that lowers its cost of production by \$1.2 million. The widget has a value to Firm B of \$2 million, and Firm B does not compete with Firm A. From either an *ex ante* or *ex post* perspective, Firm A will be willing to transfer the widget to Firm B for something more than \$1, and Firm B will be willing to pay something less than \$2 million to acquire it. The negotiated license fee could either be lower or higher than C , which equals \$1 million. (The vast range in values for L provides a nice example of why we want the law to induce a negotiation here rather than assign the task to a judge.) If the firms are competitors, however, Firm A will demand a payment at least equal to any lost profits caused by transferring the technology to Firm B, that is to say C_{trans} .

69. See BLAIR & COTTER, *supra* note 38, at 47 (explaining the place for bargaining power in the expected profit valuation for a potential infringer); Denton & Heald, *supra* note 10, at 1219–24 (describing various costs, that a licensor of a patent generally internalizes, that reduce the potential value of a patent).

70. Elhauge suggests this is true where there is only one downstream user of the invention. If there are more, he argues that competition between them will result in all of the invention's value being captured by the patentee. Elhauge, *supra* note 57, at 30–33. For this to be true, however, the downstream users must have the same cost of production and be unable to collude (say via merger or joint venture), conditions which seem highly unlikely in real markets.

Second, the share of the net gain that the inventive firm receives will be sensitive to the probability that the patent is invalid. A rational licensee will demand a discount for the possibility that it is purchasing technology that would be declared by a court to be in the public domain, free for anyone to use. Third, we assume that L is calculated for a license that lasts the remaining life of the patent. Finally, L is assumed to be calculated using a math-based approach that considers marginal values and is not based on prior negotiated royalties. Reliance on prior royalties creates circularity problems and self-fulfilling awards that have been properly criticized by several commentators.⁷¹ In addition, L must be calculated in light of the marginal value of the invention to the exploiting firm in order to avoid “royalty stacking” in situations where the exploiting firm is making use of more than one invention in the same product.⁷² Detailing the available calculation options is beyond the scope of this Article, but my prior co-authored model treats patents like real options and utilizes a novel version of the Black–Scholes equation in order to avoid both the difficulties just mentioned.⁷³ With these assumptions in mind, optimal remedies can be described for infringements where a transaction is efficient.

In the case of intentional infringement where the transaction is efficient, the exploiting firm has knowingly appropriated an existing patented invention but has failed to purchase a license from the inventor. Here, by definition, a transaction is optimal and should occur. If patent infringement were a common law wrong,⁷⁴ this would be classified as an intentional tort, a deliberate invasion of another’s property interest.⁷⁵ Under general tort principles, where firms are

71. See, e.g., Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2021–22 (2007) (arguing that using industry royalty rates is improper because they already include the value of potential lawsuits).

72. *Id.* at 1993 (“Royalty stacking refers to situations in which a single product potentially infringes on many patents, and thus may bear multiple royalty burdens. . . . As a matter of simple arithmetic, royalty stacking magnifies the problems associated with injunction threats and holdup, and greatly so if many patents read on the same product.”).

73. Denton & Heald, *supra* note 10, at 1182, 1193; see also F. Russell Denton, Rolling Equilibriums at the Pre-Commons Frontier: Identifying Patently Efficient Royalties for Complex Products 26, 30–31 (Fall 2008) (unpublished manuscript, on file with the Houston Law Review), available at http://works.bepress.com/context/f_russell_denton/article/1001/type/native/viewcontent/ (refining the Denton Variation of the Black–Scholes equation to address the problem of splintered licensing).

74. There was never a right at English common law to exclude someone from an invention. Adam Mossoff, *Patents as Constitutional Private Property: The Historical Protection of Patents Under the Takings Clause*, 87 B.U. L. REV. 689, 705 (2007).

75. See William M. Landes & Richard A. Posner, *An Economic Theory of Intentional*

competitive, lost profits and other consequential damages⁷⁶ would be awarded. Awarding only such damages, however, is not enough to channel efficient transactions into actual negotiations. First, had there been a negotiation, the inventor would have received L . L is by definition larger than the inventor's foreseeable damages because no rational inventor would license an invention to a competitor for an amount less than the competitive damage it would incur.⁷⁷ So, the presumptive award should be at least L , the license fee that would have been negotiated between the parties.⁷⁸ In a case not involving lost profits, L will obviously be smaller.

L itself will often require further enhancement in the case of intentional misappropriation. When wrongful conduct is deliberate, tortfeasors have the opportunity to cover up the wrong and escape detection. In patent infringement, for example, unauthorized uses of process patents may easily go undetected.⁷⁹ Processes can often be practiced behind closed doors, away from the prying eyes of the patent owner. For this reason, one can justify an award of augmented damages in order to account for the likelihood that the infringement would go undetected.⁸⁰ If, for

Torts, 1 INT'L REV. L. & ECON. 127 (1981). Landes and Posner note that normally "intent" is not a relevant economic concept, but they find useful a definition of intentional tort "whose distinctive attribute is that the injurer expends real resources to increase the probability of injury." *Id.* at 130. This is clearly true in cases of knowing infringement where the patentee suffers lost profits, but the case of an unauthorized, non-competing use is less clear. Should the patentee's lost licensing opportunity count as an injury? It may not matter. Intent is relevant in my model only to the question of awarding extra-compensatory damages, and both conditions favoring such awards mentioned by Landes and Posner seem to fit knowing patent infringement, even when no profits are lost. First, all intentional infringers have a "strong incentive to conceal [their] identity or . . . avoid [their] being sued." *Id.* at 135. Second, by infringing they avoid using the market to price the transaction. *Id.* ("[S]ociety is better off if the market is used, because the costs of the market are lower than the costs of a coercive transaction . . .").

76. In contract law, consequential damages are limited to those that are foreseeable. RESTATEMENT (SECOND) OF CONTRACTS § 351 (1979). In tort, there is no foreseeability bar, although causation rules provide a significant break. RESTATEMENT (SECOND) OF TORTS § 431 (1965). Consistent with this model, a court might consider foreseeability from the perspective of the patent owner, because only losses the patent owner can foresee would affect the price of the license. But that is a contract, not a tort, approach.

