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Cost-Plus Patent Damages

Michael Abramowicz[†]

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This Article assesses recent proposals to use risk-adjusted costs of producing an invention as a basis for either setting patent damages or valuing patents taken by eminent domain. In theory, cost-plus damages can address one of the central challenges of patent law: ensuring that a patentee does not obtain excessive rents for an invention. But cost-plus damages have three principal problems. First, risk may be difficult to estimate, and estimates may be infected by hindsight. Second, if the permitted rate of return is too low, there may be insufficient incentives to invent.

[†] Professor of Law, George Washington University. For excellent comments, I thank participants at the Conference on Punitive Damages at the University of Texas. I am especially grateful to Lisa Ouellette and Sarah Wasserman Rajec for helpful suggestions. I also thank the sponsors of the conference, the University of Texas and the Intel Corporation, for financial support. All errors are mine.

Indeed, even a rate of return that seems generous for existing companies may discourage entry into the industry. Third, inventors may spend much more on invention, anticipating that these greater expenses will not only increase the chance of success, but also increase the amount that they can charge. This Article assesses recent literature proposing cost-plus patent damages, and it offers a simulation model to assess the magnitude of these problems. It concludes that while these problems are serious, social welfare still might be increased by considering cost-plus damages as a factor in the patent damages calculus.

I. Introduction

Governmental mechanisms for rewarding innovation generally do not require direct assessments of the cost of the research and development (R&D) undertaken. The exceptions prove the principle that the government is wary of making individualized assessments of whether research spending is wasteful. Research-and-development tax credits effectively allow partial reimbursement of research costs,[1] but these are available to all inventors, requiring no analysis of whether private firms have spent their money well.[2] The government must police for fraud,[3] but within broad contours even inefficient research spending is subsidized. Because such tax credits will not cover anywhere near the entire cost of R&D, private actors have strong incentives to spend their money wisely. Meanwhile, government research grantors may consider the expected cost of future research activities as part of their analysis of the overall promise of research plans,[4] but this is but one factor in an open-ended inquiry.[5] And once grants are issued, recipients enjoy some flexibility in reworking budgets.[6] Grantees are often constrained less by the detailed research plan than by the desire to produce strong results and earn future research grants.

The cost of conducting research plays even less of a role in the patent system. An inventor can receive a patent even if the invention required little work, so long as the general requirements of patentability are met. Indeed, the section of the United States patent statute requiring that inventions be nonobvious explicitly requires that "[p]atentability shall not be negated by the manner in which the

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1 I.R.C. § 41(a) (2012).

2 *See, e.g.*, Daniel Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303, 311–12 (2013) (discussing the effect of tax credits on inventor incentives).

3 *See, e.g.*, United States v. Kilpatrick, 821 F.2d 1456, 1461 (10th Cir. 1987) (prosecuting defendants for creating false tax deductions on non-existent R&D payments).

4 *See, e.g.*, NATIONAL SCIENCE FOUNDATION, PROPOSAL AND AWARD POLICIES AND PROCEDURES GUIDE 67 (2017) (requiring financial and administrative reviews as a condition to funding).

5 Government research grantors consider many factors, including the qualifications of the research team, the strength of the rationale underlying the research proposal, and the social value of a successful outcome. *See id.* at 63–64.

6 *See, e.g.*, Joshua Sarnoff, *Government Choices in Innovation Funding (With Reference to Climate Change)*, 62 EMORY L.J. 1087, 1094 (2013) (noting that outputs of R&D are not measured with respect to specific spending inputs).

invention was made,"[7] whether through diligent effort or through serendipitous discovery.[8] Indeed, the provision was added to the patent statute to overrule case law requiring a "flash of genius" as a condition for receiving a patent.[9] Our historical system was antipathetic to the inventor who incurred great costs to produce an invention, and even today the inventor receives no special consideration for making large investments. The theory is not that costs are irrelevant, but that the government should monitor outputs rather than inputs.[10] Private parties will have incentives to invest in research activities that are likely to produce new inventions. If the government is capable of determining what is sufficiently new but not so good at measuring the cost of producing innovation, this theory is sensible. A patent system, the theory continues, need not even require the government to assess invention value, because inventors will naturally steer their efforts to producing the most valuable inventions as cheaply as possible.

Yet in two critical doctrinal areas, patent law necessarily requires more governmental attention. First, while the law of nonobviousness does not consider cost explicitly,[11] it is a doctrine that filters out easy (and thus cheap) inventions.[12] An invention that "would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains" cannot receive a patent.[13] Even if the courts approach this as an epistemic inquiry, resisting direct tallying of costs,[14] obvious inventions will generally be cheap inventions. The Federal Circuit, exploring whether an invention should be considered "obvious to try,"[15] has stressed the relevance of the "ease and

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7 35 U.S.C. § 103 (2012).

8 *See* Graham v. John Deere Co., 383 U.S. 1, 16 n.8 (1966) ("[I]t is immaterial whether [the invention] resulted from long toil and experimentation or from a flash of genius."); General Tire & Rubber Co. v. Firestone Tire & Rubber Co., 489 F.2d 1105, 1118 (6th Cir. 1973) ("The present statute emphasizes the proposition that it makes no difference as to patentability by what manner an invention is made."); Sbicca-Del Mac, Inc. v. Milius Shoe Co., 145 F.2d 389, 394 (8th Cir. 1944) ("It is of no consequence, whether the thing 'be discovered by accident, or by long, laborious thought, or by an instantaneous flash of mind.'").

9 The patent statute overturned a "flash of creative genius" requirement set forth in *Cuno Eng'g Corp. v. Automatic Devices Corp.*, 314 U.S. 84, 91 (1941). *See also* DONALD S. CHISUM, CHISUM ON PATENTS § 5.02 (providing a history of § 103).

10 For a model that gives special consideration to costly inventions, *see* Matthew Erramouspe, *Staking Patent Claims on the Human Blueprint: Rewards and Rent-Dissipating Races*, 43 UCLA L. REV. 961, 975 (1996).

11 For a proposal that nonobviousness doctrine should take into account cost, *see* Glynn Lunney, *E-Obviousness*, 7 MICH. TELECOMM. TECH. L. REV. 363, 413 (2001).

12 Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1613 (2011).

13 35 U.S.C. § 103 (2012).

14 For an argument that the nonobviousness doctrine should adopt an explicitly economic foundation, see Abramowicz & Duffy, *supra* note 12, at 1590.

15 *See generally* KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. 1727, 1742 (2007) (suggesting that the "obvious to try" test is appropriate when the field is sufficiently limited to present a finite number of potential solutions).

predictability" of the techniques for accomplishing the invention.[16] Thus, the nonobviousness doctrine can be viewed at least in part as an inquiry into how much one would expect it to cost to complete an invention.

Second, the patent system may not care about the value of the invention when assessing obviousness, but it does care when assessing patent damages.[17] In many cases, this is not necessary. A patentee can receive injunctive relief for infringement,[18] and then the government need not make an assessment of the invention's value. But patentees will also seek monetary relief for past infringement.[19] Moreover, since the Supreme Court's decision in *eBay Inc. v. MercExchange, L.L.C.*,[20] courts are hesitant to grant injunctions, especially when an invention may represent a small component of a large product.[21] When a potential user of a patent knows of a patent, can confirm its validity, and negotiates in advance, the possibility of an injunction should yield a price that allows the inventor and user of the invention to share in the surplus of the invention. But when a user has inadvertently made irreversible investments without knowledge of the patent, an injunction can allow the inventor to hold up the user for a much larger amount.[22] In limiting the opportunity for such holdups, *eBay* effectively requires the courts to determine, among other things, how valuable the invention was to the user. The problem is most acute for non-practicing entities, which as an empirical matter are often limited to money damages.[23]

Nonetheless, neither the nonobviousness doctrine nor patent damages considers how much it cost the patentee to complete the invention. With nonobviousness, such consideration arguably is barred by statute,[24] and the emphasis on a hypothetical person having ordinary skill in the art[25] emphasizes that the courts are considering expected, rather than actual, ease of invention. With damages, the cost of completing the invention is not one of the many factors that the courts use in calculating damages.[26] In an article prepared for last year's version of

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16 *See In re* Kubin, 561 F.3d 1351, 1360 (Fed. Cir. 2009).

17 *See, e.g.*, Christopher B. Seaman, *Reconsidering the Georgia-Pacific Standard for Reasonable Royalty Patent Damages*, 2010 B.Y.U. L. REV. 1661, 1678 (2010).

18 35 U.S.C. § 283 (2012); *see, e.g.*, Broadcom Corp. v. Emulex Corp., 732 F.3d 1325, 1339 (Fed. Cir. 2013) (granting a permanent injunction with a sunset period after finding patent infringement).

19 35 U.S.C. § 284 (2012).

20 eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388 (2006).

21 Mike Heins, *Selling Congress on eBay: Should Congress Force the ITC to Apply the eBay Standard?*, 22 FED. CIR. B.J. 589, 593 (2013).

22 *See generally* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2008–10 (2007).

23 *See* Christopher B. Seaman, *Permanent Injunctions in Patent Litigation After eBay: An Empirical Study*, 101 IOWA L. REV. 1949, 1970–71 (2016).

24 *See* Graham v. John Deere Co., 383 U.S. 1, 16 n.8 (1966) (holding that the degree to which the patentee toiled in completing the invention is irrelevant).

25 35 U.S.C. § 103 (2012); *see also* Joseph P. Meara, *Just Who Is the Person Having Ordinary Skill In The Art? Patent Law's Mysterious Personage*, 77 WASH. L. REV. 267, 273–78 (2002).

26 *See* Georgia-Pac. Corp. v. U.S. Plywood Corp., 318 F. Supp 1116, 1120 (S.D.N.Y. 1970) (listing

this symposium, however, Ted Sichelman argued that the patent system should explicitly consider risk-adjusted R&D costs in calculating damages.[27] That is, a patentee would be entitled to recover its R&D investments. Just as the goal of nonobviousness might be thought to be to provide exclusivity only when necessary to induce the invention,[28] so too might the goal of patent damages be to provide just enough compensation to induce investments. Because research is an inherently risky activity, to motivate inventors to engage in research, these costs would be adjusted upward to compensate for risk. Damages would be calculated so that an inventor's total recovery (extrapolating to the entire market, not just the individual patent defendant) would make the research project as attractive *ex ante* as the inventing firm's next best investment. Sichelman proposes only that risk-adjusted costs should be a factor in the patent damages calculus,[29] but he hints that they could serve a larger role if initial experimentation were successful.[30] In a separate article in the same symposium, John Golden and Karen Sandrik also briefly consider the possibility of incorporating cost considerations into the reasonable royalty assessment.[31]

Reimbursement of inventors based on their costs similarly could play a role in reward alternatives to patent systems. The proposals for patent system alternatives that have gained prominence in the past two decades have focused on the challenge of determining how much to value inventions procured by such systems.[32] The classic prize approach is to offer a fixed prize for a particular invention sought by the prize sponsors, with the prize presumably to be paid even if the problem turns out to be much simpler than expected.[33] Reward proposals, meanwhile, have sought to compensate inventors in proportion to their diverse contributions but many have still sought to estimate invention value.[34] Some proposals seek to measure the demand for the invention directly,[35] while others seek to piggyback on the patent

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factors relevant for calculating damages for infringement).

27 *See* Ted Sichelman, *Innovation Factors for Reasonable Royalties,* 25 TEX. INTELL. PROP. L.J. 277, 308–11 (2018).

28 *See* Abramowicz & Duffy, *supra* note 12, at 1678–79.

29 *See* Sichelman, *supra* note 27, at 311.

30 *See id.* at 323–324 (arguing that patent law should use a reliance damages regime based on R&D expenditures).

31 *See* John M. Golden & Karen E. Sandrik, *A Restitution Perspective on Reasonable Royalties*, 36 REV. OF LITIG. 335, 371 (2017).

32 *See generally* Michael Abramowicz, *Prize and Reward Alternatives to Intellectual Property,* 1 RESEARCH HANDBOOK ON THE LAW AND ECONOMICS OF INTELLECTUAL PROPERTY (Peter S. Menell, David L. Schwartz & Ben Depoorter eds., forthcoming 2018).

33 *See, e.g.*, Benjamin N. Roin, *Intellectual Property versus Prizes: Reframing the Debate*, 81 U. CHI. L. REV. 999, 1001–02 (2014).

34 *See, e.g.*, Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 225–35 (2003) (discussing factors that inform patent-prize proposals); AIDAN HOLLIS & THOMAS POGGE, THE HEALTH IMPACT FUND, MAKING NEW MEDICINES AVAILABLE FOR ALL 3 (Incentives for Global Health, 2008).

35 *See, e.g.*, Steven Shavell & Tanguy Van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 531–32 (2001).

system to determine what an invention would have been worth if it remained under patent protection instead of receiving a prize.[36] Recognizing that some inventions may make contributions that cannot be measured in direct sales, and also that some inventions may benefit individuals who cannot pay nearly the prices that inventors would charge,[37] some other reward proposals have endorsed valuation systems that take into account more general improvements to social welfare.[38] Despite this wide range of approaches, proposals have been unified in focusing on inventive contribution rather than on the cost of invention.

In a recent article, however, Hannah Brennan and coauthors (including Amy Kapczynski) defend what can be seen as a reward system that uses a cost-plus accounting metric.[39] In particular, Brennan et al. advocate that the government take advantage of statutory authority to purchase generic versions of certain medicines for less than 1% of their list price plus a reasonable royalty.[40] Brennan et al. note that exercising such a power could be analogous to eminent domain,[41] which prior advocates of reward systems have urged as a tool that could allow the government to take patents for just compensation,[42] effectively converting the patent system to a reward system. The key challenge for such a system is determining what constitutes a "reasonable royalty." Brennan et al. suggest that a baseline might be set based on the price charged by the infringer,[43] but that an award should deviate from this baseline to allow for recovery of risk-adjusted R&D costs.[44] Even if the government does not have perfect information, so long as the government gives sufficient compensation on average, there will be sufficient incentive to invent.

Under some assumptions, a patent or reward system should be able to function equally well either with an approach that aligns inventor returns with the value of innovations produced or with an approach that reimburses the risk-adjusted cost of producing those innovations. Potential inventors will monitor changes in the

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36 Michael Kremer, for example, suggests an ingenious system of auctions that would result, with high probability, in a patent being sold to the government for an amount equal to or a multiple of the market's valuation of the patent. *See* Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECON. 1137, 1146–48 (1998).

37 *See, e.g.*, Ellen 't Hoen, *TRIPS, Pharmaceutical Patents, And Access to Essential Medicines: A Long Way From Seattle to Doha*, 2 CHI. J. INT'L L. 27, 28–29 (2002) (describing the barriers patent protections impose on drug access and affordability in developing countries).

38 Amy Kapczynski, *The Continuum of Excludability and The Limits of Patents*, 122 YALE L.J. 1900, 1954 (2013).

39 Hannah Brennan et al., *A Prescription for Excessive Drug Pricing: Leveraging Government Patent Use for Health*, 18 YALE J.L. & TECH 275, 310–18 (2016).

40 *See id.* at 275.

41 *See id.* at 308–10.

42 *See, e.g.*, Daniel R. Cahoy, *Patent Fences and Constitutional Fence Posts: Property Barriers to Pharmaceutical Importation*, 15 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 623, 672 (2005).

