University of Chicago Law School
Chicago Unbound

Public Law and Legal Theory Working Papers | Working Papers

2008

Optimal Remedies for Patent Infringement: A Transactional Model

Paul J. Heald

Follow this and additional works at: https://chicagounbound.uchicago.edu/public_law_and_legal_theory

Part of the Law Commons

Chicago Unbound includes both works in progress and final versions of articles. Please be aware that a more recent version of this article may be available on Chicago Unbound, SSRN or elsewhere.

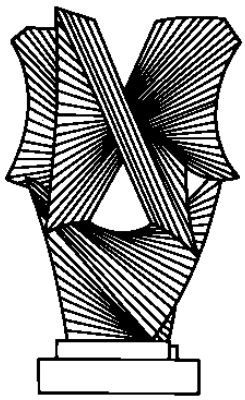
Recommended Citation

Paul J. Heald, "Optimal Remedies for Patent Infringement: A Transactional Model" (University of Chicago Public Law & Legal Theory Working Paper No. 236, 2008).

This Working Paper is brought to you for free and open access by the Working Papers at Chicago Unbound. It has been accepted for inclusion in Public Law and Legal Theory Working Papers by an authorized administrator of Chicago Unbound. For more information, please contact unbound@law.uchicago.edu.

CHICAGO

JOHN M. OLIN LAW & ECONOMICS WORKING PAPER NO. 431
(2D SERIES)
PUBLIC LAW AND LEGAL THEORY WORKING PAPER NO. 236



OPTIMAL REMEDIES FOR PATENT INFRINGEMENT: A TRANSACTIONAL MODEL

Paul J. Heald

THE LAW SCHOOL
THE UNIVERSITY OF CHICAGO

September 2008

This paper can be downloaded without charge at the John M. Olin Program in Law and Economics Working Paper Series: http://www.law.uchicago.edu/Lawecon/index.html and at the Public Law and Legal Theory Working Paper Series: http://www.law.uchicago.edu/academics/publiclaw/index.html and The Social Science Research Network Electronic Paper Collection
.

OPTIMAL REMEDIES FOR PATENT INFRINGEMENT: A TRANSACTIONAL MODEL

Paul J. Heald*

Abstract

In a world of zero transaction costs, one should observe optimal invention and innovation. As long as a system of enforceable contracts were in place, firms with inventive capacity and firms requiring inventions would negotiate for the optimal production of new creations. With adequate information, an observer could accurately predict which transactions would occur between firms and which transactions would not, thereby permitting description of the conditions for optimal inventiveness. Patent remedies in a world with transactions costs can be calibrated so that real firms behave as ideal firms, providing incentives for real world transactions to mimic those in a world without transactions costs. The goal of remedies for patent infringement should therefore be to provide incentives for efficient transactions to occur, while minimizing the cost of transacting. This approach sets the framework for a comprehensive revision of current patent remedies and resolves current debates over the relevance of an infringer's knowledge, independent invention, and the proper scope of injunctive relief.

I.

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:

---

*Allen Post Professor of Law, University of Georgia; Visiting Professor of Law, University of Chicago; Visiting Professor of Law, Bournemouth University. My thanks to the Houston Law Review Santa Fe Conference, and Bobby Bartlett, Jim Bessen, Tom Cotter, Rusty Denton, Becky Eisenberg, Einer Elhauge, John Golden, Mark Lemley, Mike Meurer, Arti Rai, Usha Rodrigues, Jason Solomon, Christian Turner, John Turner, Sam Vermont, Greg Vetter, and Elizabeth Winston for providing very helpful comments.

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]

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. 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, 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 R&D department to invent an improvement for GM cars (at least in the case where the improvement only works in GM cars).

---

[1] *See* Paul J. Heald, *Transaction Costs and Patent Reform*, 23 SANTA CLARA COMP. & HIGH TECH. L. J. 447, 448-452 (2007) (illustrating the point at length 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 hold-out or collective action problems in a world without transaction costs or property rights.

Ronald Coase, whose famous thought experiment[3] about liability rules inspires this essay, realized that the cost of transacting in the real world is usually much higher than in the GM hypothetical.[4] 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:

Discovery Costs ("the cost to discover who it is that one wishes to deal with [and] to inform people that one wishes to deal");[5]

Negotiation Costs ("[the cost to supply] terms, to conduct negotiations leading up to a bargain, [and] to draw up the contract");[6]

Monitoring Costs ("[the cost] to undertake the inspection needed to make sure that the terms of the contract are being observed and so on").[7]

All of these costs are significant in the context of contracting for inventions. It is difficult to identify inventors and inventions;[8] pricing difficulties and lack of public information make licensing and sales agreements difficult to negotiate;[9] and monitoring costs are significant, especially when the invention is still secret.[10]

---

[3] *See* Ronald Coase, *The Problem of Social Cost*, in THE FIRM, THE MARKET AND THE LAW 95-156 (1988) (showing that in two-party nuisance scenarios the parties will contract for the efficient result regardless of the legal liability rule).

[4] *See id*. at 114 (a world without transaction costs "is, of course, a very unrealistic proposition); *id*. at 117 (using airborne pollution as an example of a situation where the cost of transacting between the polluter and those effected would be very high)

[5] *Id* at 114.

[6] *Id*.

[7] *Id*.

[8] *See* James Bessen & Michael 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 clearance"); *id*. at 46 ("[innovators] find it increasingly costly to find and negotiate the necessary patent licenses"); Mark Lemley, *Ignoring Patents*, 2008 MICH. ST. L. REV. 19 (2008) (arguing that difficulties in identification have resulted in a non-searching culture).