77. This may help explain various damage rules that allow courts to augment damages beyond lost profits.

78. See Denton & Heald, *supra* note 10, at 1227–34 (using the Denton variation of the Black–Scholes equation to price an invention involving plywood veneer).

79. Alan Wright, *The North American Free Trade Agreement (NAFTA) and Process Patent Protection*, 43 AM. U. L. REV. 603, 607 (1994) ("Often, no satisfactory method exists for determining whether process infringement has occurred.")

80. Mathias v. Accor Econ. Lodging, 347 F.3d 672, 677 (7th Cir. 2003) (Posner, J.) ("If a tortfeasor is 'caught' only half the time he commits torts, then when he is caught he should be punished twice as heavily in order to make up for the times he gets away."); see

example, there is only a one-in-three chance that an intentional infringer would be caught, then L plus a detection penalty should be at least three times the infringer's expected gains from its wrongful activity. In some cases of intentional infringement, however, exploiting firms with knowledge of the patent will not know with 100% certainty that their behavior is wrongful. A reasonable opinion of counsel might advise that the patent is invalid or that a planned work-around by the exploiting firm is not infringing. Let us first consider the context of intentional infringement when the infringer knows with a high degree of certainty that its actions are wrongful, and then consider situations where the infringer may entertain legitimate doubts about the wrongfulness of its behavior.

1. High Probability Patent Will Be Held Valid and Infringed.

Even if damages are enhanced due to the likelihood of non-detection, an award of L augmented will do no more than render the infringer indifferent to the choice between infringing and paying damages, and negotiating a license. From the public welfare perspective, the infringer should be channeled toward an *ex ante* negotiation. A negotiation saves the cost of patent litigation, which is extremely expensive.⁸¹ It also means that the parties calculate L privately, rather than imposing that task on the courts at the public's expense. Private fee-setting is also more accurate, representing the market rate, and eliminates the possible cost of judicial error.⁸² Landes and Posner justify punitive damages in some intentional tort cases on these grounds: "[S]ociety is better off if the market is used, because the costs of the market are lower than the costs of a coercive transaction with compensation enforced by the legal system."⁸³ Therefore, even if properly augmented by the likelihood of non-detection, L will often need to be enhanced further to provide an adequate incentive to negotiate.

Under current law, additional enhancement occurs via two mechanisms. First, injunctive relief, which may be awarded

also BLAIR & COTTER, *supra* note 38, at 46; Landes & Posner, *supra* note 75, at 135 (noting an intentional tortfeasor "has a strong incentive to conceal his identity or . . . avoid his being sued . . . so, optimal damages would be a multiple of the victim's injury").

81. See BESSEN & MEURER, *supra* note 9, at 130–45 (exploring how soaring direct and indirect costs of patent litigation have created disincentives to innovation).

82. Cf. *In re Excello Press, Inc.*, 890 F.2d 896, 904–05 (7th Cir. 1989) ("The product of a commercially reasonable sale is the fair market value.").

83. Landes & Posner, *supra* note 75, at 135.

under 35 U.S.C. § 283,⁸⁴ will often impose significant additional costs on an infringer.⁸⁵ To see how injunctive relief can provide additional deterrence, one must consider the infringer's cost of switching to an alternative non-infringing technology. When the infringer's switching costs are larger than the post-adjudication license fee the patentee can credibly demand, then the infringer will pay to continue to use the patented technology. The infringer's cost of switching (Sw) to alternative technology can be denominated as $Sw = P + (VI_2 - VS_2)$, where P constitutes the cost of physically adopting the substitute technology. Sw equals P plus the difference between the profits that would be earned with the patented invention after adjudication (VI_2) and the profits that would be earned with the substitute technology (VS_2) after the adjudication of infringement. If an injunction issues, it will force a negotiation between the parties, and the patentee may be able to extract a licensing fee that is close to the cost of switching.⁸⁶ This fee may be in excess of the inventive firm's lost profits, if any, or the price of the license that would have been negotiated freely before the infringement.⁸⁷ Lemley uses the term "holdup" to describe this premium.⁸⁸ In fact, if the infringing firm's switching costs are high enough, it may be willing to agree to a license that results in a net loss.⁸⁹

84. 35 U.S.C. § 283 (2000) ("The several courts having jurisdiction of cases under this title may grant injunctions in accordance with the principles of equity . . .").

85. At common law, injunctions are also authorized when there is the threat of the unauthorized use of property. *See, e.g., Lambert v. Holmberg*, 712 N.W.2d 268, 275 (Neb. 2006) ("When simple acts of trespass are involved, equity generally will not act. . . . However, where the nature and frequency of trespasses are such as to prevent or threaten the substantial enjoyment of the rights of possession and property in land, an injunction will be granted.").

86. *See Lemley & Shapiro, supra* note 71, at 1991 ("[T]he threat to obtain a permanent injunction greatly enhances the patent holder's negotiating power, leading to royalty rates that exceed a natural benchmark range based on the value of the patented technology and the strength of the patent.").

87. *See, e.g., Rob Kelley, BlackBerry Maker, NTP Ink \$612 Million Settlement*, CNNMONEY.COM, Mar. 3, 2006, http://money.cnn.com/2006/03/03/technology/rimm_ntp/ (discussing the \$612.5 million settlement of a BlackBerry infringement case, where damages and prior negotiated licenses were significantly smaller).

88. He says such costs are systematic. *Lemley & Shapiro, supra* note 71, at 2020. Elhauge disagrees. *See Elhauge, supra* note 57, at 12 ("In short, applying the correct benchmark to their predicted royalty rates under neutral bargaining indicates a royalty overcharge for a strong patent only when the fixed costs of redesign exceed the expected value of the patent, taking into account the odds that the patent claim will be found invalid.").