43 Brennan et al., *supra* note 39, at 314. Note that Brennan et al. implicitly assume that the infringement is by a company that sells to users rather than by users themselves. For simplicity, the model in Part IV of this paper adopts the reverse assumption, focusing on users as potential infringers.

44 *Id.* at 315.

expected cost of inventing and the expected value of an invention, and they will invent (or try to) as soon as the expected cost drops low enough or the expected value rises high enough so that the portion of value that the inventor can appropriate will cover the risk-adjusted costs.[45] If expected costs and value change slowly over time, then invention will occur at the same time regardless of whether a cost metric or a value metric is used to provide ultimate rewards. Thus, at least placing aside the complications of calculating various types of damages, on this theory, it should not matter whether damages are based on valuation or on cost.

In practice, however, expected costs may drop abruptly, following an exogenous improvement in technology,[46] and more rarely, expected value may increase abruptly, as a result of an exogenous change in demand.[47] When this occurs, it is possible that the expected cost of an invention will be considerably lower than its social value. Indeed, the expected cost may even be much lower than the proportion of value that the inventor can appropriate from a patent, if injunctions are available or if damages are based on the patent's value. It is in this case that cost-plus damages have the theoretical potential to increase social welfare. So long as cost-plus damages truly compensate for risk, an inventor will still have sufficient incentive (just enough incentive) to pursue the invention. Meanwhile, lower damages mean that prices will be lower for consumers, producing less deadweight loss. This may produce both efficiency and distributive gains.

The possibility of reducing unnecessary compensation for inventions is the heart of the case for cost-plus damages. But considering cost in the patent damages calculation can be justified on more prosaic grounds as well. Even if one believes that the ultimate purpose of patent damages is to measure the value of a patent to the infringer (or to users to whom the infringer sells the product), the cost of producing an invention may be a proxy for patent value. Easier inventions, all else being equal, will be less valuable than harder inventions; after all, if an invention were easy and valuable, then it probably would have been invented early. So, if cost is a proxy for value, then even if value is the conceptual touchstone of the patent damages inquiry, then it likely deserves at least some weight in the multifactor calculus.[48] Multifactorial balancing tests can be unwieldy,[49] but it is hard to see the harm in extending a test that already considers many factors to considering one

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[45] For an article modeling the implications of inventors' waiting to invent until the value from invention is sufficiently high, *see* John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 459 (2004).

[46] *See, e.g.*, Abramowicz & Duffy, *supra* note 12, at 1676 (invention dependent on a newly discovered research tool could not have been invented earlier).

[47] *See id.* at 1676–77 (citing the recently felt needs for security products following the Sept. 11 terrorist attacks and for filtering the red color band in night vision goggles as exogeneous changes in demand).

[48] *See* Georgia-Pac. Corp. v. U.S. Plywood Corp., 318 F. Supp 1116, 1120 (S.D.N.Y. 1970).

[49] *See, e.g.*, Martin H. Redish & Colleen McNamara, *Back to the Future: Discovery Cost Allocation and Modern Procedural Theory*, 79 GEO. WASH. L. REV. 773, 783 (2011).

more.[50] At least in some cases, there may be firm evidence about cost-plus damages and so this may be a good proxy for patent value.

Yet there is a strong argument that this is backward—that expected cost indeed should be seen as the ultimate touchstone of the patent damages inquiry. On this account, the inquiry considers factors that seem more related to value because expected cost is too hard to measure directly. A risk-adjusted cost measure presents a number of evidentiary challenges. The most obvious of these is how we might determine the *ex ante* probability of success. This assessment requires decisionmakers to place themselves in the position of inventors at some prior point. A more serious concern is that decision making might be systematically biased. Empirical studies suggest that hindsight bias affects jurors in analyzing nonobviousness,[51] and the same might be true with cost-plus patent damages. This produces a more serious concern still: If inventors anticipate that decisionmakers will be infected by hindsight bias, they might believe that patent damages will be just a bit short of the level needed to compensate them for their investments. If patent damages focus on invention value and courts slightly underestimate that value, there will be a little bit less invention; but a systematic downward bias in estimating risk-adjusted costs could lead to *a lot less* invention. If one expected the courts never to allow enough damages to reimburse costs, then one would invent only if there were sufficient nonpatent incentives to do so.

There would, of course, be a simple remedy if risk-adjusted costs were systematically underestimated. Damages could be augmented by some percentage, enough on average to at least compensate for systematic bias. So long as the social value of an invention will generally be considerably higher than its expected cost,[52] the patent system could be generous in setting this percentage, hoping to guarantee inventors that they will receive no less than their risk-adjusted costs. But this exacerbates an entirely different risk: excessive spending. Suppose an inventor anticipates that it would cost $1,000,000 to have a 50% chance of invention. But if the inventor anticipates that successful investments are generally reimbursed at 10% more than is needed to compensate for risk-adjusted costs, then the inventor's incentive is to invest *more* than $1,000,000. After all, 10% of $1,000,000 is less than 10% of $10,000,000. A higher investment might only marginally increase the probability of invention, but no matter. An inventor who expects to receive a risk-adjusted reimbursement of a specific amount should not care about the probability

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50 *See, e.g.*, Barton Beebe, *An Empirical Study of the Multifactor Tests for Trademark Infringement*, 94 CALIF. L. REV. 1581, 1614–15 (2006) (discussing how only some core factors are determinative in the outcome of multifactor tests because judges sway other factors to follow the outcome pointed to by core factors).

51 Gregory N. Mandel, *Patently Non-Obvious: Empirical Demonstrations that the Hindsight Bias Renders Patent Decisions Irrational*, 67 OHIO ST. L.J. 1391, 1403–15 (2006).

52 Inventions are often thought to have high spillover benefits beyond what patentees can recover. *See, e.g.*, Kremer, *supra* note 36, at 1146 (describing the ideal patent buyout price as the social value of an invention, assuming the expected social benefit exceeds the cost).

anyway. This is a familiar problem with cost-plus pricing from other domains in which it is used, such as utility regulation[53] and government contracting.[54]

Thus, cost-plus damages introduce the danger that inventors will spend too much from a social welfare perspective. There remains, however, a critical restraint on reimbursement: Users might refuse to use the invention, at least unless they can negotiate a lower price. If the inventor spends a billion dollars on an invention, then a potential user who values it at a million dollars (even one with a billion dollars to spare) will not intentionally infringe if patent damages doctrine would impose a damages verdict with nine zeros. Thus, excessive spending on inventions will push up anticipated damages, thus vitiating the supposed principal benefit of cost-plus damages, but such a system will not lead users to pay more than they would if a victorious patentee could receive an injunction. Meanwhile, even courts measuring investments might count some excessive investments in research as not being investments at all, so there would be some limit on padding expense accounts. And if a little bit of gold-plating performs the same function as offering inventors some percentage above the minimum expected to be compensatory, then it could be beneficial on balance.

In short, the empirical effects of cost-plus damages are unpredictable. Different effects push in different directions from a welfare perspective. It seems unlikely that there will be opportunities for empirical analysis of cost-plus damages anytime soon. In the absence of data, this Article will seek to theorize as clearly as possible about these various effects of cost-plus patent damages. Part II will review recent proposals for cost-plus damages and highlight three central concerns: First, it is difficult to adjust for risk. Second, it is implausible to allocate the costs of entering into an industry across individual projects, yet these costs must be reimbursed if cost-plus damages are not to discourage entry. Third, cost-plus damages may lead to gold-plating—socially excessive research expenditures.

These problems notwithstanding, Part III will accuse the proponents of excessive modesty. If cost-plus damages work as the proponents anticipate, they can serve as much more than small tweaks. Properly functioning cost-plus damages have profound implications for patent doctrine, perhaps eliminating the need even for cornerstones like the nonobviousness doctrine and the patent term. Part IV will offer a simulation model that indicts the proponents of cost-plus damages for excessive optimism. It shows how cost-plus damages could be beneficial but also how slight misestimates of key parameters could lead to considerably worse outcomes than with standard approaches to damages. Finally, Part V concludes.

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[53] *See, e.g.*, Paul L. Joskow & Richard Schmalensee, *Incentive Regulation for Electric Utilities*, 4 YALE J. ON REG. 1, 9–10 (1986) (describing a prudence test, which would allow for cost-plus utility regulation so long as costs are kept to a minimum).

[54] *See, e.g.*, Robert C. Guell & Marvin Fischbaum, *Toward Allocative Efficiency in the Prescription Drug Industry*, 73 MILBANK Q. 213, 223 (1995) (discussing how the defense department and NASA's use of cost-plus pricing caused projected costs to increase).

Though there is an insufficient basis to switch to a patent damages system exclusively based on cost-plus damages, there is room for doctrinal experimentation with cost-plus damages as part of the broader analysis.

II. The Theoretical Case for Cost-Plus Damages and Rewards

The theoretical case for cost-plus damages can be made modestly or ambitiously. This Part will start with the modest recent proposals for cost-plus accounting, pointing out the core of the arguments, the limited direct application of these arguments, and some initial potential difficulties.

A. Brennan et al.'s Cost-Plus Eminent Domain

Brennan et al.'s proposal[55] is modest in several ways. First, the authors do not suggest any needed modifications to patent doctrine or indeed to the law more broadly, but instead only that the executive branch exercise an already existing statutory power.[56] Second, the authors' suggestion is limited to a particular area of technology, pharmaceuticals,[57] despite the potential for the statute to be applied in other technological fields. And third, the authors do not suggest that their approach be applied to all inventions in this field, but only for the relatively narrow area of life-saving technologies.[58]

The problem that Brennan et al. target is what they characterize as the high cost of life-saving medicines. They focus specifically on direct-acting antivirals, and even more specifically on sofosbuvir, one form of which the FDA has designated as a Breakthrough Therapy.[59] This drug offers promise for the treatment of the blood-borne virus HCV (Hepatitis C), but most versions of the medicine have a list price of nearly $100,000 for a standard course of treatment.[60] Even with discounts, many patients are unable to obtain the treatments.[61] Meanwhile, payors who can afford the treatment have used a significant percentage of their budgets on the treatment, thus reducing their ability to help patients with other problems.[62] The example is thus a vivid illustration of the familiar tension between dynamic and static incentives in innovation law.[63] Given the existence of a treatment, lower prices would benefit patients, but at least with some medicines, the ability to charge

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55 *See* Brennan et al., *supra* note 39, at 283 (suggesting methods by which the government could use § 1498 to extend public access to generic medications).

56 *Id. at* 302–03.

57 *Id.* at 319.

58 *Id.*

59 *Id.* at 287–89.

60 *Id.* at 290 tbl. 1.

61 *Id.* at 291.

62 *Id.* at 292.

63 *See generally* Thomas Cheng, *Putting Innovation Incentives Back in the Patent-Antitrust Interface*, NW. J. TECH. & INTELL. PROP. 385, 388–90 (2013) (discussing the short-term conflict between patent law's dynamic incentive focus and antitrust law's static incentive focus to achieve the common goal of improving consumer welfare).

high prices may have been necessary to induce the R&D of the drug, including the high cost of clinical trials.[64]

Brennan et al.'s innovation is their suggestion that the United States government take advantage of a statute, 28 U.S.C. § 1498,[65] which provides that when the United States uses a patented invention without a license, the patentee's sole remedy shall be "for the recovery of his reasonable and entire compensation."[66] The statute also covers use "by a contractor, a subcontractor, or any person, firm, or corporation for the Government and with the authorization or consent of the Government."[67] Brennan et al. review legislative history confirming that the statute authorizes the United States to exercise its power of eminent domain to use patented inventions, subject to the traditional requirement to pay just compensation.[68] The statute, Brennan et al. note, has been used in a variety of contexts, for example when the Treasury Department used it to immunize banks from liability for use of a patented invention on the detection of fraudulent checks.[69] In the pharmaceutical context, Bayer cut the prices of its antibiotic ciprofloxacin after the Secretary of Health and Human services threatened to import generic versions during the anthrax crisis in 2001.[70] Brennan et al. also describe an earlier episode that led pharmaceutical companies to seek to limit the statute to cases of national security emergency, an effort that failed.[71]

Brennan et al. recommend that § 1498 should be invoked when the federal government determines that "drug pricing has created sizable deadweight loss."[72] They qualify this statement, however, by identifying two primary factors: first, whether "firms command rents in excess of risk-adjusted R&D costs plus a reasonable profit,"[73] and second, whether there would be a significant "magnitude of potential public health gain."[74] The first of these qualifications highlights that Brennan et al. are not concerned with deadweight loss simpliciter. Drug prices could be high because of high risk-adjusted costs, meaning either that the research itself was expensive or that it was highly unlikely to succeed *ex ante*. Indeed, the authors allow that with rare diseases, "high prices may be justifiable because firms must spread R&D costs over a much smaller patient population."[75] While allowing

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64 Brennan et al., *supra* note 39, at 293.

65 28 U.S.C. § 1498 (2017).

66 *Id.* § 1498(a).

67 Brennan et al. note that the provision governing subcontractors was extended in 1942. Brennan et al., *supra* note 39, at 300 (citing Act of October 31, 1942, 77 Pub. L. No. 77-634 § 6, 56 Stat. 1013, 1014).

68 *See* Brennan et al., *supra* note 39, at 299–302.

69 *Id.* at 302 (citing Advanced Software Design Corp. v. Fed. Reserve Bank of St. Louis, 583 F.3d 1371, 1378–79 (Fed. Cir. 2009)).

70 *Id.* at 303.

71 *Id.* at 305.

72 *Id.* at 319.

73 *Id.*

74 *Id.*

75 *Id.*

that government guidance might be needed to make application of these factors predictable,[76] Brennan et al. conclude that "new HCV treatments satisfy both factors and are a prime candidate for government use."[77] The government, however, likely would not need to invoke § 1498 in many contexts because the mere possibility of such invocation would lead companies to lower their prices.[78]

The crux of the Brennan et al. proposal is their recommendation for calculating damages. They recommend starting with a royalty representing the infringer's earnings. In the case of pharmaceuticals with low marginal cost, this would be a "very low baseline."[79] Thus, the more important aspect of their proposal is their recommendation that "these rates should be grossed up to ensure adequate incentives for innovation."[80] This gross up appears to encompass several components. First, it reflects the actual cost of R&D.[81] Second, it would adjust for the risk of failure.[82] The authors cite general statistics on the probability that new drugs will succeed in various stages of clinical testing, such as the 20% probability that a drug will advance from Phase II to III testing.[83] The authors recommend using "inputs specific to the drug or drug class in question" to determine failure rates.[84] Third, inventors would be entitled to "'reasonable' profits, perhaps keyed to approximate average industry returns."[85] Fourth, courts could "even incorporate an additional margin to compensate for the risk of error in their R&D assessments."[86] And fifth, the courts might prorate damages "to reflect the proportion of the global market that these payors represent."[87]

In theory, this approach should work. If pharmaceutical companies are earning far more than needed to compensate them for their investments, taking into account the possibility of failure, then there is no reason for them to earn any more. Deadweight loss should be reduced, and there may be distributive benefits to improving patients' welfare at the expense of shareholders'. In practice, the success of the approach depends on the government's ability to measure the relevant parameters accurately. The most difficult parameter to estimate is likely to be risk. In the case of HCV, the authors confess lack of knowledge of the relevant risk and

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76 Brennan et al. suggest that while courts could calculate damages, it would be better for agencies to "establish guidelines that will shape any bargaining around the courts' powers, thereby influencing courts' calculations and reducing uncertainty about how courts would assess damages." *Id.* at 326.