[9] *See* F. Russell 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-

The primary means suggested by the framers of the Constitution[11] and chosen by Congress[12] 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."[13] 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.[14] The patent office web site, in theory, functions as a comprehensive bulletin board where both inventors and those seeking inventions can meet.[15] To the extent that the inventive firm or innovative firm requires capital, published patents also lower the cost of obtaining financing.[16]

Negotiation Costs: Congress requires that patentees make specific public claims about the metes and bounds of their property right.[17] Despite significant problems with the clarity of

---

Scholes equation to solve persistent problems in patent pricing); Mark Lemley, *How to Make a Patent Market*, STANFORD LAW AND ECONOMICS WORKING PAPER NO. 347 (2007) (noting that "willing licensors and licensees can't find each other" and arguing for a requirement that patent license terms be published).

[10] *See* Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. *L*. J. 473, 487-89 (2005) (noting extent of measures necessary to protect and exploit a secret invention).

[11] *See* U.*S*. Const., Art. I, § 8 ("Congress shall have the power . . . to 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")

[12] *See* 35 U.*S*.C. §101 et seq.

[13] William M. Landes & Richard Posner, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW 12-13 (2003).

[14] *See* 35 U.*S*.C. § 112 ("[t]he 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").

[15] 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 and Meurer, *supra* note 8, at 8-11.

[16] *See* Clarissa Long, Patent Signals, 69 U. CHI. L. REV. 625, 627 (2002) (patents lower the cost of communicating the strength of a firm's human capital to outside sources of financing).

[17] *See* 35 U.*S*.C. § 112 ("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 8 , at 235-53 (arguing the notice function of patent law is badly in need of reform).

written claims, published patents help transacting firms overcome Arrow's Information Paradox[18] and facilitates negotiations between parties.[19]

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.[20] 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 it to the firm.[21]

The alternative common law model, trade secrecy, suffers from much higher costs in all three areas. It's much more difficult to discover a trade secret than a patented invention. And as Arrow pointed out, it's much more costly to negotiate over a trade secret.[22] Moreover, trade secrets are "leaky." Once they are made public, they are free for all to use, which greatly raises monitoring costs at all levels of production and transfer.[23]

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

[18] *See* KENNETH J. ARROW, ECONOMIC WELFARE AND THE ALLOCATION OF RESOURCES FOR INVENTION, IN THE RATE AND DIRECTION OF INVENTIVE ACTIVITY 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) (A[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.").
[19] *See* Heald, *supra* note 10, at 487-91 (summarizing the literature).
[20] *I*d. at 487-99.
[21] *Id*. at 480-84.
[22] *See supra* note 18.
[23] *See* Heald, supra note 10, at 487-88.

rights can sometimes create transaction costs.[24] Congress is therefore sensitive to the shape of patent law in order to reduce the cost of the artificially created right.[25] 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.[26]

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. 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 the patent system.[27] As they note

[24] *See* Richard A. Posner , ECONOMIC ANALYSIS OF LAW 35 (4th ed. 1992) ("the costs of effecting a transfer of right—transaction costs—are often prohibitive, and when this is so, giving someone the exclusive right to a resource may reduce rather than increase efficiency").
[25] *Id*. at 36 (3d ed.) (giving four cost reducing examples 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).
[26] *See* 35 U.*S*.C. § 102.
[27] *See* Bessen & Meurer, *supra* note 8.

pithily: "If you can't tell the boundaries, it ain't property."[28] 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.[29] 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 producing a "gold-plated patent" entitled to greater deference by courts.[30] Others, like Jeanne Fromer, argue more generally for "invigorating the disclosure function of the patent system."[31] 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 defining 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.

---

[28] *Id.* at 8.
[29] *Id*. at 235-53.
[30] *See* Mark Lemley, Douglas Lichtman, & Bhaven Sampat, *What to do About Bad Patents?,* 28 REGULATION 12-13 (2005).
[31] Jeanne C. Fromer, *Invigorating the Disclosure Function of the Patent System*, NYU Public Law & Legal Theory Research Paper Series, Working Paper No. 07-05 (2007).

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. If the penalty for negligent driving were capital punishment, people would make too high an investment in taking care or cease driving altogether. Productive activity would be deterred. In patent law, a regime of strict liability rules where the penalty for patent infringement was the 50 years in prison would have the same effect. Draconian penalties would most likely stimulate excessive searching for rightsholders by potential users and would induce users to enter into unnecessary precautionary licenses or not innovate at all.[32] If patent damages were set too high, excessive transaction costs would be incurred and innovation would be stunted. On the other hand, if damages are set too low, inventions will 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.

Most remedial models of patent infringement focus directly on maintaining incentives to invent,[33] 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 research and

[32] Stewart Sterk has made this point forcefully. *See* Stewart 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 cost of the search.").

[33] *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 an invention."); Matthew D. Henry & John L. Turner, *Patent Damages and Spatial Competition*, available at http://www.terry.uga.edu/~jlturner/Patent Damages SpatialJuly07.pdf 6 (2007) (the ideal remedies regime "provides the best R&D incentives"); 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 (1999) ("the nature of patents should be to offer sufficient rewards to stimulate innovation").

development,[34] which suggests that remedies for patent infringement should be calibrated to optimize the amount of research and development firms invest in. There are two problems with this starting point. First, outside the pharmaceutical context, research economists have serious doubts about the tightness of the causal connection between patent law and R&D expenditures.[35] 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 *a priori* how to calculate the optimal amount of R&D a firm should conduct.[36] 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.[37]

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 the inventor. Blair and Cotter,

---

[34] *See* sources cited Heald, *supra* note 10, at 473 n.1 & 2. *See, e.g*., Bronwyn Hall & Rosemary Ziedonis, The Patent Paradox Revisited: *An Empirical Study of Patenting in the U.S. Semiconductor Industry* 1979-1995, 32 RAND J. ECON. 101, 105 ("[T] patent system aims to encourage inventors to direct more of their resources toward R&D than would otherwise be the case.").

[35] *See* Bessen and Meurer, *supra* note 8, at 216 ("Our empirical analysis indicates that the patent system provides little innovation incentive to most public firms; these are the firms that provide the lion's share of R&D."); Heald, *supra* note 10, at 499-503 (summarizing empirical research that is skeptical of the effect of patent law on R&D expenditures); Hall & Ziedonis, *supra* note 33, at ("[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.").