89. Imagine an infringing firm that expended \$1,000 to adopt a new process that reduced its operating costs by \$1,300. If switching back to the old system would cost it \$500, then the infringing firm faced with an injunction would be willing to pay, for example, \$400 to continue to use the process, leaving it with a net loss of \$100. Lemley seems most worried that the net loss scenario will occur when the exploiting firm is

Where switching costs are high, an injunction, combined with a damage award, will ensure that an exploiting firm is not indifferent to the choice between negotiating and intentionally infringing. Importantly, authorizing injunctive relief in the case of intentional infringement should not usually result in over-deterrence. It will not stimulate excessive searching by exploiting firms because those costs have already been incurred in the case of knowing infringement. At first glance, when the infringer is a pirate or counterfeiter, an injunction should issue.

If the infringer's switching costs are low enough, however, a post-adjudication injunction will provide no added deterrence. In that situation, some form of exemplary damages may be justified, especially when the infringement results in lost profits or other consequential damages to the patentee.⁹⁰ When there is no actual damage to the patentee, usually due to the fact that the infringer is exploiting the invention in a disparate technological field, the traditional rationale for punitive damages seems less applicable because the only damage suffered by the patent owner is a lost opportunity. Instead, we are interested in channeling transactions primarily to save litigation costs, reduce the cost of judicial error, and capture other benefits of private ordering. These are important goals, but they may not require as substantial a punitive award as cases involving competitive damage. It is difficult to be more precise. As Landes and Posner conclude in their discussion of intentional torts, "How high the damage award should be set in order to perform this channeling function is uncertain."⁹¹

2. Doubtful Patent/Uncertain Infringement. As Bessen and Meurer point out, the fuzzy boundaries of some patents can make it difficult for firms acting in good faith to answer two important questions: (1) Is the inventive firm's patent valid? and (2) Is my choice of alternative technology infringing?⁹² Lemley and Shapiro argue vociferously that the fuzziness of patent boundaries should be taken into account when crafting remedies for patent

selling a multi-component product subject to numerous claims of infringement. See Lemley & Shapiro, *supra* note 71, at 1994. It seems clear, however, that a single holdup involving high enough switching costs can force the infringer to negotiate a post adjudication license that results in a net loss. It may be that patent holdup and royalty stacking present analytically the same problem to injunctive relief.

90. Under U.S. patent law, a judge may award treble damages for willful infringement. 35 U.S.C. § 284 (2000).

91. Landes & Posner, *supra* note 75, at 135.

92. See BESSEN & MEURER, *supra* note 9, at 8–9, 17–19 (providing examples of how fuzzy patent boundaries create uncertainty about possible infringement).

infringement.⁹³ They suggest adjusting the patentee's entire monetary award by the *ex ante* probability that the patent would have been unenforceable against the exploiting firm.⁹⁴ Lemley and Shapiro's approach might result in some cases of undercompensation, unless C_{trans} is established as the minimum monetary remedy in all cases, not subject to any divisor. As noted above, the difference between C_{trans} and L , representing the surplus subject to bargaining, has already been discounted for the possibility that the patent is invalid. Only those awards enhanced beyond L in order to deter intentional infringement should take into account the predicted *ex ante* enforceability of the patent right.

For example, if a rational exploiting firm would conclude *ex ante* that the strength of the patent is 50%,⁹⁵ then its decision to exploit the technology does not look wholly intentionally tortious. In Landes and Posner's terms, infringement would not be wholly an act where "the injurer expends real resources to increase the probability of injury."⁹⁶ In fact, in their seminal paper on intentional torts, they suggest that "because of the presence of mistake an intentional tort may be (economically) indistinguishable from an unintentional tort, an accident case."⁹⁷ Because the remedy should aim only to deter the marginally wrongful aspect of the infringer's behavior, any enhancement of damages should be reduced by the *ex ante* probability of enforcement against the exploiting firm. If a reasonable outside opinion letter advises the exploiting firm that there is only a 50% chance that the patent is valid, then only 50% of the exploiting firm's intent should be considered to be wrongful in the economic sense. So, assuming that the exploiting firm's net expected gain from using the patent is \$1.5 million, the chance of detection is 25%, and the patent's strength is 50%, then the augmented portion of the damage award should be \$3 million [$(\$1,500,000 \times 4) \times 0.5$]. Therefore, L , plus any non-detection penalty, should equal \$3 million, not \$6 million.

But what about injunctions? As calculated above, enhancement due to non-detection should be awarded as a matter of course in cases of intentional infringement. Additional

93. See Lemley & Shapiro, *supra* note 71, at 1996–97 (including a patent strength element in their damages equation).

94. *Id.* at 1999.

95. In other words, that a court is likely to declare the patent invalid 50% of the time or is likely to declare work-around technology developed by the exploiting firm to be non-infringing 50% of the time.

96. Landes & Posner, *supra* note 75, at 130.

97. *Id.* at 138.

injunctive relief can be justified as a means to make sure infringers are not indifferent to the choice between intentional misconduct and negotiation. As noted above, in the case of patent hold-ups, injunctions function as punitive damages because when switching costs are high, patentees can “hold up” infringers and demand exorbitant post-adjudication licensing fees.⁹⁸ Accounting for the probability of non-enforcement in the case of injunctive relief is problematic. For example, if only half of the infringer’s conduct is intentionally wrongful, then how should injunctive relief be adjusted? One approach might be to substitute injunctive relief with an award of damages capped by the defendant’s switching costs multiplied by the probability that the patent is not enforceable. The defendant’s switching costs (Sw) represent the highest fee that the patent owner could negotiate in the post-injunction environment. If the patent is only likely to be enforced 50% of the time, then the exemplary portion of the award should arguably be no more than $0.5 \times Sw$.