77 *Id.* at 320.

78 *Id.* at 321.

79 *Id.* at 315.

80 *Id.*

81 *Id.* at 316 (recommending that courts "estimate R&D outlays").

82 *Id.* ("Before investing $1, for example, a company will require a potential profit of $2 if there is a 50% risk that the product it is developing will fail.").

83 *Id.* (citing Joseph A. DiMasi et al., *Innovation in the Pharmaceutical Industry: New Estimates of R&D Costs*, 47 J. HEALTH ECON. 20, 24 tbl.2 (2016)).

84 *Id.*

85 *Id.* at 315.

86 *Id.* at 315–16.

87 *Id.* at 317.

thus assume a number based on industry averages. "We lack specific information on risk of failure for these drugs, so assume a 10 to 20% chance of success (with the lower bound of 10% representing the general likelihood a drug that begins trials succeeds)."[88]

If pharmaceutical companies expect the government to make similar assumptions, then they will not develop any drugs when they estimate less than a 10% chance of success. The allowance of profits and an error margin is designed to offset the risk that the government might underestimate risk-adjusted costs, but it is at least plausible that the government might underestimate even considering this. Today, a pharmaceutical company might invest in a drug with a 5% chance of success if the rewards—in lives saved and ultimately in profit—were sufficiently high, but this will not occur if the pharmaceutical company expects the government to estimate no less than a 10% rate of success (unless the profit and error margins amount to more than 100%). Given an expectation of standard patent damages, sufficiently high social value will ultimately trigger invention for any cost and probability of success, but basing eminent domain damages entirely on cost and probability of success means that social value cannot serve this function.

The 10% success figure seems particularly inappropriate because it represents a crude empirical measure of *average* success. If that is the average, then some drugs presumably are developed even though pharmaceutical companies anticipate a much lower probability of success, while others have a higher degree of success. This highlights the stakes. If pharmaceutical companies expect the government to underestimate risk significantly in a world in which § 1498 is used aggressively, they may simply not develop a drug, regardless of the value of the drug. To be sure, the United States is just one market, but if the United States fails to give drug manufacturers a sufficient return for its prorated portion of the global market, then it seems unlikely that the manufacturers will get a sufficient return anywhere else either.

In a reward system that focuses on invention value, when an invention's value is underestimated, inventions that are of marginal social value will not be developed. But the Brennan et al. proposal is premised on the idea of converting inframarginal inventions—those that will surely be developed under the current system because the profits are so large—into marginal ones. So the danger that expectation of a risk misestimation would lead to nondevelopment of a drug becomes much greater. On the other hand, if they succeed, deadweight loss can be reduced without any harm to innovation incentives.

The deadweight losses from high pricing must be balanced against losses from drugs that might not be developed if potential innovators expect the government not to provide sufficient compensation to allow for profit. With zero marginal costs and linear demand, deadweight loss destroys one-fourth of the total potential surplus

[88] *Id.* at 329.

from an invention.[89] The failure to invent a drug that could be invented destroys the entire surplus from the invention. Moreover, this ignores the possibility that drug development may have beneficial spillover effects that the inventor cannot capture. This can occur when other companies develop "me-too" drugs[90] and more importantly once drugs enter the public domain. Thus, risk estimates must be sufficiently favorable to inventors so that the probability of discouraging invention is much lower than the probability of some unnecessary deadweight loss.

The case for § 1498, and by extension for a reward system that seeks to reimburse risk-adjusted R&D costs in any technological domain, thus depends on whether the government can be expected to make its estimates sufficiently accurately or sufficiently generously that the profit and error margin it allows will be enough not to dissuade even a small percentage of inventions. Part IV will return to this question by assessing how the government might improve its ability to make such estimates sufficiently well. Brennan et al., however, reasonably might answer that surely, the government could take the sofosbuvir-based drugs with a very generous payment that would without question provide sufficient return. After all, they emphasize that the drug has "likely already earned around *forty times* the cost of developing the drugs."[91] They thus conclude that "society has already vastly overpaid for the drugs, particularly considering how little treatment the $36 billion expenditure has purchased."[92]

Looking at this drug in isolation, their case indeed seems persuasive. Yet this persuasiveness is undermined at least somewhat by a familiar economic puzzle. If huge returns are available that greatly overcompensate pharmaceutical companies, why isn't there more entry into the market? There are at least two possible answers to this puzzle. The answer at which Brennan et al. hint is that there *is* a great deal of entry—indeed, an excessive amount of entry. "Reducing the profits available for blockbusters could even increase dynamic efficiency," they write, "because outsized rewards can induce wasteful racing wherein parties expend more effort to be first to obtain a reward . . .than society gains from their race."[93] Under standard industrial organization theory, rents must be dissipated in some way. For example, John Duffy offers a model of patent racing in which racing efficiently produces earlier invention and earlier entry of inventions into the public domain.[94] Yet even in Duffy's model, the number of entrants into a patent race may be inefficiently high.

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89 *See* Abramowicz, *supra* note 34, at 162 fig.2.

90 *See, e.g.*, Albert Wertheimer et al., *Too Many Drugs?: The Clinical and Economic Value of Incremental Innovations*, *in* 14 INVESTING IN HEALTH: THE SOCIAL AND ECONOMIC BENEFITS OF HEALTH CARE INNOVATION 77, 78 (Irena Farquhar et al. eds., 2005) (arguing that me-too drugs provide patients with valuable choices).

91 Brennan et al., *supra* note 39, at 328.

92 *Id.*

93 *Id.* at 322.

94 *See* Duffy, *supra* note 45, at 464–75 ("Racing to patent earlier (and thus to have the patent expire earlier) will therefore continue to be the predominant mechanism by which firms compete away the patent rents.").

The Brennan et al. approach thus might be seen as a technique for reducing inefficient patent races. Perhaps the government will lower returns just enough so that only one or two firms will race to develop a drug that suddenly seems obtainable. In some circumstances, this might lead to only a slight reduction of the probability of invention or a slight delay in the date of invention.

The second answer to the puzzle is much less favorable to the Brennan et al. thesis. This answer is that rent dissipation occurs not only at the stage when R&D on a particular drug is conducted, but also at an earlier stage when entrepreneurs create pharmaceutical companies that have the institutional capability to conduct drug research and to market the drugs. A challenge in applying the Brennan et al. approach is that costs incurred even before a specific drug candidate is identified ought to be risk-adjusted as well, at least if their system is designed to be something other than an appropriation of pharmaceutical company wealth. But it may be very difficult to determine how to allocate these costs among projects and how to risk-adjust these expenses. One would need data not just on pharmaceutical companies that succeed, but also on those that fail. One would need to account for the possibility that the pharmaceutical company might have never produced a single successful drug as well as the possibility that the company might have produced some successful drugs but not enough to pay a market return to the initial investors. Some venture capital and other early forms of investment reflect very high failure rates, and thus the risk-adjusted costs inherent in these initial investments may be quite high. Failure to take them into account will discourage new companies from entering into the market in the hope of someday becoming a big pharmaceutical company.

There is another potential objection to the Brennan et al. approach that is quite different. Might the government overcompensate pharmaceutical companies? Perhaps the government might take a drug as a political favor to a pharmaceutical company that has contributed to the campaign. Of course, Brennan et al. highlight that the government should act only in the fact of great deadweight loss, but there is at least some danger that the government, once using this power, might abuse it. This potential leads to rent-seeking behavior of a different sort,[95] as pharmaceutical companies seek to influence the government in its exercise of the power. Indeed, the danger might be less that the government would pay too much in individual cases as that the legislative and administrative processes might be perverted so that the government would pay systematically too large a sum. One can advocate for a system with particular rules, but must also face the prospect that any actual implementation of a proposal may be quite different from what has been recommended.

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[95] *See generally* Gordon Tullock, *Rent Seeking: The Problem of Definition*, *in* TOWARD A THEORY OF THE RENT-SEEKING SOCIETY 97, 97–112 (James Buchanan et al. eds., 1980) (developing a theory of rent-seeking in politics).

If that is a danger, there is an argument that cost-plus damages should be used not as a tool when the government takes a patent, but instead as part of the patent damages calculation itself. Patent litigation is adversarial, and this should reduce at least the risk of excessive compensation of patentees. The traditional justification for a reward system as an alternative to the patent system is that it can reduce deadweight loss. The government exercising its § 1498 powers might well sell drugs at marginal cost, thus achieving this goal. But reluctance to raise taxes and spending may help explain the failure of reward systems to become more prominent than they are today. If the program is to be revenue neutral, then the government would need to pass its expenses along to consumers. This could still represent a dramatic decrease in deadweight loss by eliminating unnecessary overcompensation, but in principle a patent damages system could achieve much the same end. To see this, let us turn to Ted Sichelman's proposal.

B. Sichelman's Cost-Plus Damages

Sichelman's goal is not to create an alternative to the patent system but to reform the calculation of patent damages. Calculation of damages is necessary where an injunction is not fully compensatory, because infringement occurred before the issuance of the injunction,[96] or where an injunction cannot be entered, for example because the invention is a small component of a product and there is a danger that an injunction would allow the patentee to "hold up" the infringer.[97] Although patentees who lose profits can receive lost-profits damages, it is difficult to prove lost profits,[98] and so many practicing entities and all non-practicing entities have damages calculated on the basis of a "reasonable royalty."[99] The goal in a reasonable royalty case is for the court to reconstruct the hypothetical agreement that the parties would have reached on a licensing price.[100]

The canonical reasonable royalty case, still influential in the Federal Circuit,[101] is *Georgia-Pacific Corp. v. U.S. Plywood Corp.*[102] This case creates a multifactorial

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96 *See, e.g.*, Finjan, Inc. v. Secure Computing Corp., 626 F.3d 1197, 1213 (Fed. Cir. 2010) (finding that a patentee should be awarded damages for pre-injunction infringement).

97 *See* Lemley & Shapiro, *supra* note 22, at 2009 ("[H]oldup is of particular concern when the patent itself covers only a small piece of the product, as is common in the industries in which so-called patent trolls predominate.").

98 *Id.* at 2017.

99 35 U.S.C. § 284 (2012) (requiring that at minimum, an infringer pay the patent holder "a reasonable royalty for the use of the invention").

100 *See, e.g.*, Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1312 (Fed. Cir. 2011) ("The 25 percent rule of thumb is a tool that has been used to approximate the reasonably royalty rate that the manufacturer of a patented product would be willing to offer to pay to the patentee during a hypothetical negotiation.").

101 *See, e.g.*, Astrazeneca AB v. Apotex Corp., 782 F.3d 1324, 1332 (Fed. Cir. 2015) (indicating that the district court "employed the so-called *Georgia–Pacific* factors, the set of 15 factors drawn from the frequently cited opinion in *Georgia–Pacific Corp. v. U.S. Plywood Corp.*").

102 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970), *modified sub nom.* Georgia-Pac. Corp. v. U.S. Plywood-Champion Papers Inc., 446 F.2d 295 (2d Cir. 1971).

balancing test. Placing aside two factors that are not so much factors as overarching philosophy and procedural guidance,[103] Sichelman groups the factors into four categories: first, whether the patentee is a practicing entity;[104] second, the benefit provided by the technology over preexisting technologies;[105] third, the extent to which profit "should be credited to the invention as distinguished from non-patented elements";[106] and fourth, actual negotiations between either the patentee and other licensees or between the infringer and holders of similar patents.[107] We might loosely group all of these factors into one even larger category, representing the *value* provided by the invention. An invention, at least if the thrust of *Georgia-Pacific* is accepted, is more valuable when its inventor practices the invention, when it represents a large technological advance, when it accounts for the success of products incorporating it, and when the market would ordinarily reward it with a high licensing price.

Sichelman offers a thorough critique of *Georgia-Pacific*. It may be unpredictable, especially because different courts will place different emphasis on different factors.[108] It may be especially difficult to apply to multicomponent products, leading to "the so-called royalty stacking and apportionment problems."[109] Juries may not have the cognitive capacity to apply the test effectively,[110] yet jury damages are generally upheld even if the basis for them is not clear.[111] Meanwhile, the portions of the test considering market royalties are circular, since those royalties are set in anticipation of what the courts will decide.[112] Jonathan Masur has shown that this can create a vicious cycle; if judicially calculated damages are too low, royalty rates in anticipation of levied damages will fall, and that will make judicially calculated damages fall in turn.[113] Sichelman also critiques reforms that seek to improve the courts' ability to gauge value. He agrees, for example, that the goal should be to assess a patent's contribution over prior art, but this can be difficult to assess "when the value of the invention turns on increased consumer demand,"[114] and especially when an invention is incorporated into a multicomponent product.

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[103] Sichelman, *supra* note 27, at 283 (discussing a factor that explains that the test is designed to mimic a hypothetical negotiation and a factor that allows expert opinion to be used).

[104] *Id.* at 283–84 (discussing factors three through six).

[105] *Id.* at 284–85 (discussing factors eight through eleven).

[106] *Georgia-Pac.*, 318 F. Supp. at 1120; Sichelman, *supra* note 27, at 285–86 (discussing factor 13).

[107] Sichelman, *supra* note 27, at 286 (discussing factors one, two, and twelve).

[108] *Id.* at 287.

[109] *Id.* at 288; *see, e.g.*, Lemley & Shapiro, *supra* note 22, at 2025–29 (describing case studies that "document examples of the royalty seeking problem outside the litigation context in the development of new technologies within a standard-setting organization").

[110] Sichelman, *supra* note 27, at 289.

[111] *Id.* at 289 (citing Monsanto Co. v. McFarling, 488 F.3d 973, 981 (Fed. Cir. 2007)).

[112] *Id.* at 290–93.

[113] *See* Jonathan S. Masur, *The Use and Misuse of Patent Licenses*, 110 NW. U. L. REV. 115, 116 (2015) (describing the dual trends of increasing patent litigation and decreasing damages awards).

[114] Sichelman, *supra* note 27, at 295.

To promote his argument that patent law should focus on the risk-adjusted cost of inventions rather than on the value those inventions provide, Sichelman argues that the conceptual foundation of patent damages doctrine is flawed. Patent law, he argues, follows traditional tort law in seeking to return a victim to the status quo ante.[115] Patent law, however, "is not designed to remedy private wrongs," but "to promote innovation."[116] Compensatory damages may be excessive from a social welfare perspective "when a patent covers a minor component of a complex product,"[117] when patent rewards are far in excess of what is needed to induce invention,[118] and when infringement resulted from valid (if ultimately rejected) questions about "whether a given patent is infringed, valid, or enforceable."[119] In all of these situations, it may be appropriate to grant a patentee not what it would have received if a negotiation had been completed, but an amount sufficient to compensate for the costs of innovation.