[36] Siebrasse makes a similar argument about copyright law, stating: "While there is indeed a level of copyright protections that strikes the optimal balance between incentives to create and restrictions on dissemination . . . determining the optimal level of protection requires far too much information than is available to courts or, for the most part, to the legislature."). *See* Norman Siebrasse, *A Property Rights Theory of the Limits of Copyright*, 51 U. TORONTO L. J. 3 (2001).

[37] The incentive theory of patent law assumes that capital flows to develop patented inventions are going to their most highly valued uses. *See* Heald, *Transaction Costs and Patent Reform*, *supra* note 1, at 450-51 & n.7. The hope of obtaining a patent, for example, may stimulate the flow of $10 million dollars 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 non-patent 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* Richard A. Posner, ECONOMIC ANALYSIS OF LAW 37 (3d ed. 1986) (noting that "the costs of the patent system include . . . inducing excessive investment in inventing").

among others, suggest this as the baseline damage award in their model.[38] 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. 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.

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.[39] As noted above, patents help solve the problem of negotiating over secret information.[40] Clear property rights increase trust when parties bargain over inventions.[41] As studies conducted on the effect of the Bayh-Dole Act[42] suggest, when patents become available, technology transfer is stimulated.[43] Second, as noted above, Coasean analysis suggests that in a world without transaction costs, one would observe the optimal level of inventive activity. 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

[38] *See*, *supra*, note 33, at 42-44.
[39] *See* Heald, *Transaction Costs Theory*, *supra* note 10, at 489-91 (collecting empirical sources).
[40] *See* Ashish Arora, et al, MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY (2002) ("[D]rafting an enforceable contract is virtually impossible without some additional means to ensure compliance. That is where patents come in.").
[41] *See* Ashish Arora & Robert Merges, *Property Rights, Firm Boundaries, and R&D Inputs* 1 (2001) at http://papers.ssrn.com/sol13/papers.cfm?abstract_id=255869 ("[patents] reduce the risk of buyer opportunism.").
[42] 35 U.S.C. § 200-212 (2000).
[43] *See* Rebecca Henderson, et al, *Universities as a Source of Commercial Technology: A Detailed Analysis of University Patenting*, 1965-1988, 80 REV. ECON. & STAT. 119 (1998) ("the increase in university patenting [after Bayh-Dole] probably reflects an increased rate of technology 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 (2001) (discussing the effect of congressional authorization of Cooperative Research and Development Agreements on national laboratories).

optimal R&D expenditures. 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 paper 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 than to negotiate licenses. Since 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, engage in patent office practices that hide inventions, or otherwise lay 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 is similarly sensitive. In theory, negligence law incentivizes the optimal number of accidents; yet, justifying optimal damage rules for negligence does not require an ex ante calculation of how many accidents should occur.[44] The due care standard plus the compensatory damages rule provide adequate incentives for behavior without the need to predict or even model the optimal amount of accidents.[45] The path taken is indirect in that the goal of efficiently deterring accidents is achieved without assuming their optimal number. 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

[44] *See* William M. Landes & Richard A. Posner, THE ECONOMIC STRUCTURE OF TORT LAW 85-122 (1987)
[45] *Id*.

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 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 lawn mowers 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 lawnmowers. Assuming that the widget improves the lawnmowers, and therefore society is marginally better off if Firm C uses the widget, 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.[46] 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.

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

[46] 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.

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 (hereafter "inventing firm") and a party needing an invention (hereafter "exploiting firm") when:

VI – min{S, SI} - VS > C

where:

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 = *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.[47] 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 $VI - min\{S, SI\} - VS < C$. Since 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 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.[48] In other words, the model assumes a property right is available to the inventive firm.

[47] *See* Einer Elhauge, *Correcting Current Models of Patent Holdup and Royalty Stacking*, Discussion Paper No. 614 6-7, HARVARD JOHN M. OLIN DISCUSSION PAPER SERIES 7 (2008).

[48] 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

As noted above, making a property right available to inventive firms reduces public costs in various important ways.[49] Although the patent right may raise costs in some individual cases, the overall savings of 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.[50] Of course, the patent law presently establishes a property rule, imposing strict liability for the unauthorized appropriation of patented inventions.[51]

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.

A) Intentional infringement/efficient transaction (where $VI - min\{S, SI\} - VS - C > 0$);

B) Infringement by self-invention/efficient transaction;

C) Intentional infringement/inefficient transaction (where $VI - min\{S, SI\} - VS - C < 0$);

and

D) Infringement by self-invention/inefficient transaction.

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

---

office, as opposed to rewarding the first to actually invent. Rewarding the first to make a public disclosure and thereby reduce search costs has a significant appeal. For the purposes of this paper, 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.

[49] *See supra* notes 14 -21 and accompanying text.

[50] *See* Paul J. Heald & James C. 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).

[51] *See* 154 U.*S*.C. § 154(a)(1).

the efficient result, and it would be unnecessary to establish a regime of liability rules. But as Coase himself noted, once transaction costs are accounted for, the choice of rules may affect public welfare.[52] 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.[53] 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.[54] They found that only 31.1% of cases involved an allegation that the defendant knew about the patent before the lawsuit was filed.[55] Moreover, only 10.9% alleged that the infringer copied the patent owner's invention,[56] and copying was only established in 1.7% of the cases in their sample.[57] 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

[52] *See* Coase, *supra* note 3, at 114 ("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.").
[53] *See* Heald & Smith, *supra* note 50, at 97-98.
[54] *See* Christopher Cotropia & Mark Lemley, *Copying in Patent Law* (copy of paper on file with the author).
[55] *Id*. at 23.
[56] *Id*. at 24.
[57] *Id*. at 32 (studying 200 patent infringement complaints filed in Delaware and Texas from 2000 to 2007).

infringement is analytically easier to address once the 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 $VI - min\{S, SI\} - VS > L > C_{trans.}$ Simply put, depending on the relative bargaining power of the parties,[58] they will each share a portion of the net return, $VI - min\{S, SI\} - VS - C$.[59]

The model makes four assumptions about L. First, L may 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

[58] *See* Blair & Cotter, *supra* note 33, at 47; Denton & Heald, *supra* note 9, at 1219-24.