B. Infringement by Self-Invention / Efficient Transaction

In this case, the exploiting firm’s acquisition of the invention increases wealth, but the exploiting firm acquires the technology through self-invention rather than through searching and appropriating. Given the Cotropia & Lemley study discussed at the beginning of the prior section, unintentional infringement through self-invention is likely to present the most common case.⁹⁹ Under these conditions, infringement is unintentional and looks negligent. In general, the exclusive goal in negligence cases is to award adequate compensation to the tort victim,¹⁰⁰ so awarding the infringer’s profits, an injunction, or other enhanced damages should require special justification. Two sub-cases exist: (1) where searching and negotiating would have been more costly than self-inventing ($S > SI$); and (2) where searching and negotiating would have been less costly than self-inventing ($S < SI$).¹⁰¹

1. $S > SI$. First, where the cost of searching and negotiating is more costly than self-inventing, the infringing firm

98. See *supra* Part III.A.1.

99. See *supra* notes 65–68 and accompanying text.

100. Cf. Earl C. Dudley, Jr., *Federalism and Federal Rule of Evidence 501: Privilege and Vertical Choice of Law*, 82 GEO. L.J. 1781, 1799 (1994) (noting the importance of the social goal of adequate compensation in negligence awards).

101. There is only one case in the discussion of intentional infringement because in such cases S always equals zero.

has saved resources by self-inventing. Society should prefer the transfer to occur without searching and negotiation, so at first cut damages should be set equal to L , the amount the parties would have agreed upon had they costlessly encountered each other. Should damages be adjusted to account for the possibility that the infringer's behavior will sometimes go undetected, creating the chance of systematic undercompensation? Given the high search costs present, it is efficient for both parties to invent. The law does not want to encourage inefficient searching in this case. A multiplier might provide an extra incentive for the patentee to invent in a marginal case,¹⁰² but that gain would be offset by a proportional disincentive to the exploiting firm whom we also want to invent. Multiplication would therefore result in no net gain and a wasted transfer payment.

Indeed, one might ask if there should be liability at all when self-invention is efficient, at least where the patentee suffers no lost profits. Several commentators have suggested that a defense of independent invention should vitiate the normal rule of strict liability for some unintentional infringements.¹⁰³ In a world without transaction costs, this problem does not arise—the exploiting firm would simply enter into a licensing agreement with the inventive firm, thereby saving the cost of self-invention.¹⁰⁴ This suggests that L is an appropriate starting point consistent with transactional assumptions. However, in reality, when the cost of searching and negotiating is higher than the cost of self-inventing, then it is efficient for the exploiting firm to self-invent instead. If so, damages should be adjusted to account for that expenditure, and optimal damages can be represented by $L - SI$ (the licensing fee minus the reasonable cost of self-invention by the exploiting firm). Any higher award would deter the exploiting firm from efficient self-invention.¹⁰⁵ The minimum

102. Where the cost of inventing is higher than the value of the invention to the patentee firm, but lower than that value plus anticipated license fees paid by third parties.

103. See Samson Vermont, *Independent Invention as a Defense to Patent Infringement*, 105 MICH. L. REV. 475, 503–04 (2006) (advocating the independent invention defense in order to lower total research costs); cf. Carl Shapiro, *Prior User Rights*, 96 AM. ECON. REV. 92, 95 (2006) (advocating rights for both parties in a simultaneous invention scenario).

104. It is assumed that rational inventive firms—and in this scenario both parties function as inventive firms—would agree to a regime where the first-to-invent (or alternatively the first-to-apply for a patent) receives a property right in the invention. A complete defense of independent invention would create serious uncertainties in patent enforcement by adding deliberate copying as an element of the offense. Patents would become less predictably enforceable and less reliable as an asset subject to transfer or collateralization.

105. Assume the infringer's cost of self-inventing a widget that saves it \$1.2 million

award, of course, must at least be equal to C_{trans} (the patentee's lost profits, if any). Here, interestingly, the most important remedial benchmark for both parties is an award that maintains the infringer's incentive to self-invent. Without self-invention by the infringer, the patentee earns no royalty at all.

This qualified "defense" of self-invention deserves a comment. It is obviously in the interest of inventive firms to lower the costs of searching and negotiating. Successful reform of patent law's notice function, perhaps along the lines of Bessen and Meurer's laundry list of suggestions, would diminish the scope of this suggested limitation on damages.¹⁰⁶ Assigning damages as $L - SI$ provides incentives for inventive firms to write clearer patents and to eschew patent office ploys, like the use of continuing applications, to hide technology from the public.¹⁰⁷ In this case, awarding $L - SI$ looks like a strict liability regime plus a defense of contributory negligence.

The appropriateness of injunctive relief under these conditions differs from the case of intentional infringement. Here, awarding injunctive relief may be costly from a welfare perspective. When switching costs are high enough and a substantial premium can be extracted by the patentee in a post-adjudication licensing negotiation, the exploiting firm may invest excessively in searching for the patentee. Remember, in this sub-case, any searching is wasted. In fact, if switching costs are high enough, an award of injunctive relief could even result in a net loss to the self-inventing firm. In such a case, an injunction would deter the infringer from self-inventing under conditions when self-inventing is the optimal behavior. In this sub-case, no injunction should issue, and the patentee should be adequately compensated by money damages. This fact situation may cover many scenarios involving patent "trolls."¹⁰⁸

in production costs is \$1 million, and there are no alternative widgets that will lower production costs. If the patentee and the infringer had encountered each other costlessly, L would likely be quite high, given that the patentee controls technology worth \$1.2 million to the infringer. However if L is awarded in the infringement context, and L is calculated at more than \$200,000, then the efficient infringer will suffer a net loss. Its net gain from self-invention is only \$200,000 (\$1.2 million - \$1 million). So fear of an award greater than that amount might result in no self-invention.

106. See BESSEN & MEURER, *supra* note 9, at 235–52 (suggesting various reforms that would make claim boundaries quickly transparent, making patent interpretation less difficult, and improving opportunity for firms to search patents).

107. See *id.* at 62–63, 220–21 (explaining how continuations surprise unaware infringers).

108. Gerard N. Magliocca, *Blackberries and Barnyards: Patent Trolls and the Perils of Innovation*, 82 NOTRE DAME L. REV. 1809, 1810 (2007) (“[P]atent troll . . . is a derogatory term for firms that use their patents to extract settlements rather than license or manufacture technology.”).