As a remedy, Sichelman suggests incorporating cost considerations into the patent damages calculus. A court, he argues, should "examine the actual costs—R&D, commercialization, and related opportunity costs—of the invention at hand."[120] Sichelman recognizes that R&D costs must include not only wages, but also "amounts for materials, equipment, and facilities that can be allocated to work on the patented invention."[121] Commercialization costs, meanwhile, include not only marketing, but also "clinical and safety testing, pricing analysis, and other costs directly related to transforming the invention into a commercial product."[122] Finally, Sichelman insists that costs include "opportunity costs," i.e., the next best investment that a patentee could have made as an alternative to the patented product.[123]

Like Brennan et al., Sichelman recognizes the need to adjust for risk. Indeed, the approach that he recommends for performing the risk adjustment is similar: "Using retrospective cost accounting from survey data from multiple pharmaceutical companies, the average cost at each pre-clinical and clinical phase can be calculated."[124] As noted above,[125] this is potentially problematic. Risk may differ greatly from one project to another. If the *average* risk is the measure of risk for which inventors expect to be reimbursed, then inventors simply will not undertake inventions that have a high risk. Sichelman does note that the examination can be "more fine-grained," taking into account different risks at

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115 *Id.* at 297–98.
116 *Id.* at 298.
117 *Id.* at 301–02.
118 *Id.* at 302–03 (focusing especially on software patents).
119 *Id.* at 304.
120 *Id.* at 309.
121 *Id.*
122 *Id.* at 309.
123 *Id.* at 310.
124 *Id.* at 311–12.
125 *See* Brennan et al., *supra* note 39, at 317.

different stages and the specific type of relevant invention.[126] But there is still ample room for debate about the size of risk, and it is hard to know whether courts will tend to overestimate or to underestimate risk.

Even at a conceptual level, it is not easy to define the risk that one is estimating. The pharmaceutical example simplifies matters. A firm engages in a high-risk research project that either will produce a blockbuster drug (in the sense that many individuals would be willing to pay a great deal for it if unable to get it cheaper) or will fail. But in many inventive contexts, and even with pharmaceuticals, any project may lead to a number of different possible inventions, and any invention will have a distribution of potential success levels. A research project might "succeed" in earning a patent (or two) yet interest a much smaller number of consumers than expected or cost much more than expected to manufacture or require marketing expenses so great that the project would not have been worthwhile *ex ante*.

Thus, the court needs to know the distribution of potential success levels. Moreover, the court needs to know how this distribution changes at the time of each investment the firm makes, so that it can take account of changing success levels as a project moves closer to market. But even knowing all of these distributions does not resolve the court's inquiry. Cost-plus damages will meaningfully lower patent damages relative to alternatives only for the relatively successful portion of the distribution at each point in time. For relatively unsuccessful outcomes, cost-plus damages will be in excess of customers' willingness to pay. Willingness to pay will then be the limiting factor on profits, at least assuming those customers have adequate notice of the invention and negotiation occurs *ex ante*. Thus, the court's challenge in the cases in which the invention is successful is to reduce damages enough so that *ex ante*, the inventor would have had an incentive to undertake the investment, taking into account that in some cases, the inventor would be able to recover some fraction of its costs.[127]

One advantage of Sichelman's proposal over Brennan et al.'s, however, is that even if courts are expected to underestimate risk, the effect may be only marginal. This is because Sichelman suggests only that cost be one factor in the patent damages calculus, and thus its effects will operate largely on the margin. But Sichelman hints at the possibility that the use of cost-plus damages could be increased in the future.[128] And Brennan et al.'s proposal in principle could be adjusted so that cost is just one factor in the eminent domain inquiry as well. The problem remains that once cost is a sufficiently large factor in the calculus, investors will forego projects where they expect that the courts will substantially underestimate risk, even if the net social welfare benefits of those projects are expected to be high.

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[126] *See* Sichelman, *supra* note 27, at 312.
[127] *Id.* at 324.
[128] *Id.* at 323–25.

Just as Brennan et al. allow for reasonable profits and a margin of error, so too might underestimation of risk be a relatively small concern if the courts are generous in determining opportunity costs, and thus the interest rate that the courts will permit the patentee to receive on its risk-adjusted costs. Sichleman recognizes some problems with determining opportunity costs, however. In particular, there is a danger of circularity.[129] For many inventive entities, the opportunity cost is another project that also might result in the grant of a patent. But if that is so, the value of that alternative project would also depend on the structure of cost-plus damages. The inquiry thus becomes recursive and intractable. Measuring risk of the project at issue is hard enough; measuring risk of the best project not undertaken is a fool's errand.

Sichelman does not suggest scrutinizing the hypothetical next best project. Rather, Sichelman suggests that if a "firm requires an internal rate of return of 30% to perform such projects over time," then it should receive compensation for this internal rate of return.[130] But how would we know what rate of return a firm required? Presumably, we could look at how successful a firm's other projects are. But what if this is a firm's first project? And what if the firm has many projects, but all expect to be rewarded based on cost-plus damages? The circularity problem re-emerges. A firm might decline to undertake good projects because it wants courts to think it has a high internal rate of return. Moreover, if a firm believes that a court likely would underestimate the internal rate of return, then it may decide not to undertake certain projects that in fact are above its internal rate of return.

This analysis suggests that internal rate of return may not be the relevant concept. Indeed, one can make an argument that the relevant return is the return provided by a risk-free asset or close to that level. In principle, the risk that a particular research project will fail is idiosyncratic risk,[131] and so with well-functioning securities markets, this risk can be eliminated in a diversified portfolio.[132] Even if the risk is not entirely idiosyncratic—perhaps multiple firms will run into similar problems—the correlation of the risk with the market as a whole will be low, and so only a small interest rate should be necessary to induce investment.

But this argument has two problems. First, one can defend the idea of an "internal rate of return" on the basis that a successful company will not undertake marginal projects with slightly-above-market rates of return, because those projects

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[129] *Id.* at 314.

[130] *Id.* at 310.

[131] *See, e.g.*, Kevin G. Bender, *Giving the Average Investor the Keys to the Kingdom: How the Federal Securities Laws Facilitate Wealth Inequality*, 15 J. BUS. & SEC. L. 1, 17 (2015) (explaining the concept of idiosyncratic risk).

[132] *See* Lee Drucker, *A Financial Perspective on Commercial Litigation Finance*, 12 N.Y.U. J.L. & BUS. 665, 671 (2016) ("Idiosyncratic risk is asset-specific risk that has little or no correlation with the market and can be mitigated by diversification.").

may distract the firm from higher-return projects.[133] Thus, at least implicitly, risk-adjusted patent damages must compensate for these distraction costs. Second, firms are run by agents whose human capital is undiversified, and these agents will not be willing to undertake risky projects absent sufficient compensation. Cost-plus damages must take into account the salaries these workers require, but once they receive these salaries, workers may steer a firm in the direction of low-risk projects if high-risk projects do not provide a significant premium above what the market offers.

Thus, cost-based patent damages are likely to be more feasible if courts (or the legislature) simply pick a rate of return, or perhaps a few different rates of return based on crude factors such as industry. The rate of return must be one that will almost always be sufficient to compensate for the risks of development. This rate also should perform the function of Brennan et al.'s error margin.[134] That is, it must be high enough so that a firm that expects courts to underestimate risk will nonetheless think that the rate of return is so attractive as to compensate for such underestimation. Because the social costs of a decision not to engage in a research project as a result of expected underestimation of risks are much greater than the social costs of deadweight loss,[135] this will need to be a considerable rate of return indeed. The optimal rate will necessarily still allow for some false negatives—inventions that will be abandoned at loss of social value. But the cost of such false negatives is much greater than the cost of such false positives, so we must increase the permissible rate of return to a level where they will be quite rare. Developing an empirical model for figuring out the optimal rate may be quite difficult, and picking too low a rate could reduce innovation, while picking too high a rate might reduce the advantages of the cost-based approach or even increase deadweight loss.

It should be much more straightforward for the courts to estimate the costs incurred in the inventive process than to estimate either the needed rate of return or the level of risk faced by a particular firm. Indeed, one of the strengths of Sichelman's proposal is that costs are real numbers, backed by accounting, rather than hypothetical constructs. Yet even here there are risks. As with the Brennan et al. proposal,[136] there is the challenge of allocating costs across research projects that those costs may promote. Inventors will have an incentive to argue that costs were incurred in connection with a patented project rather than in conjunction with other projects producing different revenue streams. Especially when products incorporate

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[133] *See generally* Roy J. Epstein & Alan J. Marcus, *Economic Analysis of the Reasonable Royalty: Simplification and Extension of the Georgia-Pacific Factors*, 85 J. PAT. & TRADEMARK OFF. SOC'Y 555, 560 (2003) ("The IRR can be compared to the cost of capital to indicate project profitability. This is particularly useful in a royalty analysis because the documents in the litigation often already provide information on the cost of capital and the IRR of the infringing project.").

[134] *See* Brennan et al., *supra* note 39, at 316 ("[C]ourts could . . . incorporate an additional margin to compensate for the risk of error in their R&D assessments.").

[135] *See* Abramowicz, *supra* note 34, at 125–26.

[136] *See supra* Part II.A. (discussing the difficulty of allocating entry costs).

patented and non-patented elements, or incorporate many different patents, these allocations will not be easy. A particular challenge involves allocating costs in creating an enterprise or in expanding it that must be amortized over a number of different projects. If the courts underestimate the proportion of these costs that should be attributed to a particular project, they will reduce incentives to enter the technological field, though not incentives of existing market participants to engage in invention.

An additional concern is that inventors may spend excessively. It may seem that it should not matter whether costs are reasonable, so long as they are genuinely undertaken to advance the project. In ordinary circumstances, after all, inventors' incentives in determining how much to invest are at least correlated with the public benefit from the invention that might result. An inventor that invests more is more likely to win a patent, while an inventor that invests less saves money. But with a cost-plus damages regime that reimburses all costs, the calculus changes. If the inventor concludes that there is a sufficiently high chance of winning the patent to make any investment worthwhile, then the inventor might as well invest more. If the permitted rate of return is attractive, then every dollar invested will return considerably more than a dollar if the inventor is successful, so the inventor might as well invest as much as possible.

Investing more will increase the inventor's chance of winning. But oddly, this is a neutral consideration, since a higher chance of winning should produce a lower risk adjustment. The benefit of the investment is simply the greater return in the event the inventor wins the patent. A potential remedy is to limit the inventor to only reasonable investments. But that is not easy to define. Is it reasonable to hire ten scientists instead of five? To pay the president of the firm (who may also be the owner) an especially high salary? There are no easy answers to these questions. In principle, what ought to matter is the *expected* cost of invention. Even at a theoretical level, however, this is an elusive concept. If investing $1,000,000 would produce a 50% probability of invention, and investing $5,000,000 would produce a 100% probability of invention, is the expected cost $2,000,000 or $5,000,000? Moreover, focusing too much on expected costs vitiates the virtue of being able to focus on the *actual* costs spent by an inventor.

There are, however, at least three possible answers to this objection. First, the courts might use actual costs spent as a baseline for assessing risk-adjusted costs, but reserve the right to raise or lower the costs should they seem excessive. While this would trigger difficult questions about reasonable investment, inventors anticipating this might restrain their investment at least somewhat. Second, there is at least some limit on the amount of money that inventors can spend. Cost-plus damages serve effectively as a damages cap, but not as a damages floor. Users can always stay away from the invention, and so a patentee can only expect to recover high costs if the invention is valuable relative to the needed costs of production. Third, high spending may not be all bad. Because inventors can appropriate only

some of the benefits of their inventions, they ordinarily might have incentives to spend *too little*.

III. Reform Possibilities for Patent Law

The various criticisms that Part II has levied at the admittedly ingenious proposals to use cost-plus accounting either for providing rewards for patents taken by eminent domain or for patent damages might be reduced to two broad yet opposite concerns. The first concern is about the possibility of undercompensation. The concern is not just that costs are difficult to calculate; virtually any methodology for determining patent damages will have its challenges. The concern is that even a slight shortfall in expected risk adjustment may lead to the failure to engage in research projects that would surely be undertaken in the traditional patent system. The only plausible way to respond to this concern is to offer a very substantial premium in the return permitted successful patentees, though this naturally reduces the benefit of cost-plus accounting. The second concern is that of excessive compensation. Conditional on the invention being produced, this may not make things any worse for users, who can still negotiate lower prices. But it reduces the benefit of cost-plus accounting still more. Moreover, the problem of excessive compensation does not simply cancel out with the problem of insufficient compensation. Compensation can be excessive because cost-plus damages caused excessive spending on research, yet simultaneously insufficient because the risk adjustment was too low.

If the cost-plus damages proposals were mere tweaks to patent law, these practical problems would probably be sufficient to doom them. But they should not be disregarded so easily. While the dangers of cost-plus damages are substantial, the potential benefits, should it be possible to overcome these problems, are high as well. This section imagines that the courts could develop a well-functioning patent damages doctrine based entirely on cost-plus accounting, substantially responding to the concerns raised here. In that case, cost-plus damages would have the potential to revolutionize patent law. Cost-plus damages solve a number of distinct problems of the patent system and thus could lead to a patent system that looks quite different from the patent system of today. In particular, there would be no need for a nonobviousness doctrine or even for a patent term. Patentable subject matter could be relaxed, and patent scope would become much less important.

A. Nonobviousness

The nonobviousness doctrine, as noted in the Introduction, is designed to avoid giving intellectual property rights unnecessarily. The Supreme Court in *Graham v. John Deere Co.* casts the problem this way,[137] and John Duffy and I have argued

[137] Graham v. John Deere Co., 383 U.S. 1, 11 (1966) ("The inherent problem was to develop some means of weeding out those inventions which would not be disclosed or devised but for the inducement of a patent."). The Court's language is infelicitous, as the Court's point was that the nonobviousness doctrine would filter out those inventions that would have been devised and dis-

that whether a patent is needed to induce an invention should indeed be the touchstone of the nonobviousness analysis.[138] But even if one accepts our argument that a focus on inducement improves the administrability of nonobviousness doctrine, that doctrine has an unavoidable limitation: it is binary. Inducement, by contrast, is not binary. Even absent a patent system, most inventions would be invented *eventually*, and so the question is how much the patent system accelerates invention.[139] Even a properly functioning nonobviousness doctrine guided by the inducement standard will leave two problems: First, when a patent is granted, it may provide more protection than is needed to induce invention. Second, the absence of patent protection for inventions that will be invented soon anyway means that there may be no incentive to accelerate those inventions.

In principle, cost-plus damages can fix these problems. First, cost-plus damages eliminate the problem of excessive protection by restricting rents. An invention that is borderline nonobvious will no longer provide the patentee with a windfall. Second, with properly functioning cost-plus damages, there is little downside to granting a patent on a relatively trivial invention. So long as the patentee is limited in the damages it can recover to the risk-adjusted costs incurred, the deadweight loss associated with the patent grant will be correspondingly low. The principal harm from a patent on a relatively obvious invention is that it may allow damages well above cost recovery and thus impose substantial deadweight loss, but cost-plus damages would limit recovery to risk-adjusted costs.

It might seem that a patent still ideally should not be granted in such a situation. By hypothesis, the invention would have been invented soon anyway, and any patent will produce at least some deadweight loss. But that is not so clear. The patent may at least slightly accelerate invention, providing benefits that may offset deadweight loss. Moreover, cost recovery may promote efficiency. The inducement test assesses whether existing firms in an industry would have had incentives to invent. But this ignores incentives to enter into the industry in the first place. A company is more likely to enter into an industry if it expects to be able to recover a category of its costs than if it does not. The law does not generally seek to deny producers the ability to pass along their costs to consumers.