[59] Elhauge suggests this is only 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. *See* Elhauge, *supra* note 47 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.

million. (The vast range in values for L provides a nice example of why we want to 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}.

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.[60] 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.[61] Detailing the available calculation options is beyond the scope of this paper, but my prior co-authored model that treats patents like real options and utilizes a novel version of the Black-Scholes equation avoid both the difficulties just mentioned.[62] With these assumptions in mind, optimal remedies can be described for infringements where a transaction is efficient.

---

[60] Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEXAS L. REV. 1991 (2007).

[61] *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.").

[62] *See* F. Russell Denton & Paul J. Heald, *Random Walks, Non-Cooperative Games, and the Complex Mathematics of Patent Pricing*, 55 RUTGERS L. REV. 1175-1288 (2003). *See also* F. Russell Denton, *Rolling Equilibriums at the Pre-Commons Frontier: Equipping* Georgia-Pacific *to Disperse Patent Log*

In the case of intentional infringement where the transaction is efficient, the exploiting firm has knowingly appropriated an existing patented invention yet 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,[63] this would be classified as an intentional tort, a deliberate invasion of another's property interest.[64] Under general tort principles, where firms are competitive, lost profits and other consequential damages[65] would be awarded against an intentional tortfeasor. 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.[66] So, the presumptive award should be at least *L*, the license fee that

---

Jams Efficiently (draft manuscript on file with author) (refining the Denton Variation of the Black-Scholes equation to address the problem of splintered licensing).

[63] There was never a right at English common law to exclude someone from an invention.

[64] *See* William M. Landes & Richard A. Posner, *An Economic Theory of Intentional Torts*, 1 INT'L REV. OF LAW & 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 his identity [or] avoid being sued." *Id*. at 135. Second, by infringing they avoid using the market to price the transaction. *Id*. ("Society is better off if the market is used because the costs of the market are lower than the costs of a coercive transaction.").

[65] In contract law, consequential damages are limited to those that are foreseeable. In tort, there is no foreseeability bar, although causation rules provide a significant break. Consistent with this model, a court might consider foreseeability from the perspective of the patent owner, because only losses it can foresee would affect the price of the license. But that's a contract, not a tort, approach.

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

would have been negotiated between the parties.[67] 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. 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 likelihood that the infringement would go undetected.[68] If, for 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's 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

[67] *See* Denton & Heald, *supra* note 63, at 1226-34 (using the Denton variation of the Black-Scholes equation to price an invention involving plywood veneer).

[68] Mathias v. Accor Economy 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* Landes & Posner, *supra* note 64, at 135 (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."); Blair & Cotter, *supra* note 33, at 46.

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.[69] 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.[70] 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 the compensation enforced by the legal system."[71] Therefore, even if properly augmented by the likelihood on 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 under 35 U.S.C. § 283,[72] will often impose significant additional costs on an infringer.[73] To see how injunctive relief can provide additional deterrence, one must consider the infringer's cost of switching to an alternative 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. Let's denominate the infringer's cost of switching (*Sw*) to alternative technology as $Sw = P + (VI_2 - VS_2)$, where *P* constitutes the cost of physically adopting to the substitute technology. *Sw* equals *P* plus the

[69] *See* Bessen & Meurer, *supra* note 8, at 9, 130-45.
[70] *Cf.* In re Excello Press, Inc., 890 F.2d 896 (7th Cir. 1989) ("The product of a commercially reasonable sale is the fair market value.").
[71] Landes & Posner, *supra* note 64, at 135.
[72] *See* 35 U.S.C. § 283 ("[t]he several courts having jurisdiction under this title may grant injunctions in accordance with the principles of equity").
[73] 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 NW.2d 268, 271 (Neb. 2008) ("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.")

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.[74] This 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.[75] Lemley uses the term "hold up costs" to describe this premium.[76] 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.[77]

Where switching costs are high, an injunction, combined with a damage award, will assure 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.

---

[74] *See* Lemley & Shapiro, *supra* note 60 ("[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.").

[75] *See* http://money.cnn.com/2006/03/03/technology/rimm_ntp/ ($612.5 million settlement in Blackberry infringement case, where damages and prior negotiated licenses were significantly smaller).

[76] He says such costs are systematic. Elhauge disagrees. *See* Elhauge, *supra* note 47, at 10 ("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.").

[77] Imagine an infringing firm that expended $1000 to adopt a new process that reduced its operating costs by $1300. 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 selling a multi-component product subject to numerous claims of infringement. *See supra* note 61, 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.

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.[78] 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 negotiating. 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."[79]

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: Is the inventive firm's patent valid? Is my choice of alternative technology infringing?[80] Lemley and Shapiro argue vociferously that the fuzziness of patent boundaries should be taken into account when crafting remedies for patent infringement.[81] They suggest dividing the patentee's entire monetary award by the ex ante probability that the patent would have been unenforceable against exploiting firm.[82] Lemley and Shapiro's approach might result in some cases of undercompensation, unless C_{trans} is established as the minimum monetary

[78] Under U.S. patent law, a judge may award treble damages for willful infringement. *See* 35 U.S.C. § 284.
[79] *See* Landes & Posner, *supra* note 64, at 136.
[80] *See* Bessen & Meurer, *supra* note 8, at 8-9, 17-19.
[81] *See* Lemley & Shapiro, *supra* note 60, at 1996-97.
[82] *Id.* at 1999.

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 be discounted for the possibility that the patent in valid. Awards enhanced beyond L in order to deter intentional infringement, like multipliers based on the likelihood of non-detection, should take into account the predicted ex ante enforceability of the patent right.

If a rational exploiting firm would conclude ex ante that the strength[83] of the patent is 50%, 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."[84] 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."[85] Since 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 non-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 x 4) x .5]. Therefore, L, plus any non-detection penalty, should equal $3 million, not $6 million.