2. $S < SI$. When searching and negotiating is less costly than self-inventing, then the exploiting firm has wasted resources by self-inventing in the amount of $SI - S$. This is the minimum amount that should be awarded to provide incentives for the exploiting firm to conduct a reasonable search. If the presumptive award of L is smaller, then it should be augmented to equal at least $SI - S$. Such an award should be adequate when the infringing firm's chance of being detected is 100%. Enhancing damages, however, may be necessary to provide an adequate incentive for the infringing firm to search when it knows that sometimes it will infringe and not be caught. This suggests augmenting $SI - S$ to account for the probability that the infringement will go undetected. A multiplier would assure that when an infringing firm gets caught it will bear the full cost of not searching over time. Nonetheless, the activity of self-inventing without knowledge of the patent looks negligent, so the question arises whether multiplying damages—typically found in cases of intentional or reckless torts where tortfeasors seek to cover their tracks—is appropriate.

A limited version of damage multiplication could theoretically be justified in some versions of this sub-case. Inefficient self-invention in this case could be the result of the intentional decision not to search, a deliberate choice to turn a blind eye to the patent notification system. The choice to harm is not intentional, but self-invention without searching could be characterized as reckless. As Judge Posner points out in *Mathias v. Accor Economy Lodging*, reckless and grossly negligent conduct may justify the application of a damage multiplier based on the chance that the wrong will go undetected or unchallenged.¹⁰⁹ Lemley points out, however, that the notice function of the patent system is currently so dysfunctional that the industry norm is one of not searching.¹¹⁰ Bessen and Meurer concur.¹¹¹ It would be hard to call failures to search reckless if commentators are correct about the standard practice. Application of a multiplier in negligence cases, in other words, may have to wait for reform of patent law's notice function.

For related reasons, it may be difficult to justify a multiplier in a case of negligent patent infringement where the patentee

109. *Mathias v. Accor Econ. Lodging*, 347 F.3d 672, 675–76, 678 (7th Cir. 2003) (Posner, J.) (holding punitive damages amounting to thirty-seven times compensatory damages not excessive in case of known and untreated bed bug infestation).

110. Lemley, *supra* note 9, at 21–22.

111. See BESSEN & MEURER, *supra* note 9, at 70 (explaining that companies generally do not conduct patent searches).

has not lost profits. If the inventive firm and a self-inventing infringer operate in different commercial fields, the organization of information in the patent office makes the potentially infringed patent much harder to find. Also, the lack of damages in the case of noncompetition further weakens the need for additional deterrence through a multiplier, especially when the infringer conducts a reasonable search prior to self-inventing. Finally, if the infringing firm conducted a reasonable search¹¹² prior to self-inventing, and yet failed to find the invention, it seems clear that the damage award should not be augmented.

The appropriateness of injunctive relief under these conditions is more complex than in the prior sub-case. Like an accounting of the infringer's profits or punitive damages, an injunction functions as extra-compensatory relief. In light of the discussion immediately above, significant extra-compensatory relief is unlikely to be justified. Nonetheless, allowing the patent royalty "holdup" in this sub-case may be desirable on occasion. The injunction, with its attendant cost to the exploiting firm, has the benefit of increasing incentives to search where searching is the efficient strategy, although the fear of paying a heavy post-adjudication licensing premium could encourage wasteful over-searching. Even when an injunction might be considered, conducting a reasonable search should therefore provide a defense to injunctive relief.

C. Intentional Infringement / Inefficient Transaction

In a world with perfect information and with no bargaining or search costs, no transaction between the inventive firm and the exploiting firm would occur when the inventive firm's cost of inventing is greater than the net value of the invention. Why then do such transactions occur in reality? And most importantly, under these conditions, what stimulates the creation of the invention in the first place when a deal with the potential buyer is inefficient? First, some inventions are fortuitous ($C = 0$), and some are the result of miscalculations by the inventing firm. For example, if the inventing firm believes that a new widget will help it save \$3 million in production costs, it might invest \$2 million to create it. If the inventing firm turns out to be mistaken (the widget generates no cost savings at all), it

112. What constitutes a reasonable search might be assessed by looking at the searching practices of firms. See Jay P. Kesan, *Carrots and Sticks to Create a Better Patent System*, 17 *BERKELEY TECH L.J.* 763, 766 (2002) (noting various industry "sub-groups" define customs for their particular disciplines in researching).

will be left with a widget that could still have some lesser value (say \$1 million) to another firm that might infringe.

One can imagine an alternative scenario where invention still occurs despite the fact it would be inefficient from an *ex ante* perspective. For example, if the exploiting firm believes that a widget will lower its production costs by \$2 million, it may contract with the inventive firm for the production of the widget for payments of \$70,000 per year for the 20-year life of the widget patent. Ignoring the time value of money, the inventive firm may be willing to invent the widget if the cost of invention is, say, \$800,000. Assume further that once the widget is invented, the exploiting firm finds that its production cost savings are only \$500,000, and it breaches the licensing agreement. From an *ex ante* perspective, the transaction is inefficient ($\$500,000 - \$800,000 = -\$300,000$); nonetheless, the exploiting firm is an infringer if it continues to use the widget. Moreover, from an *ex post* perspective, it may be efficient for the infringing firm to continue to use the widget if there are no better alternatives or switching costs are high.

In these situations, L has a positive value and should be awarded. Indeed, it has already been calculated by the parties as the contract price. Although the deal is inefficient from an *ex ante* perspective, from an *ex post* perspective it looks like an efficient salvage operation. The inventive firm has created something of value to the infringing firm, and all our reasons for preferring a voluntary transfer apply, especially when a deal has already been negotiated. The infringer's opportunistic behavior looks very much like an intentional tort, so relief beyond L may be justified to deter the infringing firm's behavior. An accounting of the infringer's profits is an option, but since the probability of nondetection is zero when the parties have contracted, no multiplier would likely be available. Injunctive relief is another likely means of deterrence. If switching costs are high, then the hold-up premium should have a significant deterrent effect. If switching costs are low, then the infringer will adopt a noninfringing substitute and be guilty merely of breach of contract. There is no reason not to award injunctive relief in all cases, subject to the caveats set forth in Part III.A. The hypothetical in the prior paragraph should be treated in a similar fashion.