Blocking windfall damages is not the only function of the nonobviousness doctrine. Perhaps the nonobviousness doctrine serves as a carrot that leads some inventors to make more significant contributions than they otherwise would.[140] Meanwhile, perhaps some inventions might be so trivial that they would not be

closed even absent the inducement of a patent.

138 *See* Abramowicz & Duffy, *supra* note 12, at 1596 (aspiring to "revitalize the inducement standard as the touchstone for understanding and refining the obviousness doctrine").

139 *Id.* at 1599.

140 *Cf.* Michael J. Meurer & Katherine Strandburg, *Nonobviousness – The Shape of Things to Come: Patent Carrots and Sticks: A Model of Nonobviousness*, 12 LEWIS & CLARK L. REV. 547, 549 (2008) ("The nonobviousness threshold may be used as a 'stick' to induce researchers to pursue more difficult, socially preferred research projects.").

worth the administrative costs of patentability. But these are second-order considerations. Many critics of the patent system in the United States view the relative generosity of the Patent and Trademark Office in granting patents as one of its chief flaws.[141] This is not an easy problem to solve doctrinally or administratively.[142] But bad patents that produce only modest rewards seem at least like a much smaller problem. If patent damages were assessed based on risk-adjusted costs, the primary function of the nonobviousness doctrine would be unnecessary, and any administrative deficiencies in enforcing it would be of little moment.

B. Patent Term

A related benefit of cost-plus patent damages is that it might be unnecessary to limit the patent term. A primary function of the patent term is to limit the extent to which a patentee can extract rents from the public. The patent term does this by allowing the patentee full power over price within the patent term and no power over price after the patent term. But cost-plus damages provide an alternative mechanism for restraining power over price. The patentee could collect damages until risk-adjusted costs were recovered. In setting damages against a particular defendant, a court might ordinarily assume a collection schedule of duration comparable to the patent term. But a patentee might choose to charge less and collect over a longer period of time. Indeed, the patent system might encourage this by applying a generously high discount in determining cost recoveries.

There are two primary benefits of such a regime. First, Ian Ayres and Paul Klemperer have argued that longer patents with reduced power over price may increase welfare relative to shorter patents with greater power over price.[143] The reason is that the last increment of monopoly pricing places the greatest strain on deadweight loss. Ayres and Klemperer suggest that probabilistic enforcement of a patent may be one way to reduce power over price;[144] restricting damages recoveries is another. Second, the current patent term may unduly induce incentives for creating inventions whose benefits will largely accrue after the patent term. The problem is recognized in the area of pharmaceuticals, where the local clinical trial process may mean that a patentee gets relatively few years of patent term.[145] The

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[141] *See, e.g.*, Shawn P. Miller, *Where's the Innovation: An Analysis of the Quantity and Qualities of Anticipated and Obvious Patents*, 18 VA. J.L. & TECH. 1, 10 (2013) (citing ADAM B. JAFFE & JOSH LERNER, INNOVATION AND ITS DISCONTENTS: HOW OUR BROKEN PATENT SYSTEM IS ENDANGERING INNOVATION AND PROGRESS, AND WHAT TO DO ABOUT IT 8 (Princeton Univ. Press 2004)).

[142] *See* Michael Abramowicz & John Duffy, *Ending the Patent Monopoly*, 157 U. PA. L. REV. 1541, 1546–58 (2009).

[143] 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, 992–94 (1999).

[144] *Id.*

[145] *Compare* Henry G. Grabowski & John M. Vernon, *Effective Patent Life in Pharmaceuticals*, 19 INT'L J. TECH. MGMT. 98, 109–17 (2000) (estimating between ten and twelve years) *with* Amy Kapczynski et al., *Polymorphs and Prodrugs and Salts (Oh My!): An Empirical Analysis of "Sec-*

law partially adjusts for delays in that context,[146] but breakthrough inventions in many fields take a long time to commercialize. Cost-plus damages would allow creators of such breakthroughs to recover damages over a longer period of time. Someone who invested a billion dollars for a technological solution to global warming would probably not recover the investment, because potential users of the technology would just wait for it to enter the public domain.[147] Cost-plus damages would improve the ability of inventors to place long bets.

Like the nonobviousness doctrine, the patent term may have functions besides reducing the total return to inventors. It may, for example, reduce the nuisance of administrative costs associated with patents with little economic power. But there are simpler solutions to this problem, such as insisting on renewal fees so that patentees would not unnecessarily drag out patent lifetimes.

C. Patentable Subject Matter

Though the issue of cost-plus damages seems distant from the issue of patentable subject matter, limitations on patentable subject matter can be seen as reflecting concerns similar to those animating nonobviousness and the patent term. A principal concern of defenders of patentable subject matter limitations is that patents on abstract ideas might allow a patentee to obtain control over an entire field, potentially earning excessive rents and impeding further technological developments.[148] Meanwhile, some have argued that patentable subject matter should be used to exclude certain technological fields, such as software, where there may be considerable incentives to invent even absent patent incentives.[149] If many patents are granted on relatively trivial inventions in these fields, and if those patents place a burden on legitimate inventive activity, then a blanket patentable subject matter ban may be justifiable.

Patentable subject matter doctrine, however, is at best an unfortunate compromise. If a mathematician can devise a new theorem that has great practical import, why should that mathematician be any less entitled to a patent than a biologist or chemist making an equal contribution?[150] Meanwhile, while software

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ondary" Pharmaceutical Patents, 7:e49470 PLoS ONE, Dec. 2012, at 4–5 (arguing that secondary patents can increase the effective patent term by 6–7 years).

146 *See* 35 U.S.C. § 156(a) (2012).

147 *See* Michael Abramowicz, *Orphan Business Models: Toward a New Form of Intellectual Property*, 124 HARV. L. REV. 1362, 1404 (2011).

148 *See* Bilski v. Kappos, 561 U.S. 593, 611–12 (2010) ("Allowing patent petitioners to patent risk hedging would preempt use of this approach in all fields, and would effectively grant a monopoly over an abstract idea.").

149 *See generally* Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 U.C. IRVINE L. REV. 1115, 1138–41 (2015) (discussing the nonpatent incentives for software innovation).

150 *See* John F. Duffy, *Rules and Standards on the Forefront of Patentability*, 51 WM. & MARY L. REV. 609, 623 (2009) ("[I]t should be a rare situation in which an entire class of patents complies with the nonobviousness requirement and yet still somehow discourages or impedes the development and spread of useful knowledge.").

technology appears to advance rapidly, it seems plausible that it might advance more rapidly if there were more theoretical computer scientists. Much of the software powering modern artificial intelligence applications reflects advances in algorithms,[151] and with greater patent incentives, those advances might have been made earlier than they were. The same is true of advances in basic research in biology and life sciences. Government funding of basic research is limited, so if the patent system could lead to increases in funding, that could increase social welfare. The challenge is for the patent system to increase incentives in these fields without risking inventors earning excessive control over a technological field.

At least in theory, cost-plus damages can achieve this goal. A mathematician (or university or private firm employing mathematicians) would be able to receive patents for contributions, but the market power that these patents would provide would be limited. This would have two significant benefits. First, it might help induce patents on many modest inventions in fields currently beyond the scope of patentable subject matter. The argument above concerning nonobviousness applies here; there is no need to filter out small inventions, so long as the return on these inventions is proportional. Second, eliminating the patentable subject matter hurdle could allow inventions that are quite significant, albeit not so significant as to entitle the inventors to injunctive relief or patent damages under traditional formulae.

D. Patent Scope and Infringement

The doctrine of patentable subject matter has long been closely associated with the doctrine of patent scope. *O'Reilly v. Morse*,[152] for example, can be read either as a case about whether the telegraph is within patentable subject matter or about whether Samuel Morse claimed more than he had invented.[153] Patent scope is one of the most challenging areas of patent doctrine conceptually, because there are no obvious conceptual limiting principles. Should Morse have received a patent only on the particular mechanism that he devised, or, as he sought, on the use of electromagnetism "however developed for marking or printing intelligible characters, signs, or letters, at any distances"?[154] If a patent is too narrow, it might be too easy for others to free-ride on the inventor's contribution by changing the invention slightly; if a patent is too broad, then an inventor may receive a windfall beyond the contribution provided. The only way to answer this question in a particular context is to consider the specifics of the inventive contribution, but in our current system it is hard to give much more concrete guidance than that.

A working cost-plus damages system would make it feasible to grant broad patent scope without granting powerful monopoly rights. An inventor like Morse

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[151] *See, e.g.*, Image Assessment Using Deep Convolutional Neural Networks, U.S. Patent No. 9,536,293 (issued Jan. 3, 2017).

[152] O'Reilly v. Morse, 56 U.S. 62 (1854).

[153] *See* Aaron J. Zakem, *Rethinking Patentable Subject Matter: Are Statutory Categories Useful?*, 30 CARDOZO L. REV 2983, 2991–92 (2009).

[154] *O'Reilly*, 56 U.S. at 112.

would be entitled, like any other, to receive his risk-adjusted returns on an invention that could not have been made without the insight that he provided. As this formulation suggests, patent law would no longer need to require inventors to engage in "peripheral claiming" wherein they carefully identify the metes and bounds of their invention.[155] The patent system could instead return to a system of central claiming. That does not mean that patents would have no bounds at all. The courts should be sure that an inventor was the first to have an insight represented by a central claim and that this insight was indeed necessary to the allegedly infringing product. But in principle, multiple inventors who contributed key insights could each receive patents on different related insights. In today's patent system, having a large number of patents that read on broad categories of technology can lead to inefficient royalty stacking.[156] But in a well-functioning cost-plus damages system, each contributor would be limited in what he or she could collect.

This utopian vision should not be confused with an endorsement. My discussion is predicated on the premise that the cost-plus damages system is well functioning. Yet in Part II.A, we identified concerns—that cost-plus damages might undercompensate if permissible returns are set too low and that inventors might spend excessively in anticipation of a significant return on investment. It is easy to imagine these problems ruining our utopian patent system. If returns were set too low, Morse might have found another line of work. And if anyone could claim an insight central to later inventions, many inventors might have unnecessarily fancy offices and unnecessarily large salaries, contributing very small insights that others easily could have obtained without a patent. To address this, we would need to require patentees to limit their patent scope carefully. Indeed, if the problems are sufficiently severe, we might need to keep many features of the patent system designed to prevent inventors from receiving excess rents. We thus return to these problems to try to gauge their scope.

IV. Modeling Cost-Plus Damages

In principle, cost-plus damages can be implemented by allocating every expense by an inventor across all projects the inventor is undertaking, estimating the distribution of returns that the inventor would have expected in the traditional patent system at the time of each expense, determining the inventor's internal rate of return at the time of each expense, identifying a range of outcomes in which the inventor would earn more than was needed to incentivize the investments *ex ante*, and finally determining what rate of return should be allowed in those cases to ensure that the inventor would have had just enough incentives. We can further complicate the analysis by accounting for the distribution of possible measurement errors that the inventor or the court might make in assessing amounts, allocations, or probabilities.

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155 *See generally* Dan L. Burk & Mark. A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction?*, 157 U. PA. L. REV. 1743, 1748–49 (2009).

156 *See* Lemley & Shapiro, *supra* note 22, at 2047.

This is too complicated. As Part II.A's critique of Brennan et al.'s and Sichelman's proposals indicated, it is difficult even to conceptualize how to calculate risk-adjusted returns, and such calculations would be even more difficult in practice to get exactly right. Any attempt to implement cost-plus damages is thus likely to require some crude approximation. Probably it will be infeasible to determine the risk associated with investments in creating a firm, since it will be difficult to allocate these investments among all past and future projects. At best, a court can estimate costs actually incurred for a particular research project and the risk associated with that project. Rather than attempt to determine the exact internal rate of return necessary to compensate investors, it will likely be more feasible simply to specify a permissible rate of return and to set that large enough to overcome the failure to include early stage costs.

The question is whether such a strategy can succeed. The government must set the permissible rate of return not so low that it thwarts investments and not so high that it generates excessive expenditures. Is it even plausible that there exists some permissible rate of return that would increase social welfare? And if so, how difficult might it be for the government to identify that rate of return? The ultimate challenge for the government is one of calibration. This paper's goal is not to perform that calibration, a task that, if achievable at all, would require a great deal of empirical work. Rather, the goal is to develop an approximate sense of how different parameters will affect social welfare and how precise the government will need to be in its calibration if it ultimately seeks to adopt a regime of cost-plus damages.

A. Analytical Model

We will begin with a simple analytical model. Assume that there is a fixed cost to research c, producing a probability p of a successful invention. Success results in an invention valued by users at v. Assume that standard damages will equal v, and the inventor is able to extract the full surplus of the value, thus receiving v. Thus, the *ex ante* expectation of revenue is pv, and the inventor will engage in research so long as $c < pv$.

With cost-plus damages, assume that the inventor can recover $\min(v, (1 + r)kc)$. Thus, r represents the permitted rate of return, and $k > 1$ if the courts will overvalue costs and $k < 1$ if the courts will undervalue costs. Note that the recovery will never be greater than v, because if the inventor set a price greater than v, then users will not use the invention. So, expected damages is $\min(pv, p(1 + r)kc)$. If $c > pv$, then $c > \min(pv, p(1 + r)kc)$, so, just as with standard damages, the inventor will not invent. If $c < pv$, then c will invent so long as $c < p(1 + r)kc$, i.e., $1/p < (1 + r)k$. This reflects that the rate of return r must be sufficient to compensate both for the risk associated with the possibility of research failure and also for any undervaluation of costs.

This highlights the primary effects of cost-plus damages placing aside concerns about excessive investment. If the rate of return r is set too low, then the

inventor will not undertake research even in cases in which it would have been socially optimal (and also privately optimal with standard damages) to do so. But if the inventor *does* invent, then the amount paid to the inventor is reduced from v to $p(1 + r)kc$, which is less than or equal to v in cases in which invention occurs.

Suppose, however, that the inventor can choose c, producing a probability of success $p(c)$, where $p'(c) > 0$ and $p''(c) < 0$. That is, the inventor can spend more than the minimal amount needed to complete the invention, resulting in an increased probability of completing the invention but with decreasing marginal returns. With standard damages, an inventor will set c to maximize $p(c)v - c$, i.e., where $p'(c) = 1$. This is the point where both the marginal benefit of additional spending (from both the private and social perspectives, since the inventor is assumed to be able to extract the user's full value) equals the marginal cost.

But with cost-plus damages, the inventor will optimize $\min(p(c)v, p(c)(1 + r)kc) - c$. Assume that $p(c) = m/(1 + r)$ where m is some constant, i.e., that the permissible rate of return is expected to vary proportionately with the probability of invention. Then, the inventor is optimizing $mkc - c$. If $mk > 1$, then the inventor will set c so that $mkc = p(c)v$, i.e., up to the point where the inventor receives the same amount as the inventor would receive with standard damages. This is a worse outcome from a social perspective since damages are no lower but expenditures are higher.

This analytical model identifies the fundamental promise and dangers of cost-plus damages. But it is simplified in important respects. Critically, it imagines just one inventor. This ignores both the dynamics of entry when some entry costs are not likely to be reimbursed and the dynamics of rent-dissipating entry. A more realistic environment would include multiple potential inventors, each with its own estimate of the value of the invention and with varying costs of successful invention. Modeling many potential heterogeneous inventors is likely to be analytically intractable.