[83] In other words, that 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.
[84] Landes & Posner, *supra* note 64, at 130.
[85] *Id*. at 138.

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 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. 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 .5*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 invention 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.[86] 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, so awarding the infringer's profits, an injunction, or other enhanced damages should require special justification. Two sub-cases exist: a) where searching and negotiating would have been more

[86] *See supra* notes 54-57 and accompanying text.

costly than self-inventing ($S > SI$); and b) where searching and negotiating would have been less costly than self-inventing ($S < SI$).[87]

1. $S > SI$. First, where the cost of searching and negotiating is more costly than self-inventing, the infringing firm 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 the parties 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,[88] 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 unintentional infringement.[89] 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.[90] This suggests that L is an appropriate starting point consistent with

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

[88] 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.

[89] *See* Samson Vermont, *Independent Invention as a Defense to Patent Infringement*, 105 MICH. L. REV. 475 (2006); *cf*. Carl Shapiro, *Prior User Rights*, 96 AM. ECON. REV. 92 (2006).

[90] 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)

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.[91] The minimum 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 incentive to self-invent. Without self-invention by the infringer, the patentee earns no royalty.

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. 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.[92]

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

---

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.

[91] Assume the infringer's cost of self-inventing a widget that saves it $1.2 million in production costs is $800,000, 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 infringer may be deterred from self-invention. Its net gain from self-invention is only $200,000 ($1.2 million – 1 million). Fear of an award greater than that amount might result in no self-invention.

[92] *See* Bessen & Meurer, *supra* note 8, at 62-63 & 220-221.

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."[93]

2. *S* < *SI*. When searching and negotiating is less costly that 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, than 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.

[93] Gerard Magliocca, *Blackberries and Barnyards: Patent Trolls and the Perils of Innovation*, 82 NOTRE DAME L. REV. 1809, 1809 ("'patent troll' … is a derogatory term for firms that use their patents to extract settlements rather than license or manufacture technology.").

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,*[94] 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. 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.[95] Bessen and Meurer concur.[96] 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 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 non-competition 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 search[97] 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

[94] 347 F.3d 672, 677 (7th Cir. 2003) (Posner, J.) (punitive damages amounting to 37 times compensatory damages not excessive in case of untreated bed bug infestation).
[95] *See* Lemley, *supra* note 8.
[96] *See* Bessen & Meurer, *supra* note 8.
[97] What constitutes a reasonable search might be assessed by looking at the searching practices of firms.

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 "hold up" 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 to it at all), it 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 $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 from an ex ante perspective, the deal is inefficient, from an ex post perspective it is 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 non-detection 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 non-infringing 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 Section 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 most such transactions should be self-deterring, granting a 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 the 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 $VS + (SI - VI)$.[98] 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.

The need for rethinking of remedies for patent infringement is pressing in a world where "patent-granting countries have yet to identify a regime that maximizes welfare and is

[98] Strictly speaking, VS here is the cost of switching to the best alternative substitute.

universally applicable."[99] 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 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.[100] 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.[101] So, calculating the necessary variables 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

[99] *See* Henry & Turner, *supra* note 33, at 2.
[100] *See* Georgia-Pacific Corp. v. United States Plywood Corp., 318 F. Supp. 1116 (S.D.N.Y. 1970) (setting forth 15-factor test to estimate result of ex ante hypothetical reasonable royalty negotiation between infringer and patentee).
[101] *See* Denton & Heald, *supra* note 9, at 1226-34 (2003) (providing an example of how to price a license involving a plywood veneer product).

the determination whether injunctive relief is appropriate.[102] The present law on injunctive is ambiguous and provides no express role for any of these factors. Third, a qualified defense of independent invention is justified for the first time as part of a comprehensive model of patent remedies.[103]

C. Descriptive Conclusions

As a descriptive matter, the model has significant explanatory power, especially in a time of controversial patent reform proposals.[104] 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 amount found or assessed."[105] In addition, it "may grant injunctions in accordance with the principles of equity . . . on such terms as the court deems reasonable."[106] 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.[107] In a very

[102] *See* Mark Lemley, *Should Patent Infringement Require Proof of Copying*, 105 MICH. L. REV. 1525, 1535 (2007) (suggesting that independent invention should be relevant to when injunctive relief is appropriate).

[103]Several scholars have argued that patent law should provide a defense in certain cases of independent invention. *See, e.g.,* Samson Vermont, *Independent Invention as a Defense to Patent Infringement*, 105 MICH. L. REV. 475 (2006). 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 non-competing; 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.

[104] *See* Advertisement by Professional Inventors Alliance, *N.Y. Times*, A-10 & A-11(April 7, 2008) (two page advertisement railing against current reform proposals in Congress).

[105] *See* 35 U.*S*.C. § 284.

[106] *See* 35 U.*S*.C. § 283.

[107] *See* eBay, Inc. v. Mercexchange, *L.L*.C., 547 U.*S.* 384, 394-95 (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'."

controversial decision,[108] the Court recently reversed this trend and articulated a four-part test for granting injunctive relief.[109] Courts must now employ principles of equity in determining whether injunctive relief is appropriate.[110] The remedial model described here provides substantial support for the Court's decision to abandon the prior *per se* rule. 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.[111]

The statutory language concerning enhanced damages is similarly open-ended. Although courts have traditionally only multiplied damages in cases of willful infringement,[112] the statute provides no direct guidance at all on enhancement. Wilfulness is defined by the Federal Circuit to include reckless behavior.[113] In recent highly controversial opinion,[114] the Federal Circuit recently overruled its own precedent and redefined its rules for when enhanced damages based

---

[108] Since the Court 2006 ruling, as of May 15, 2008, Westlaw lists at least 47 articles on the case having "eBay" in the their title, taking a wide variety of positions on the propriety of the decision.

[109] *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.").

[110] *Id*. at 394

[111] 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 hold-ups might be considered under the public interest rubric). 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.