Finally, a transaction may also be inefficient if the infringer's use of the invention results in a net loss to it. For example, if an infringing widget is less productive than an alternative substitute ($VI - VS < 0$) to the infringing firm, then the infringement will result in a net loss to the exploiting firm. It

will not only have behaved wrongfully, but it will have suffered for its behavior. Given that such transactions are usually self-detering, granting relief may not be crucial to overall efficiency. Analyzing the scenario more closely, L will be nominal or zero. There is no net gain for the exploiting firm and the inventive firm to share. In addition, there should be no lost profits because had the infringing firm chosen the better substitute technology, it would have caused more damage to competitive firms. This leaves injunctive relief as the only potential remedy. Given that the infringer should already be adequately deterred from appropriating the invention, there seems little reason to give an incentive to the inventing firm to engage in costly litigation in the hope of capturing some of the infringer's switching costs. The game does not seem worth the candle here.

D. Infringement by Self-Invention / Inefficient Transaction

Most infringements via self-invention in this category result in a net loss to the exploiting firm. These are cases where the exploiting firm has miscalculated the value of the invention (including the cost to invent it) or underestimated the value of alternative technology. In other words, the infringer is a victim of its own negligent behavior. In the absence of competitive losses by the patentee, one could argue that only nominal damages should be awarded. An award of nominal damages, however, would provide no incentives for the exploiting firm to search in a context where some searching might be efficient. A search may have revealed the invention, thereby saving the cost of inventing. If the exploiting firm would be deterred from self-inventing by that discovery, then a case for damages might be made when the cost of the search is smaller than the loss to the exploiting firm from its inefficient self-invention. Note this argument is somewhat odd, in that the existence of those costs should already be sufficient to deter the firm from its inefficient behavior.

Even if, *ex ante*, the inventive firm and the exploiting firm would not have entered into a license, an injunction will force a post-adjudication license where the infringing firm's switching costs are high. Having to pay a hold-up license fee will exacerbate the infringer's losses due to its miscalculation and provide extra incentives for it to take care. But will it stimulate excessive care? Search costs incurred beyond the loss caused by self-invention are clearly wasted, so injunctive relief may in some circumstances stimulate excessive searching (e.g., when both switching costs and the hold-up license fee are very large). On the other hand, if the fear of paying the fee provides the marginal

extra incentive necessary to reveal the invention and reduce significant losses, then injunctive relief would be justified. The infringer's loss from self-invention can be represented as $SI - VI$, the cost of self-invention minus the value of the invention. To account for the opportunity cost of not using the best known alternative substitute, we set the infringer's loss at $VS + (SI - VI)$.¹¹³ This loss is the incentive for the infringer to search for the invention in the absence of injunctive relief. We want the exploiting firm to search, therefore, when $S < VS + (SI - VI)$. Under these conditions an injunction should issue.

IV. CONCLUSIONS

The need for rethinking remedies for patent infringement is pressing in a world where "patent granting countries have yet to identify a regime that maximizes welfare and is universally applicable."¹¹⁴ A series of normative and descriptive conclusions can be drawn from the elucidation of the model above.

A. *Strong Normative Conclusion*

One could argue that courts should adopt the model when actually awarding damages. If remedies are calibrated properly, then optimal incentives for transacting would be established (within the confines of the existing patent regime). The biggest impediment to judicial implementation is the difficulty in calculating variables. In the infringement context, discovery should reveal hard numbers upon which to calculate VI , VS , SI , and C . Industry evidence should provide a good estimate of S . However, calculating L requires multiple inputs, and, where relevant, calculating *ex ante* patent strength is bound to be tricky. One could credibly argue, however, that calculation difficulties under the present reasonable royalty regime are just as severe.¹¹⁵ The literature on how to calculate a reliable royalty figure is enormous, but my co-authored work that employs a derivation of the Black-Scholes equation provides a coherent math-based solution.¹¹⁶ So, calculating the necessary variables

113. Strictly speaking, VS here is the net value of switching to the best alternative substitute.

114. Henry & Turner, *supra* note 38, at 2.

115. See *Georgia-Pacific Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (setting forth a fifteen-factor test to estimate result of *ex ante* hypothetical reasonable royalty negotiation between infringer and patentee).

116. See Denton & Heald, *supra* note 10, at 1226-34 (providing an example of how to price a license involving a plywood veneer product).

may be no more formidable a task than that faced by courts now in calculating both damages and reasonable royalty figures.

B. Weak Normative Conclusions

Even if one believes that actual variable values are too difficult to calculate under the model, several other reforms of patent law remain supported. First, the model provides guidelines for when extra-compensatory damages should be awarded, clarifying a muddy area of remedies law. Second, the infringer's intent and the cost of searching are both made relevant to the determination of whether injunctive relief is appropriate.¹¹⁷ The present law on injunctive relief is ambiguous and provides no express role for any of these factors.¹¹⁸ Third, a qualified defense of independent invention is justified for the first time as part of a comprehensive model of patent remedies.¹¹⁹

C. Descriptive Conclusions

As a descriptive matter, the model has significant explanatory power, especially in a time of controversial patent reform proposals.¹²⁰ The patent act provides that "the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty . . . [and] may increase the damages up to three times the

117. See Mark A. Lemley, *Should Patent Infringement Require Proof of Copying?*, 105 MICH. L. REV. 1525, 1535 (2007) (suggesting that independent invention should be relevant when determining if injunctive relief is appropriate).

118. See Andrew Beckerman-Rodau, *The Aftermath of eBay v. MercExchange*, 126 S. Ct. 1837 (2006): *A Review of Subsequent Judicial Decisions*, 89 J. PAT. & TRADEMARK OFF. SOC'Y 631, 657 (2007) (concluding that courts continue to grant injunctive relief in most cases and the primary determining factors are direct competition of the plaintiff and defendant); Edward D. Manzo, *Injunctions in Patent Cases After eBay*, 7 J. MARSHALL REV. INTELL. PROP. L. 44, 93–96 (2007) (adding that judges have wide discretion in the public interest factor and seek to ensure that the infringer is simply no longer able to infringe).