B. Simulation Model

Thus, we will turn to a simulation model that will allow for us to better estimate the implications of different parameter values. Simulations are helpful when the goal is to develop back-of-the-envelope calculations rather than to prove that under some assumptions, certain results will necessarily obtain. The purpose of this exercise is not to prove that cost-plus damages can or cannot work, but rather to test the sensitivity of a cost-plus damages regime to various parameters. Because a simulation makes it easy to plug in potential parameter values and see how that affects welfare outcomes, it is an appropriate tool for this project.

1. The Patent Damages Game

To describe the model, we will first explain the game that our computerized agents are playing and then describe the optimization protocol.

a. Game Structure

The model that follows is independent of the analytical model in Part IV.A, replacing its notation and assumptions. The extensive form game that we are modeling is one in which inventors first choose whether to enter into a market and later choose whether to attempt to create a particular invention, and if so, how much to invest in the effort. The justification for this approach is to reflect that one reason to create a firm capable of innovating is that doing so will provide later opportunities for innovation. In a more realistic model, a single entering firm might consider a wide range of opportunities over time and allocate its assets to working on the most attractive opportunities, and firms would survive or fail depending on their success. With our model, the cost of entry can be thought of as the proportion of the cost of entering a market that can be allocated to a particular opportunity that presents itself.

Assume that an inventor has initial wealth w_0. The inventor must choose whether to enter the market and pay an entry cost c_e. This choice is made solely on the basis of how many other inventors have so far decided to enter. Once entry is complete, an investment opportunity presents itself. The opportunity is to attempt to make an invention. For an *average* inventor to attempt the invention will require the inventor to spend a minimum of $s_{\min}$, where $s_{\min}$ is drawn from a uniform distribution (0, s). For a particular inventor i, the minimum amount is $s_i s_{\min}$, where s_i is drawn from a uniform distribution between 0.5 and 1.5. That is, inventors will differ in the cost efficiency of their inventive efforts, so inventors who can accomplish an invention at low cost will be more likely to make an attempt than inventors with high costs. An inventor who invents can choose m_i where $m_i \geq 1$. The inventor's total spending will be $m_i s_i s_{\min}$.

The probability that an inventor succeeds in making an invention is parameterized by three values, p_1 (representing the probability of success with a minimum investment), p_2 (representing the probability of success with an investment of twice the minimum), and p_{10} (representing the probability of success with an investment of ten times the minimum, which is the maximum permitted). We will define $p(m)$, the probability for a particular spending level, as a curve between these three points. More concretely, let $k = ln(1/9)/(ln(p_2 - p_1) / ln(p_3 - p_1))$. Then, for a particular m, $p(m) = p_1 + (p_3 - p_1)*(((m - 1)/9)^{1/k})$. Note that $p(m)$ is the same for all inventors, but because s_i varies across inventors, two inventors spending the same amount have different probabilities of success. If more than one inventor succeeds at invention, the patent is granted to one of the succeeding inventors chosen at random (using a pseudo-random number generator).

The invention is embodied in a product that sells for zero marginal cost. The demand for the product is linear, and the highest amount any potential user values the product is v/n, where n represents the total number of potential users and v is drawn from a uniform distribution from the interval (0, □). We can thus think of v as the total utility that all potential users would receive from the invention if

everyone who valued the invention at all valued it as much as the highest valuing user. Because demand is linear, the average utility for a potential user is $v/(2n)$.

Each inventor i receives only a signal of v, namely $v + \delta_i$, where δ_i is drawn from a normal distribution with mean 0 and standard deviation σ. Each user j knows that its utility from the product would be $u_j v/n$, where $0 \leq u_j \leq 1$. Based on this signal, the inventor calculates $v_i = E(v)$, drawing valid Bayesian inferences considering the distributions of v and δ. Each inventor thus has a valid but noisy estimate of the highest valuation.

An inventor i who wins the patent chooses α where $0 \leq \alpha \leq 1$ and offers the product for sale to users at a price $I = \alpha v_i$. (Note that we are assuming that the inventor cannot price discriminate but must offer a single price to all users.) Each user may choose to accept this price, to infringe the patent, or to not use the product. If the user accepts the price, the product is sold at this price, and the inventor is assumed to collect all the revenue. If the user infringes, then a court chooses β to produce a court-ordered price of $C = \beta v_c$. When intentional infringement occurs, each side bears a litigation cost c_l, so a user j with valuation $u_j v/n$ receives a benefit of $u_j v/n - C - c_l$, and the inventor earns revenues of $C - c_l$. We define v_c to be the court's estimate of the valuation of the highest valuing user based on the court's own signal of v drawn from a distribution with the same standard deviation as the inventor's. Thus, a user with valuation $u_j v/n$ will infringe if $I > u_j v/n - C - c_l > 0$, i.e., if intentional infringement is cheaper than paying the offered price and is better than not using the product at all. A user who does not infringe will pay if $I < u_j v/n$. Note that because users know v, it will never be the case that some users infringe while other users pay. If the inventor prices sufficiently high, then some users will infringe while others will not use the product; otherwise, some users may pay the price while others will not use the product.

The approach that the court takes in setting β and thus C depends on the legal regime. In the *standard damages* frame, the court chooses $\beta = 0.5$. If $v_c = v$, then this is the profit-maximizing price that the inventor would choose if the inventor had perfect information. In the *cost-plus damages* frame, the court sets β so that $C = (1 + r)m_i s_i s_{\min} p'$, where r represents the permitted rate of return and p' represents the *ex ante* probability that eventual patent winner inventor i would win the patent. Note that if there was only one inventor, then $p' = p(m_i)$. Where multiple inventors attempt to complete an invention, the simulation calculates p' by using an algorithm that takes into account each investor's investment and probability of winning, as well as the randomization of the patent to one of the winning inventors. For example, if $r = 0.5$ and an inventor invests $1,000,000 producing a 0.2 chance of ultimately receiving the patent, then the inventor will receive $7,500,000. Note that cost-plus damages thus reward the inventors' investments in attempting to invent, but not investments in initially entering the market.

Given a set of investment decisions, the pricing decision of the winning patentee (if any), and the potential court's valuation, it is straightforward to estimate

the final wealth of the patentee, w_f, and the combined utility of all users. We assume that the patentee and users are risk neutral and that private welfare W_{priv} can properly be represented as the sum of the users' utilities plus the change in each inventor's wealth. We further define social welfare W_{soc} as $W_{priv} + \theta v$, where the θv represents a spillover from invention that cannot be captured by the users or the patentee.

b. Optimization Protocol

Many of the parameters in the patent damages game can either be set as constant settings that are inputs into the optimization process or calculated on the fly as the game proceeds. For example, the users' decisions whether to infringe and the court's decision in cases in which infringement occurs can be simulated without need for any optimization. We also assume that the inventor sets $\alpha = \min(0.5, E(C)/v_i)$. That is, with standard damages, the inventor sets α to the profit-maximizing level conditional on $v = v_i$. With cost-plus damages, the inventor sets α to the inventor's best estimate of β, unless this is greater than the profit maximizing level of 0.5. Given these assumptions, only the inventor's decisions whether to enter the market and whether to invest need to be optimized.

An inventor i who has entered the market is assumed to decide on a value $m_i \in \{0\} \cup \{x \mid 1 \leq x \leq 10\}$. In making this decision, the inventor has several pieces of information besides inputs to the optimization process: the number of inventors who have entered the market (some of whom also may choose to try to invent), s_i, s_{min}, and v_i. We optimize separately the decision whether to try at all (i.e., whether $m_i = 0$) and how much to try conditional on $m_i \geq 1$. The optimization process occurs over ten rounds; in each round, first the decision whether to try at all is optimized, and then the decision of how hard to try is optimized. Each round results in a strategy that chooses for the first potential entrant the investment amount that is expected to lead to the maximum score for any given set of inputs. All potential entrants but the first use the strategy that is the result of the optimization in the previous round, except in the first round, where all potential entrants but the first play $m_i = 0$. Using ten rounds allows the strategies to converge so that the strategy from the tenth round is quite close to the strategy resulting from the ninth round. (Qualitative results were the same when running the simulation over a smaller or larger number of rounds.)

To perform each optimization in a single round, a neural network optimization process is used. The neural network optimization process is described in more detail in a separate article concerning a different model,[157] but a capsule summary will be provided here: The game is played a large number of times (up to 25,000), with the first entrant choosing m_0 drawn at random from the permissible values (with all values between 0 and 1 converted to 0). A general regression neural network is

[157] *See generally* Mina Niknafs, Neural Network Optimization 1 (Feb. 6, 2016) (unpublished manuscript), *available at* http://courses.mai.liu.se/FU/MAI0083/Report_Mina_Nikanfs.pdf.

constructed based on the plays of the game, where the inputs for each play of the game are s_i, s_{min}, v_i, and m_0, and the output is the final wealth of the first potential entrant, w_f. The general regression neural network thus can produce a predicted score for each potential investment amount, given a set of inputs. The optimization process thus selects the maximum possible predicted score for each set of inputs.

The simulation can be conducted either by fixing the number of entrants at one or by optimizing the number of entrants given the optimization of the decisions on how much to invest. Fixing the number at one is useful for assessing the static effects of a change in patent damages on a single potential inventor; optimizing the number makes it possible to also consider how patent damages may affect entry into the market. Because the optimization of spending amounts takes into account how many firms have entered into the market, it is straightforward to optimize the number of entrants. The simulation plays the game a large number of times to estimate $E(w_f)$ with just one entrant. If this is less than w_0, then we assume that no firms will enter the market and thus no inventions will be produced. In this case, $W_{soc} = W_{priv} = 0$. Otherwise, the simulation plays the game repeatedly to determine the number of entrants n to make $E(w_f)$ as close to $w0$ as possible. This reflects the standard assumption in the industrial organization literature that entry will dissipate all rents.[158] If entering would earn an inventor positive economic profits, then entry would occur until those profits were dissipated. Note that the simulation allows *fractional entry*. For example, if the entry that dissipates profits is 1.5, then there will be a 0.5 probability of one entrant and a 0.5 probability of two entrants. In any play of the game, those who enter choose how much, if any, to invest in invention.

2. Single Entrant Model

To facilitate exposition of the results, we will start with a simplified version of the model. In this version, we assume that the number of entrants is fixed at one, i.e., that the entry-optimizing step is skipped. In other words, we imagine that a particular inventive opportunity is presented to a single firm. If that firm does not try to invent or does not succeed in an attempt, then the invention does not occur and no users enjoy any surplus from the invention. We repeat the entire optimization process once for the standard damages frame and a number of times under the cost-plus damages frame for different values of r. The goal is to see how changing the value of r will affect investments, the likelihood of invention, and private and social welfare.

For each of the optimizations, we set various parameters to specific values. While plausible values are chosen, it is worth emphasizing that the purpose is not to calibrate the model closely to the actual patent process. Rather, the goal is to assess the sensitivity of the model to r. If the success of cost-plus damages proves to be highly sensitive to r, we know that there is at least a risk that the government will

[158] *See* Michael Abramowicz, *An Industrial Organization Approach to Copyright Law*, 46 WM & MARY L. REV. 33, 51 (2004).

not set the appropriate value of r, and because the other parameters in this Article may not be accurate, this Article cannot be seen as a definitive source for determining the optimal value of r if cost-plus damages were to be enacted. If cost-plus damages are successful across a wide range of r values, that should give us some confidence that cost-plus damages have potential, but can hardly be viewed as a conclusive demonstration for any particular value of r.

We have set the parameters as follows. We assume that $\overline{v} = 10$ and that $\sigma = 1$. We normalize n to 1. One might consider this to mean that if all users had the valuation of the highest valuing user, then in the average run of the simulation they would be willing to pay in total up to $5,000,000 for the invention. Meanwhile, $s = 0.5$, representing the top of the distribution from which the cost for the average inventor is drawn. The cost of litigation $c_l = 0.1$. We have set $\theta = 1.0$ so that we can consider social welfare in a world with high spillovers.

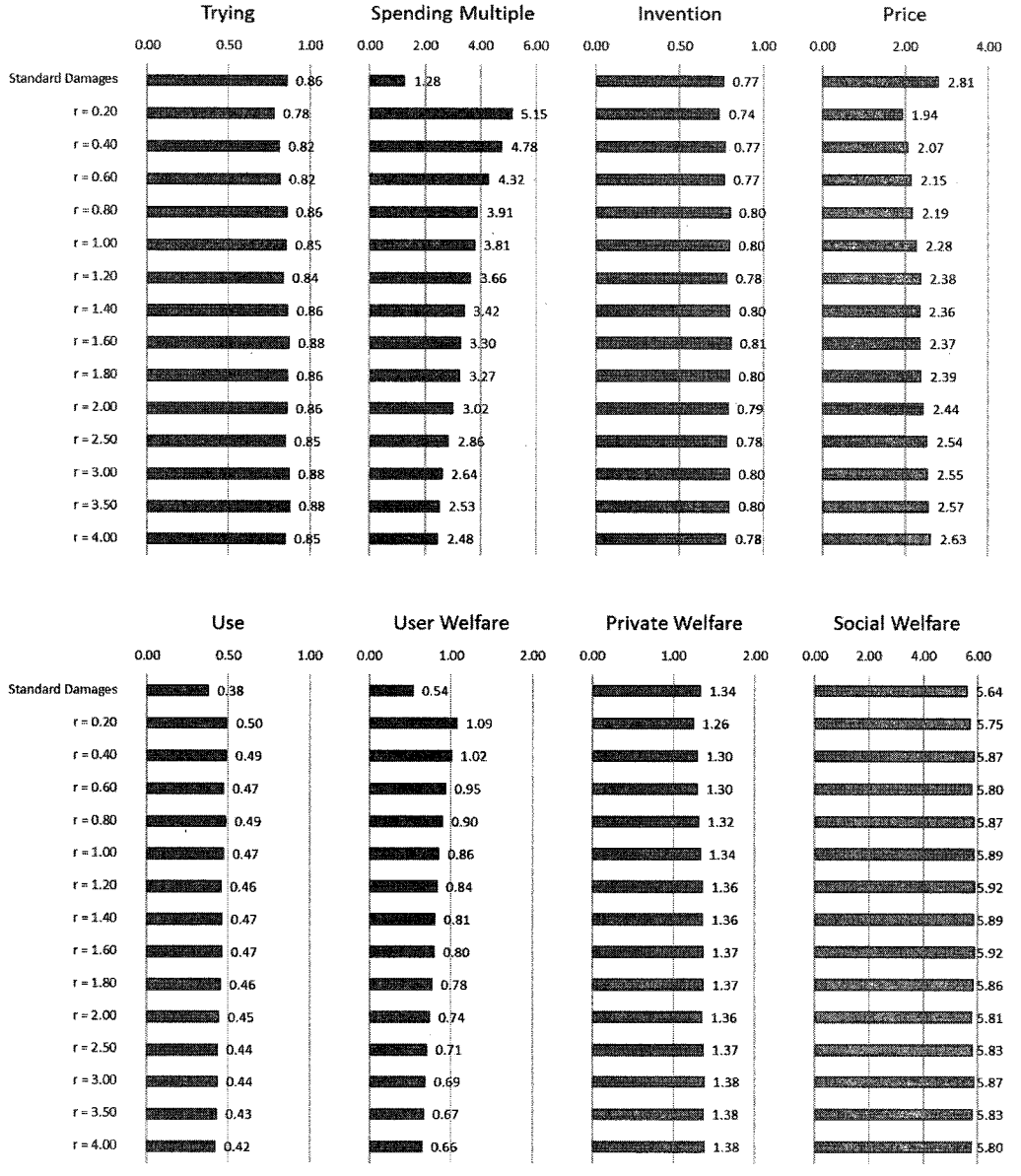
We will start with a baseline simulation, for which we have set p_1, p_2, and p_3 to 0.75, 0.8, and 0.9, respectively. In other words, the minimum investment produces a 75% chance of success, but higher levels of investment add only incrementally to success. These are arbitrary values—some inventions in the real world are much easier, some are harder—and we will deviate from this baseline to assess the robustness of the model later. Meanwhile, in this baseline, we begin with an assumption that the inventor knows the value of the invention. That is, $\sigma_n = 0$, so for each I, $v_i = v_c = v$. This is not a perfect information assumption, however, because the neural network optimization is necessarily imperfect. The neural network optimization figures out the "optimum" based on other, similar cases. It does not permit the inventor to calculate the exact amount of investment that would maximize its welfare.