[112] *See* In re Seagate Technology, *L.L.*C., 497 F.3d 1360, 1368 (Fed. Cir. 2007) ("Absent a statutory guide, we have held that an award of enhanced damages requires a showing of willful infringement.").

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

[114] Although the opinion in *In re Seagate Technology, L.L.C*., 497 F.3d 1360 (Fed. Cir. 2007), is barely a year old, as of May 15, 2008, Westlaw lists 14 publications written about it that contain "Seagate" in the title).

on willful infringement are appropriate. It made it 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.[115] 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. Sometimes searching is wasteful, and it would be senseless to enhance damages in those situations. Like its renegade sister *ebay*, *Seagate* 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, 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 accounting[116] and caps the wilfullness multiplier at 3x. 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 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

[115] *Id*. at 1371 ("we abandon the affirmative duty of due care [and] reemphasize that there is no affirmative obligation to obtain opinion of counsel").
[116] *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.")

trademark and copyright infringement) supporting arguments that it should be reinstated.[117] This is important when "economic research has yet to . . . offer any efficiency argument for the abandonment of unjust enrichment, the most commonly used regime into the 1960s."[118] 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.[119] Elhauge challenges Lemley's methodology and doubts his claims of "systematic overcompensation."[120] In this model, patent hold ups are primarily relevant when infringement is negligent, self-invention is cost-effective, and switching costs are high. If this describes a significant percentage of cases (and it well might) then Lemley may have made a better prediction as an empirical matter.[121] Nonetheless, Lemley's baseline royalty calculation has been criticized,[122] 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 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 non-exploiting 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

---

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

[118] *See* Henry & Turner, *supra* note 33, at 2.

[119] *Compare* Elhauge, *supra* note 47, and Lemley & Shapiro, *supra* note 60.

[120] *See also* John Golden, *Commentary: "Patent Trolls and Patent Remedies*," 85 TEXAS L. REV. 2111 (2007) ("it is difficult to see how Lemley and Shapiro's claim to have theoretically proven systematic overcompensation can succeed.").

[121] *See supra* notes 53-56 and accompanying text.

[122] *See* Elhauge, *supra* note 47; Golden, *supra* note 120, and Gregory Sidak, *Hold Up, Royalty Stacking, and the Presumption of Injunctive Relief for Patent Infringement: A Reply to Lemley and Shapiro*, available at http://ssrn.com/abstract=988694.

who engage in a 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 hold-ups, would be less acute if it were 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 attractive 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 non-infringing 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: $VI - min\{S, SI\} - VS > C$, when

1. Intentional Infringement/Efficient Transaction

Piracy/Counterfeiting**: max{*L,ρNg*} + injunction (+ punitives if *Sw* < 0)**
Doubtful Patent/Uncertain Infringement **max{*L, ρNg*} + *θSw***

2. Independent Invention/Efficient transaction

Searching Inefficient: ***L - SI***
Searching Efficient: ***max{L,(SI – S)}* + 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)

Readers with comments should address them to:

Professor Paul Heald
University of Chicago Law School
1111 East 60th Street
Chicago, IL 60637
heald@uchicago.edu

Chicago Working Papers in Law and Economics
(Second Series)

For a listing of papers 1–299 please go to Working Papers at http://www.law.uchicago.edu/Lawecon/index.html

300. Adam B. Cox, The Temporal Dimension of Voting Rights (July 2006)
301. Adam B. Cox, Designing Redistricting Institutions (July 2006)
302. Cass R. Sunstein, Montreal vs. Kyoto: A Tale of Two Protocols (August 2006)
303. Kenneth W. Dam, Legal Institutions, Legal Origins, and Governance (August 2006)
304. Anup Malani and Eric A. Posner, The Case for For-Profit Charities (September 2006)
305. Douglas Lichtman, Irreparable Benefits (September 2006)
306. M. Todd Henderson, Paying CEOs in Bankruptcy: Executive Compensation when Agency Costs Are Low (September 2006)
307. Michael Abramowicz and M. Todd Henderson, Prediction Markets for Corporate Governance (September 2006)
308. Randal C. Picker, Who Should Regulate Entry into IPTV and Municipal Wireless? (September 2006)
309. Eric A. Posner and Adrian Vermeule, The Credible Executive (September 2006)
310. David Gilo and Ariel Porat, The Unconventional Uses of Transaction Costs (October 2006)
311. Randal C. Picker, Review of Hovenkamp, The Antitrust Enterprise: Principle and Execution (October 2006)
312. Dennis W. Carlton and Randal C. Picker, Antitrust and Regulation (October 2006)
313. Robert Cooter and Ariel Porat, Liability Externalities and Mandatory Choices: Should Doctors Pay Less? (November 2006)
314. Adam B. Cox and Eric A. Posner, The Second-Order Structure of Immigration Law (November 2006)
315. Lior J. Strahilevitz, Wealth without Markets? (November 2006)
316. Ariel Porat, Offsetting Risks (November 2006)
317. Bernard E. Harcourt and Jens Ludwig, Reefer Madness: Broken Windows Policing and Misdemeanor Marijuana Arrests in New York City, 1989–2000 (December 2006)
318. Bernard E. Harcourt, Embracing Chance: Post-Modern Meditations on Punishment (December 2006)
319. Cass R. Sunstein, Second-Order Perfectionism (December 2006)
320. William M. Landes and Richard A. Posner, The Economics of Presidential Pardons and Commutations (January 2007)
321. Cass R. Sunstein, Deliberating Groups versus Prediction Markets (or Hayek's Challenge to Habermas) (January 2007)
322. Cass R. Sunstein, Completely Theorized Agreements in Constitutional Law (January 2007)
323. Albert H. Choi and Eric A. Posner, A Critique of the Odious Debt Doctrine (January 2007)
324. Wayne Hsiung and Cass R. Sunstein, Climate Change and Animals (January 2007)
325. Cass. R. Sunstein, Cost-Benefit Analysis without Analyzing Costs or Benefits: Reasonable Accommodation, Balancing and Stigmatic Harms (January 2007)
326. Cass R. Sunstein, Willingness to Pay versus Welfare (January 2007)
327. David A. Weisbach, The Irreducible Complexity of Firm-Level Income Taxes: Theory and Doctrine in the Corporate Tax (January 2007)
328. Randal C. Picker, Of Pirates and Puffy Shirts: A Comments on "The Piracy Paradox: Innovation and Intellectual Property in Fashion Design" (January 2007)
329. Eric A. Posner, Climate Change and International Human Rights Litigation: A Critical Appraisal (January 2007)
330. Randal C. Picker, Pulling a Rabbi Out of His Hat: The Bankruptcy Magic of Dick Posner (February 2007)
331. Bernard E. Harcourt, Judge Richard Posner on Civil Liberties: Pragmatic (Libertarian) Authoritarian (February 2007)
332. Cass R. Sunstein, If People Would Be Outraged by Their Rulings, Should Judges Care? (February 2007)
333. Eugene Kontorovich, What Standing Is Good For (March 2007)
334. Eugene Kontorovich, Inefficient Customs in International Law (March 2007)
335. Bernard E. Harcourt, From the Asylum to the Prison: Rethinking the Incarceration Revolution. Part II: State Level Analysis (March 2007)
336. Cass R. Sunstein, Due Process Traditionalism (March 2007)