119. Several scholars have argued that patent law should provide a defense in certain cases of independent invention. See, e.g., Vermont, *supra* note 103, at 503–04 (advocating the defense in order to increase efficiency in research). Although the model does not establish a broad defense based on independent invention, the model supports the intuition that self-invention should be a relevant consideration. Indeed, in a situation where transacting between the exploiting firm and the inventive firm is inefficient, the firms are noncompeting, and the exploiting firm's switching costs are lower than L_2 , something like a defense is provided (nominal damages and a valueless injunction). Thus, the model gives courts a more precise instrument to determine when self-invention is relevant.

120. See Advertisement by Professional Inventors Alliance, N.Y. TIMES, Apr. 7, 2008, at A-10 to A-11 (railing against current reform proposals in Congress in a two-page advertisement).

amount found or assessed.”¹²¹ In addition, it “may grant injunctions in accordance with the principles of equity . . . on such terms as the court deems reasonable.”¹²² As usual, the statutory language does not tell the whole story. For example, for decades federal courts in patent cases followed a virtual per se rule of granting an injunction to prevailing patent owners in infringement cases.¹²³ In a very controversial decision, the Court recently reversed this trend and articulated a four-part test for granting injunctive relief.¹²⁴ Courts must now employ principles of equity in determining whether injunctive relief is appropriate.¹²⁵ The remedial model described here provides substantial support for the Court’s decision to abandon the prior per se rule.¹²⁶ It demonstrates that injunctive relief should not be automatic but rather depend on several factors, including the infringer’s knowledge and intent, and whether the infringer conducted a reasonable search. The former rule was clearly inappropriate.¹²⁷

The statutory language concerning enhanced damages is similarly open-ended. Although courts have traditionally only multiplied damages in cases of willful infringement,¹²⁸ the statute

121. 35 U.S.C. § 284 (2000).

122. 35 U.S.C. § 283 (2000).

123. See *eBay, Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 393–94 (2006) (“The [Federal Circuit] articulated a ‘general rule,’ unique to patent disputes, ‘that a permanent injunction will issue once infringement and validity have been adjudged.’”).

124. *Id.* at 391 (“According to well-established principles of equity, a plaintiff seeking a permanent injunction must satisfy a four-factor test before a court may grant such relief. A plaintiff must demonstrate: (1) that it has suffered an irreparable injury; (2) that remedies available at law, such as monetary damages, are inadequate to compensate for that injury; (3) that, considering the balance of hardships between the plaintiff and defendant, a remedy in equity is warranted; and (4) that the public interest would not be disserved by a permanent injunction.”). Since the Court’s 2006 ruling, as of May 15, 2008, Westlaw lists at least fifty-two articles in its journal and law review database (JLR) on the case having “eBay” in their title, taking a wide variety of positions on the propriety of the decision.

125. *Id.* at 394.

126. See *supra* Part III.A.1 (explaining that when switching costs are low, an injunction provides no added deterrence); see also *supra* Part III.B.1–2 (explaining when injunctive relief may cause excessive searching).

127. Although the Court is on the right path with abandonment of the per se rule, its adoption of the four-part test focusing on irreparable injury, inadequacy of monetary remedies, the balance of hardships, and the public interest, seems ill-suited to the consideration of key factors like the infringer’s mental state (although deterring inefficient post-adjudication holdups might be considered under the public interest rubric). *eBay*, 547 U.S. at 391. In order for injunctive relief to better serve the purposes underlying patent law, a broader understanding of what factors are relevant at equity should be employed. The statutory language, “may grant injunctions in accordance with the principles of equity . . . on such terms as the court deems reasonable,” is certainly flexible enough to facilitate the inquiry suggested in this model. 35 U.S.C. § 283 (2000).

128. See *In re Seagate Technology, L.L.C.*, 497 F.3d 1360, 1368 (Fed. Cir. 2007)

provides no direct guidance at all on enhancement. Willfulness is defined by the Federal Circuit to include reckless behavior.¹²⁹ In a highly controversial opinion,¹³⁰ the Federal Circuit recently overruled its own precedent and redefined its rules for when enhanced damages based on willful infringement are appropriate. It made clear that there is no affirmative duty on the part of an exploiting firm to search for a patent, nor any duty to search for advice from counsel on the validity of a patent that is uncovered if a search is done.¹³¹ Like the landmark decision in *eBay*, the *Seagate* opinion is consistent with the model, in that it does not automatically multiply a damage award simply for a failure to search.¹³² Sometimes searching is wasteful, and it would be senseless to enhance damages in those situations. Like its renegade sister *eBay*, *In re Seagate Technology, L.L.C.* is movement in the right direction.

The Federal Circuit, however, could provide further guidance as to what constitutes a legitimate basis for enhancing damages. Its express focus in the willfulness inquiry is on the infringer's intent, while ignoring the chance that the infringement will go undetected. Just as Judge Posner's decision in *Accor Management* brings likelihood of detection to the fore in the reckless tort context,¹³³ the Federal Circuit could issue a clarifying opinion in the patent realm. In addition, the statute itself is not perfectly suited to enhancing damages based on the likelihood that infringement will be detected. It does not permit an accounting¹³⁴ and caps the willfulness multiplier at 3x.¹³⁵ This is undoubtedly sufficient in cases involving the infringement of products sold on the open market where the likelihood that the infringer will be caught are quite low, but a 3x multiplier in

("Absent a statutory guide, we have held that an award of enhanced damages requires a showing of willful infringement.").

129. *Id.* at 1370 ("Although the statute does not define willful, it has consistently been defined as including reckless behavior.").

130. Although the opinion in *In re Seagate* is barely a year old, as of May 15, 2008, Westlaw lists ten publications in its journal and law review database (JLR) written about it that contain "Seagate" in the title.

131. *Id.* at 1371 ("[W]e abandon the affirmative duty of due care [and] reemphasize that there is no affirmative obligation to obtain opinion of counsel.").

132. *Id.* (requiring a clear and convincing standard for willful infringement).