We can now compare outcomes, including social welfare results, for standard damages and cost-based damages with different permitted rates of return given these baseline parameters. Consider first the spending multiple, i.e., the average value of m excluding those who set $m = 0$. This thus represents the amount spent by each inventor divided by the minimum spending amount. Even with standard damages, this amount is greater than 1, reflecting that at least in some situations (especially when the invention is estimated to be highly demanded), the inventor finds it optimal to invest more than the minimum to increase the probability of succeeding with invention. But the spending multiple is *much* greater for cost-plus damages. This is illustrated in the second panel of the top row of Figure 1. With cost-plus damages, greater investments allow greater recoveries, and so inventors invest much more, even though with our parameters, the marginal increase in the probability of invention from additional investment is relatively low.

There is *some* limit to gold-plating even with cost-plus damages. This is so for two reasons. First, users have an option besides paying damages. They can simply decide not to use the patented invention. Greater cost-plus damages limit the likelihood that users will be willing to engage in intentional infringement, and they

thus increase the inventors' ability to charge close to the profit-maximizing price. But an inventor will not want to charge more than the profit-maximizing price (the same price charged in the standard damages model), so at some point, the benefits to gold-plating are reduced. Second, as permitted rates of return rise, there may be less need for gold-plating. If one can recover 400% of one's investment, then the investment need not be high to charge as much as one wants. This explains why the spending multiple gradually declines as the permitted rate of return increases.

Figure 1. Baseline (Single Entrant)

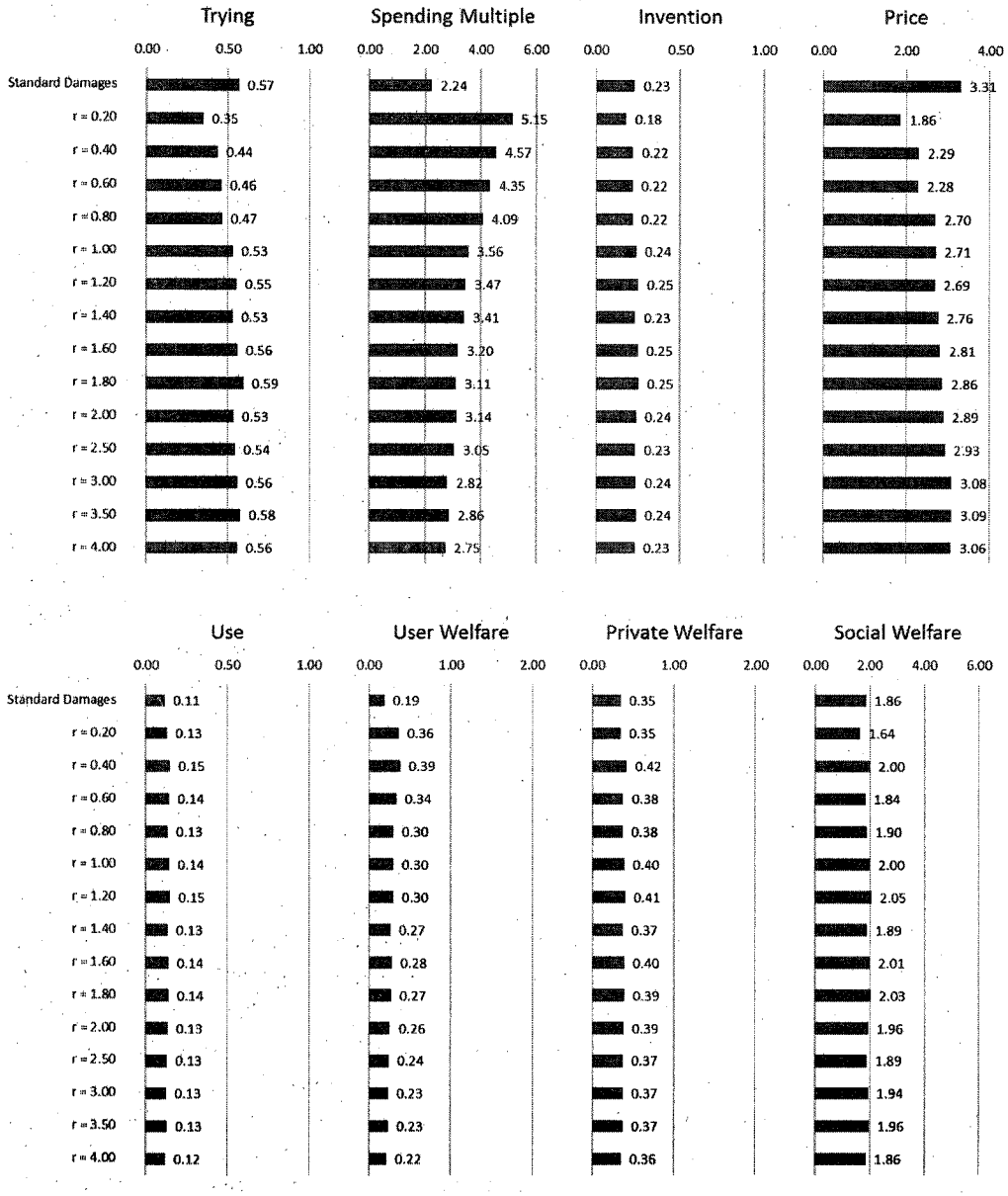


Because increased spending multiples increase the probability of invention, gold-plating has potential benefits. But in the model represented by Figure 1, with relatively low permitted rates of return, invention occurs less often with cost-plus damages than with standard damages. Because the effect of cost-plus damages is to restrict the inventor's ability to charge the profit-maximizing price, the inventor perceives a risk of spending more than can be recovered. Thus, the inventor is somewhat less likely to try to invent at all. With standard damages, an attempt to invent occurs 86% of the time, but with a permitted return of 20%, it occurs only 78% of the time. With higher permitted rates of return, the constraint on the inventor's pricing is reduced, and so the inventor is roughly as likely to try to invent as with standard damages. In Figure 1, once the permitted rate of return is approximately 80%, the effect of the spending multiple dominates, and the rate of invention is generally at least as much as with cost-plus damages.

Figure 1 also shows the effect on price and on the proportion of potential users who ultimately use an invention. The use metric is not conditional on invention, so when no invention occurs, that is counted as zero use. As one would expect, price is highest with standard damages, considerably higher than with a low permitted rate of return. As the permitted rate of return rises, damages increase, and price increases accordingly, though never higher than the amount that can be received with standard damages. Under the parameters represented by Figure 1, even though cost-plus damages slightly decrease the rate of invention with a low permitted rate of return, the increase in use conditional on invention results in more users using the invention overall. With high permitted rates of return, the higher prices mean that use returns closer to the level associated with standard damages.

The welfare consequences of this are also illustrated in Figure 1. User welfare is especially high with a low permitted rate of return. As the permitted rate of return rises, user welfare declines, but it still remains consistently above the user welfare level associated with standard damages. Private welfare takes into account both user welfare and the inventor's interests. The inventor fares much worse with cost-plus damages, and thus despite the benefits to users, total private welfare is lower with low permitted rates of return. Private welfare is greater than with standard damages once permitted rates of return exceed 100%; at this point, the inventor is only slightly adversely affected, and users still receive considerable gains. Finally, our measure of social welfare assumes that mere invention produces spillover effects. Once the permitted rate of return is sufficiently high that invention rates are not much affected by cost-plus damages, the combination of higher user welfare and high rates of invention maximize social welfare.

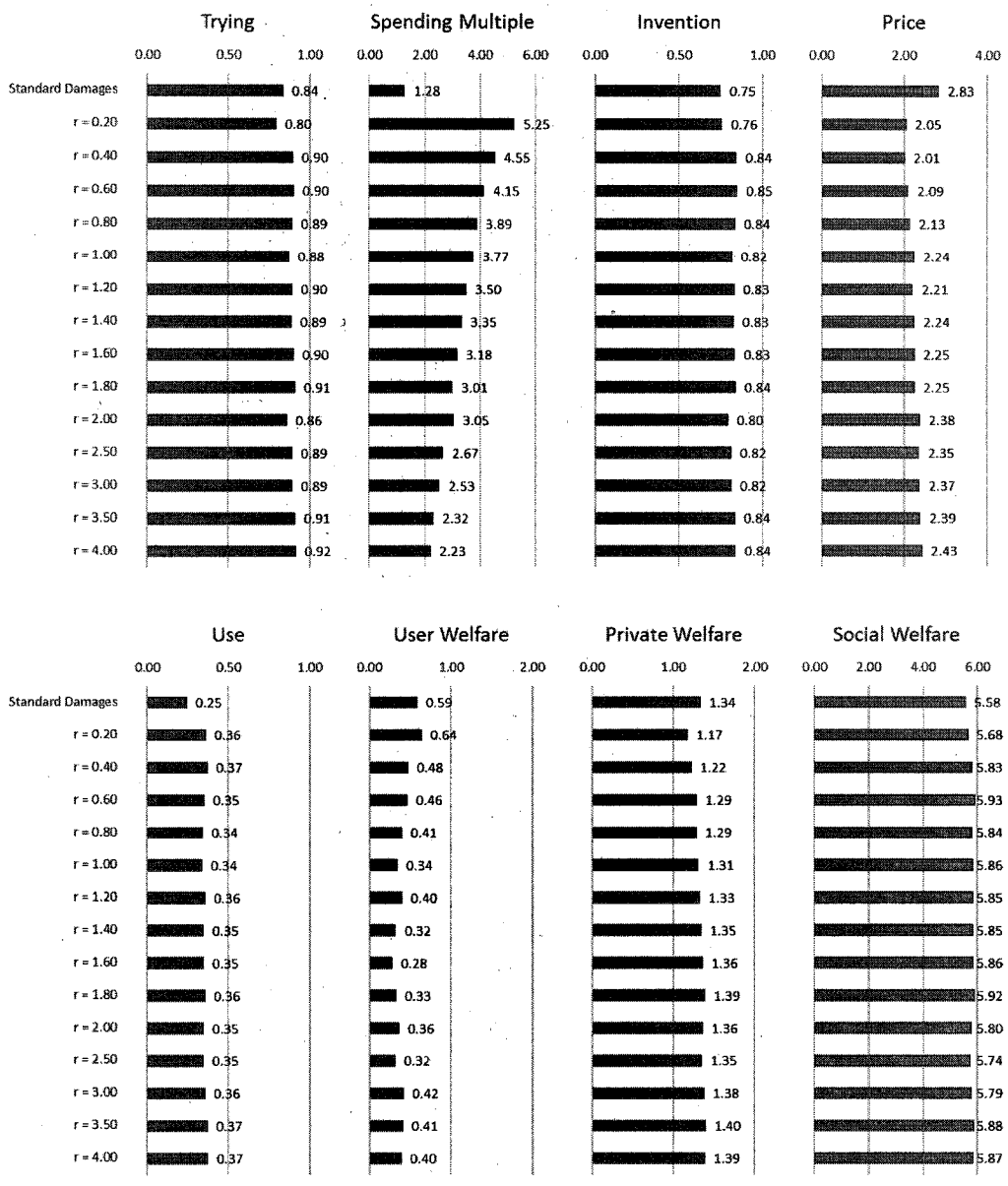
Figure 2. Low Probability of Invention (Single Entrant)



These welfare analyses make cost-plus damages appear promising. To consider the robustness of the results, we also ran the simulation with some changes in parameters. Figure 2 shows the effect of increasing the difficulty of invention. The simulations are the same as those in Figure 1, except that p_1, p_2, and p_3 are set to 0.35, 0.45, and 0.55, respectively. The story remains qualitatively similar to the story above. Naturally, the overall levels of trying to invent and of succeeding at invention are lower. But Figure 2 confirms that spending multiples are considerably higher with cost-plus damages and that this effect continues to dissipate with higher permitted levels of return. The pricing pattern is similar to that of Figure 1, with the lowest prices achieved with the lowest permitted rates of return, and the usage pattern is similar too, with more users able to take advantage of the invention with cost-plus damages, especially with relatively low rates of return. Very low permitted rates of return, however, bring a lower probability of invention and lower welfare overall, but again mostly the same pattern as Figure 1.

In addition, we assess the impact of valuation uncertainty by setting $\sigma_n = 1$. This means that potential inventors cannot be sure of the amount that the highest valuing user is willing to pay, and also that with standard damages, the court may err in setting this amount. With either form of damages, users (who know their own valuations) may believe that the inventor has priced the product too high and therefore choose to infringe. Figure 3 shows that valuation uncertainty makes the welfare case for cost-plus damages more equivocal. Welfare is lower across the board, because with valuation uncertainty, intentional infringement and litigation are more likely, and the cost of litigation is deducted from user welfare. Meanwhile, when cost-plus damages lead the inventor to decide not to invent, this will sometimes be because the inventor is greatly underestimating the value of the invention. Thus, some foregone inventions will be valuable, and a small decrease in the probability of invention thus makes a bigger difference.

Figure 3. Valuation Uncertainty (Single Entrant)



3. Racing Model

Our models so far have assumed that there is a single firm that considers whether to invent. This places to the side two important aspects of the analysis. First, we have ignored the question of whether a firm would have an incentive to enter the industry in the first place. Now, we assume that firms choose whether to enter the industry for the opportunity to compete for the invention. Second, we have ignored the effect of competition among multiple firms for invention. When multiple firms compete to invent, the probability of the invention's occurrence increases. Our racing model is simple. Consistent with the standard assumption in the industrial organization literature,[159] the number of entrants into the market will be the number that dissipates all rents to entrants. All entrants have an opportunity to decide whether to try to invent, based on both shared and private information, and if multiple entrants succeed, one chosen at random obtains the patent.