337. Adam B. Cox and Thomas J. Miles, Judging the Voting Rights Act (March 2007)
338. M. Todd Henderson, Deconstructing Duff & Phelps (March 2007)
339. Douglas G. Baird and Robert K. Rasmussen, The Prime Directive (April 2007)
340. Cass R. Sunstein, Illusory Losses (May 2007)
341. Anup Malani, Valuing Laws as Local Amenities (June 2007)
342. David A. Weisbach, What Does Happiness Research Tell Us about Taxation? (June 2007)
343. David S. Abrams and Chris Rohlfs, Optimal Bail and the Value of Freedom: Evidence from the Philadelphia Bail Experiment (June 2007)
344. Christopher R. Berry and Jacob E. Gersen, The Fiscal Consequences of Electoral Institutions (June 2007)
345. Matthew Adler and Eric A. Posner, Happiness Research and Cost-Benefit Analysis (July 2007)
346. Daniel Kahneman and Cass R. Sunstein, Indignation: Psychology, Politics, Law (July 2007)
347. Jacob E. Gersen and Eric A. Posner, Timing Rules and Legal Institutions (July 2007)
348. Eric A. Posner and Adrian Vermeule, Constitutional Showdowns (July 2007)
349. Lior Jacob Strahilevitz, Privacy versus Antidiscrimination (July 2007)
350. Bernard E. Harcourt, A Reader's Companion to *Against Prediction*: A Reply to Ariela Gross, Yoram Margalioth, and Yoav Sapir on Economic Modeling, Selective Incapacitation, Governmentality, and Race (July 2007)
351. Lior Jacob Strahilevitz, "Don't Try This at Home": Posner as Political Economist (July 2007)
352. Cass R. Sunstein, The Complex Climate Change Incentives of China and the United States (August 2007)
353. David S. Abrams and Marianne Bertrand, Do Judges Vary in Their Treatment of Race? (August 2007)
354. Eric A. Posner and Cass R. Sunstein, Climate Change Justice (August 2007)
355. David A. Weisbach, A Welfarist Approach to Disabilities (August 2007)
356. David S. Abrams, More Time, Less Crime? Estimating the Deterrent Effect of Incarceration using Sentencing Enhancements (August 2007)
357. Stephen J. Choi, G. Mitu Gulati and Eric A. Posner, Professionals or Politicians: The Uncertain Empirical Case for an Elected Rather than Appointed Judiciary (August 2007)
358. Joseph Bankman and David A. Weisbach, Consumption Taxation Is Still Superior to Income Taxation (September 2007)
359. Douglas G. Baird and M. Todd Henderson, Other People's Money (September 2007)
360. William Meadow and Cass R. Sunstein, Causation in Tort: General Populations vs. Individual Cases (September 2007)
361. removed by author
362. Richard McAdams, Reforming Entrapment Doctrine in *United States v. Hollingsworth* (September 2007)
363. M. Todd Henderson, From *Seriatim* to Consensus and Back Again: A Theory of Dissent (October 2007)
364. Timur Kuran and Cass R. Sunstein, Availability Cascades and Risk Regulation (October 2007)
365. David A. Weisbach, The Taxation of Carried Interests in Private Equity (October 2007)
366. Lee Anne Fennell, Homeownership 2.0 (October 2007)
367. Jonathan R. Nash and Rafael I. Pardo, An Empirical Investigation into Appellate Structure and the Perceived Quality of Appellate Review (October 2007)
368. Thomas J. Miles and Cass R. Sunstein, The Real World of Arbitrariness Review (November 2007)
369. Anup Malani, Maciej F. Boni, Abraham Wickelgren, and Ramanan Laxminarayan, Controlling Avian Influenza in Chickens (November 2007)
370. Richard H. McAdams, The Economic Costs of Inequality (November 2007)
371. Lior Jacob Strahilevitz, Reputation Nation: Law in an Era of Ubiquitous Personal Information (November 2007)
372. Thomas J. Miles and Cass R. Sunstein, The New Legal Realism (December 2007)
373. M. Todd Henderson, Everything Old Is New Again: Lessons from *Dodge V. Ford Motor Company* (December 2007)
374. Jonathan Remy Nash, Economic Efficiency versus Public Choice: The Case of Property Rights in Road Traffic (December 2007)
375. Edward L. Glaeser and Cass R. Sunstein, Extremism and Social Learning (December 2007)
376. Stephen J. Choi, G. Mitu Gulati, and Eric A. Posner, Are Judges Overpaid?: A Skeptical Response to the Judicial Salary Debate (December 2007)
377. Eric A. Posner, Does Political Bias in the Judiciary Matter?: Implications of Judicial Bias Studies for Legal and Constitutional Reform (January 2008)