133. *Mathias v. Accor Econ. Lodging, Inc.*, 347 F.3d 672, 677 (7th Cir. 2003) (Posner, J.) (noting that awarding punitive damages prevents the tortfeasor from profiting from a failure to detect the tort).

134. *See Water Techs. Corp. v. Calco, Ltd.*, 850 F.2d 660, 673 (Fed. Cir. 1988) ("[U]nlike copyright and trademark infringements, patent infringement carries no remedy of an accounting for an infringer's profits.").

135. 35 U.S.C. § 284 (2000).

hard-to-detect cases of process patent infringement may provide insufficient deterrence.

The model sheds light on at least two other remedial controversies. First, it suggests the infringer's profits should sometimes be part of a remedy for patent infringement (as it is for trademark and copyright infringement), supporting arguments that it should be reinstated.¹³⁶ This is important when "literature has yet to model bargaining with richness sufficient to characterize the potential gains to efficient licensing of a second, spatially differentiated firm, which are key to the relative performance of damage regimes."¹³⁷ Finally, the model helps to mediate the debate between Elhauge and Lemley/Shapiro over the relevance of the possibility of post-adjudication patent "hold ups" by victorious patentees.¹³⁸ Elhauge challenges Lemley's methodology and doubts his claims of "systematic overcompensation."¹³⁹ In this model, patent hold ups are primarily relevant when infringement is negligent, self-invention is cost-effective, and switching costs are high.¹⁴⁰ If this describes a significant percentage of cases (and it well might), then Lemley may have made a better prediction as an empirical matter.¹⁴¹ Nonetheless, Lemley's baseline royalty calculation has been criticized,¹⁴² and neither he nor Elhauge offers a comprehensive model for patent remedies. They have dived deep into the heart of an important matter and accurately describe some of the

136. See Mohamed Yusuf M. Mohamed, *Unjust Enrichment for Patent Infringement: A Novel Idea?*, 4 J. INTELL. PROP. L. 123, 159 (1996) (advocating a return to restitutionary damages). An amendment to the Patent Act eliminated the remedy in 1946. See Dane S. Ciolino, *Reconsidering Restitution in Copyright*, 48 EMORY L.J. 1, 55 (1999) ("From at least 1819 through 1946, a prevailing patentee could obtain an accounting of a patent infringer's profits.").

137. Henry & Turner, *supra* note 38, at 2.

138. Compare Elhauge, *supra* note 57, at 36–37 (noting that Lemley & Shapiro's model comes to incorrect conclusions about overcompensation due to royalty stacking), with Lemley & Shapiro, *supra* note 71, at 2044–45 (concluding that a reasonable-royalty calculation awards plaintiffs excessive damages that impede innovation).

139. Elhauge, *supra* note 57, at 9; see also Golden, *supra* note 44, at 2115 ("[I]t is difficult to see how Lemley and Shapiro's claim to have theoretically proven systematic overcompensation can succeed.").

140. See *supra* Part III.B (explaining the role of an injunction as motivator for efficient searching).

141. See *supra* notes 64–67 and accompanying text.

142. See Golden, *supra* note 44, at 2161 (describing the lack of measure of excessive rewards and real world litigation considerations); J. Gregory Sidak, *Holdup, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro*, 92 MINN. L. REV. 714, 731–32 (2008) (stating that Lemley's calculation only considers "factors that may tend to inflate royalties"); Elhauge, *supra* note 57 at 36–37 (noting several real world situations where the Lemley calculation is incorrect).

problem's critical contours. This model seeks to provide the full picture.

To conclude, one thrust of current patent reform efforts focuses on remedies, with the most frequent object of discussion being the "patent troll," the nonexploiting owner of a patent whose business model is based on extracting licensing fees from unintentional infringers. To the extent that the model described here provides significant protection for negligent self-inventors who engage in reasonable searching practices, the issue of the patent troll is dealt with indirectly but effectively. Thinking more clearly about remedial patent issues, however, is only one part of patent reform. Unless the notice function of the patent system is improved, patent litigation will consume resources that could be spent on research and development. For example, the troll problem, possibly exacerbated by post-injunction patent holdups, would be less acute if it was cheap and easy to discover patent property rights and their owners, and those rights were more predictably enforceable. A critical variable in every equation presented here is S , the cost of searching for a patented invention. As S grows smaller, the patent system becomes more efficient, and patent remedies become more powerful tools for patent owners.

PATENT REMEDIES

Variables:

- VI = gross *value* of the *invention* to the exploiting firm in terms of additional profits earned from additional sales or manufacturing costs saved
- S = cost of *searching* for the invention and negotiating a license
- SI = cost to the exploiting firm of *self-inventing*
- VS = *value* to the exploiting firm of the known best *substitute* for the invention
- C = pro rata *cost** to the inventing firm of producing the invention for the infringer
- Ng = the exploiting firm's *net gain*, equaling $VI - \min\{S, SI\} - VS$
- L = *license fee*
- Sw = the infringer's cost of *switching* to a noninfringing technology
- θ = the probability that the patent is valid and infringed
- ρ = the probability that the infringement will go undetected

Assuming a transaction is efficient when: $VI - \min\{S, SI\} - VS > C$, then it follows for:

1. Intentional Infringement/Efficient Transaction
 - Piracy/Counterfeiting: $\max\{L, \rho Ng\} + \text{injunction (+ punitives if } Sw < 0)$
 - Doubtful Patent/Uncertain Infringement $\max\{L, \rho Ng\} + \theta Sw$
2. Independent Invention/Efficient Transaction
 - Searching Inefficient: $L - SI$
 - Searching Efficient: $\max\{L, (SI - S)\} + \text{injunction if no reasonable search}$
3. Intentional Infringement/Inefficient Transaction
 - L (often 0) + Injunction (often worthless)
4. Independent Invention/Inefficient Transaction
 - Nominal damages + Injunction when $S < VS + (SI - VI)$

*. Where there is more than one source of licensing revenue from the invention, then each user should be allocated its pro rata portion of the overall cost of invention.