378. Susan Bandes, The Heart Has Its Reasons: Examining the Strange Persistence of the American Death Penalty (January 2008)
379. Susan Bandes, After Innocence: Framing Wrongful Convictions (January 2008)
380. Jacob E. Gersen and Ann Joseph O'Connell, Deadlines in Administrative Law (January 2008)
381. Richard A. Epstein, The Property Rights Movement and Intellectual Property (January 2008)
382. Richard A. Epstein, Some Reflections on Custom in the IP Universe (January 2008)
383. Richard A. Epstein, Decentralized Responses to Good Fortune and Bad Luck (January 2008)
384. Richard A. Epstein, How to Create—or Destroy—Wealth in Real Property (January 2008)
385. Richard A. Epstein, The Human and Economic Dimensions of Altruism: The Case of Organ Transplantation (January 2008)
386. Cass R. Sunstein, Adolescent Risk-Taking and Social Meaning: A Commentary (January 2008)
387. Cass R. Sunstein and Adrian Vermeule, Conspiracy Theories (January 2008)
388. Ariel Porat, Expanding Restitution: Liability for Unrequested Benefits (January 2008)
389. Randal C. Picker, *Twombly, Leegin* and the Reshaping of Antitrust (February 2008)
390. Alon Harrel and Ariel Porat, Aggregating Probabilities across Offences in Criminal Law (March 2008)
391. John Bronsteen, Christopher Buccafusco, and Jonathan Masur, Hedonic Adaptation and the Settlement of Civil Lawsuits (March 2008)
392. Randal C. Picker, Fair Use v. Fair Access (March 2008)
393. Jonathan S. Masur, Process as Purpose: Administrative Procedures, Costly Screens, and Examination at the Patent Office (March 2008, revised July 2008)
394. Eric A. Posner, Human Welfare, Not Human Rights (March 2008)
395. Lee Anne Fennell, Slices and Lumps, 2008 Coase Lecture (March 2008)
396. Eric A. Posner, Fault in Contract Law (March 2008)
397. Cass R. Sunstein, Is OSHA Unconstitutional? (March 2008)
398. Randal C. Picker, Take Two: Stare Decisis in Antitrust/The Per Se Rule against Horizontal Price-Fixing (March 2008)
399. M. Todd Henderson and Anup Malani, Corporate Philanthropy and the Market for Altruism (April 2008, revised September 2008)
400. Shyam Balganesh, Foreseeability and Copyright Incentives (April 2008)
401. Cass R. Sunstein and Reid Hastie, Four Failures of Deliberating Groups (April 2008)
402. M. Todd Henderson, Justin Wolfers and Eric Zitzewitz, Predicting Crime (April 2008)
403. Richard A. Epstein, Bell Atlantic v. Twombly: How Motions to Dismiss Become (Disguised) Summary Judgments (April 2008)
404. William M. Landes and Richard A. Posner, Rational Judicial Behavior: A Statistical Study (April 2008)
405. Stephen J. Choi, Mitu Gulati, and Eric A. Posner, Which States Have the Best (and Worst) High Courts? (May 2008)
406. Richard H. McAdams and Janice Nadler, Coordinating in the Shadow of the Law: Two Contextualized Tests of the Focal Point Theory of Legal Compliance (May 2008)
407. Cass R. Sunstein, Two Conceptions of Irreversible Environmental Harm (Mary 2008)
408. Richard A. Epstein, Public Use in a Post-*Kelo* World (June 2008)
409. Jonathan R. Nash, The Uneasy Case for Transjurisdictional Adjudication (June 2008)
410. Adam B. Cox and Thomas J. Miles, Documenting Discrimination? (June 2008)
411. M. Todd Henderson, Alan D. Jagolinzer, and Karl A. Muller, III, Scienter Disclosure (June 2008)
412. Jonathan R. Nash, Taxes and the Success of Non-Tax Market-Based Environmental Regulatory Regimes (July 2008)
413. Thomas J. Miles and Cass R. Sunstein, Depoliticizing Administrative Law (June 2008)
414. Randal C. Picker, Competition and Privacy in Web 2.0 and the Cloud (June 2008)
415. Omri Ben-Shahar, The Myth of the "Opportunity to Read" in Contract Law (July 2008)
416. Omri Ben-Shahar, A Bargaining Power Theory of Gap-Filling (July 2008)
417. Omri Ben-Shahar, How to Repair Unconscionable Contracts (July 2008)
418. Richard A. Epstein and David A. Hyman, Controlling the Costs of Medical Care: A Dose of Deregulation (July 2008)
419. Eric A. Posner, *Erga Omnes* Norms, Institutionalization, and Constitutionalism in International Law (August 2008)
420. Thomas J. Miles and Eric A. Posner, Which States Enter into Treaties, and Why? (August 2008)
421. Cass R. Sunstein, Trimming (August 2008)

422. Cass R. Sunstein, Second Amendment Minimalism: Heller as Griswold (August 2008)
423. Richard A. Epstein, The Disintegration of Intellectual Property (August 2008)
424. John Bronsteen, Christopher Buccafusco, and Jonathan Masur, Happiness and Punishment (August 2008)
425. Adam B. Cox and Thomas J. Miles, Judicial Ideology and the Transformation of Voting Rights Jurisprudence (August 2008)
426. Daniel Abebe and Jonathan S. Masur, A Nation Divided: Eastern China, Western China, and the Problems of Global Warming (August 2008)
427. William Birdthistle and M. Todd Henderson, One Hat Too Many? Investment Desegregation in Private Equity (August 2008)
428. Irina D. Manta, Privatizing Trademarks (abstract only) (September 2008)
429. Paul J. Heald, Testing the Over- and Under-Exploitation Hypothesis: Bestselling Musical Compositions (1913–32) and Their Use in Cinema (1968–2007) (September 2008)
430. M. Todd Henderson and Richard A. Epstein, Introduction to "The Going Private Phenomenon: Causes and Implications" (September 2008)
431 Paul Heald, Optimal Remedies for Patent Infringement: A Transactional Model (September 2008)