We start first with the analogue to Figure 1. That is, this is the baseline model in which the probability of invention for a successful invention is relatively high, 0.75. The cost of entry c_e is assumed to be 0.05. This may seem so low as to be insignificant, but we will see later that this choice is critical in assessing social welfare. Figure 4 shows the results. Entry is highest with standard damages, because there is the least restraint on pricing. This also means that the level of invention is highest with standard damages. In Figure 4, the "Trying" chart represents the number of firms that try to invent. In Figure 1, the single entrant was less likely to try to invent with cost-plus damages and low permitted rates of return. In Figure 4, the shape of the chart is similar, though the effect now is a direct result of the entry chart. Not every entrant will try to invent, but the relative low number of firms trying to invent in Figure 4 is attributable to reduced entry in those cases. Finally, the overall levels of invention are higher than in Figure 1. The more firms that try to invent, the greater the likelihood of success. Meanwhile, the advantage of standard damages in stimulating invention is slightly more pronounced as a result. There is more entry with standard damages because the profits available to inventors are greater, and this leads to more invention.

The effects on price and use are similar to those in Figure 1, though muted. Welfare effects are also qualitatively similar. (Note that because entry dissipates rents, private welfare is equal to user welfare, and the separate chart for private welfare is thus omitted.) The social welfare gains, however, are more prominent in Figure 4 with low permitted rates of return. This is because of the rent dissipation. The positive rents earned by a single entrant affected the social welfare measure in Figure 1, but those are irrelevant in Figure 4.

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[159] *See, e.g.*, *id.* at 50–51.

Figure 4. Baseline (Racing)

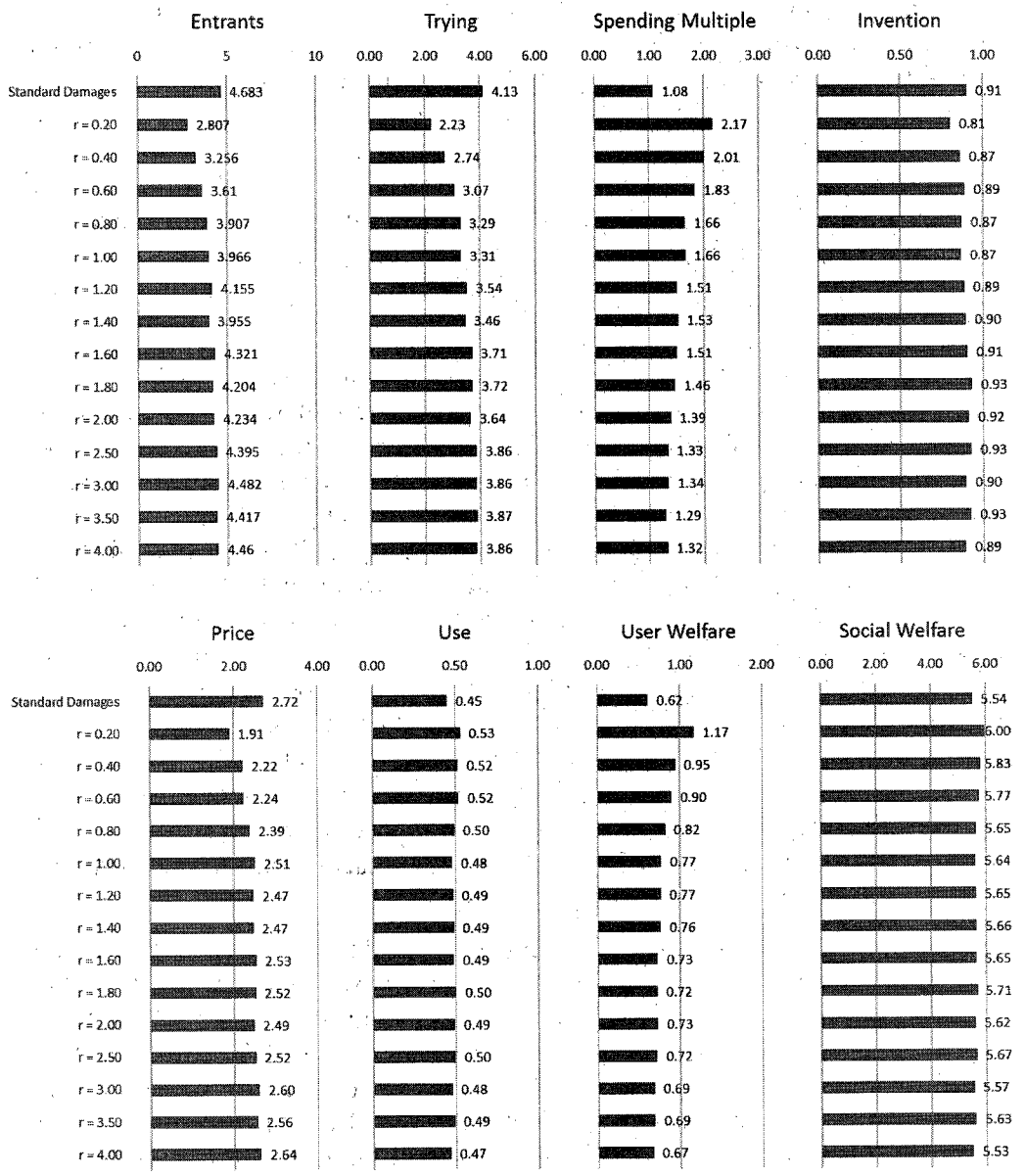


Figure 5 is the analogue to Figure 2. Figure 5 reflects a simulation in which a minimum investment produces only a 0.35 probability of successful invention. For the most part, the simulation results are qualitatively similar. But there is one noticeable difference: the bars corresponding to the 20% level of permitted return are missing. This absence reflects that at this level of return, it is not worth it for even a single firm to enter the market. Above, we noted that if inventors anticipate that they will not recover their risk-adjusted investments in attempting to invent, they will not invent at all. In our model, the inventors do recover their investments associated with the attempt to invent itself. (Our model simply assumes that the courts are accurate in measuring the probability of success.) But the inventors do *not* necessarily recover their investments in building a business that may be in a position to undertake the invention. Therefore, they may not build that business in the first place. This is what happens in these simulations. The rate of return is great enough to allow recovery of investments conditional on entry but not great enough to allow recovery of investments on entry itself.

Figure 6 adds an additional change to the simulation represented in Figure 5. In particular, the cost of entry is assumed to be \$0.10 instead of \$0.05. This may seem to be a very modest difference, especially considering that there may be users who value an invention at as much as \$10. But this change has an important effect. Now, entry also fails to occur at a permitted rate of return as high as 80%. Intuitively, it might seem that an 80% rate of return is generous, especially considering that our model does not take into account discount rates associated with the time value of money. This might seem especially so given that the portion of the cost of entry allocated to the investment opportunity (\$0.10) is considerably smaller than the average cost of a minimal attempt to produce the invention (\$0.25). Even under these circumstances, the rate of return proves insufficient, and so all user welfare and social welfare that could have resulted from invention is lost. Even with higher rates of return, the effects of reduced entry are considerable. User welfare is only slightly higher than with standard damages, and the reduced incidence of successful invention drags social welfare below the level associated with standard damages until the permitted rate of return rises to approximately 120%.

Finally, we consider one other situation in which cost-plus damages are especially problematic: when users may infringe inadvertently. In Figure 7, the baseline parameters are reproduced but 10% of users infringe accidentally, without any calculus of whether using the invention might be beneficial. This scenario does not discourage entry—to the contrary. The existence of users who will have no choice but to infringe greatly increases entry and effort. There are benefits to this, of course, in the form of high entry. But the effects on users are disastrous. For all cost-plus damages levels, users experience *negative* utility. They are forced to pay damages in excess of the valuation of the products. Importantly, while inadvertent infringement is undesirable even with standard damages, the effect on user welfare

Figure 5. Low Probability of Invention (Racing)

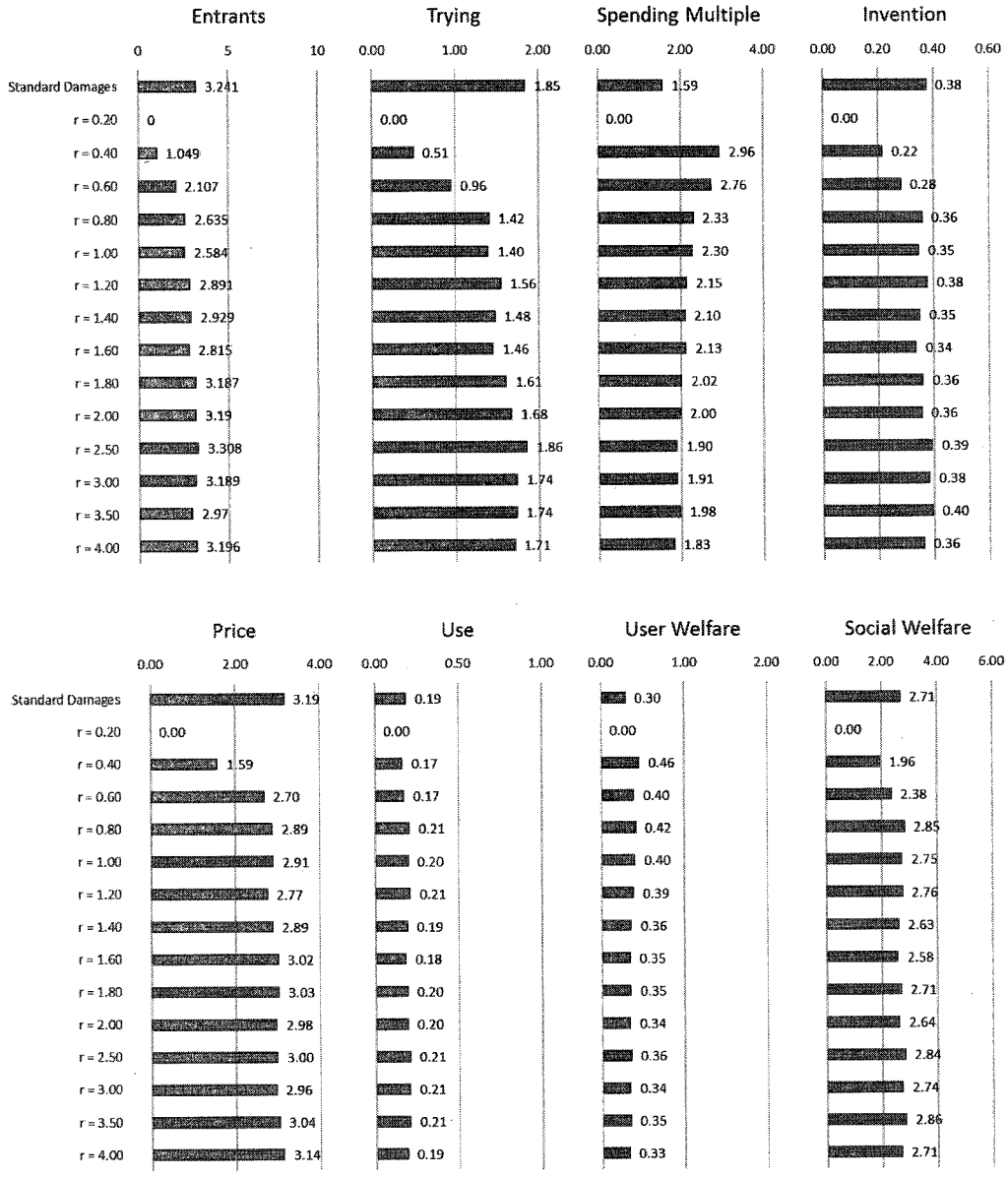


Figure 6. High Entry Cost, Low Probability of Invention (Racing)

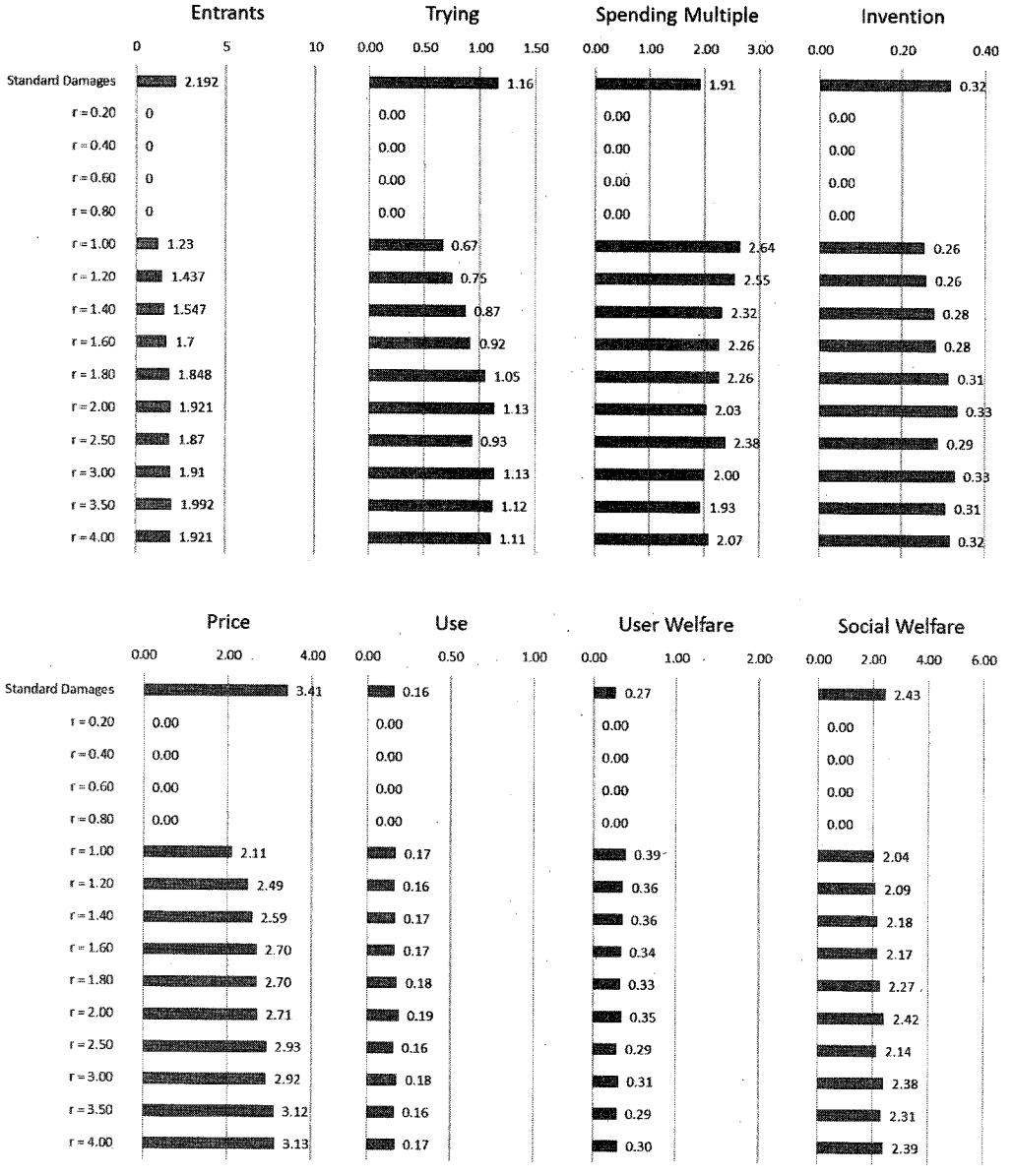
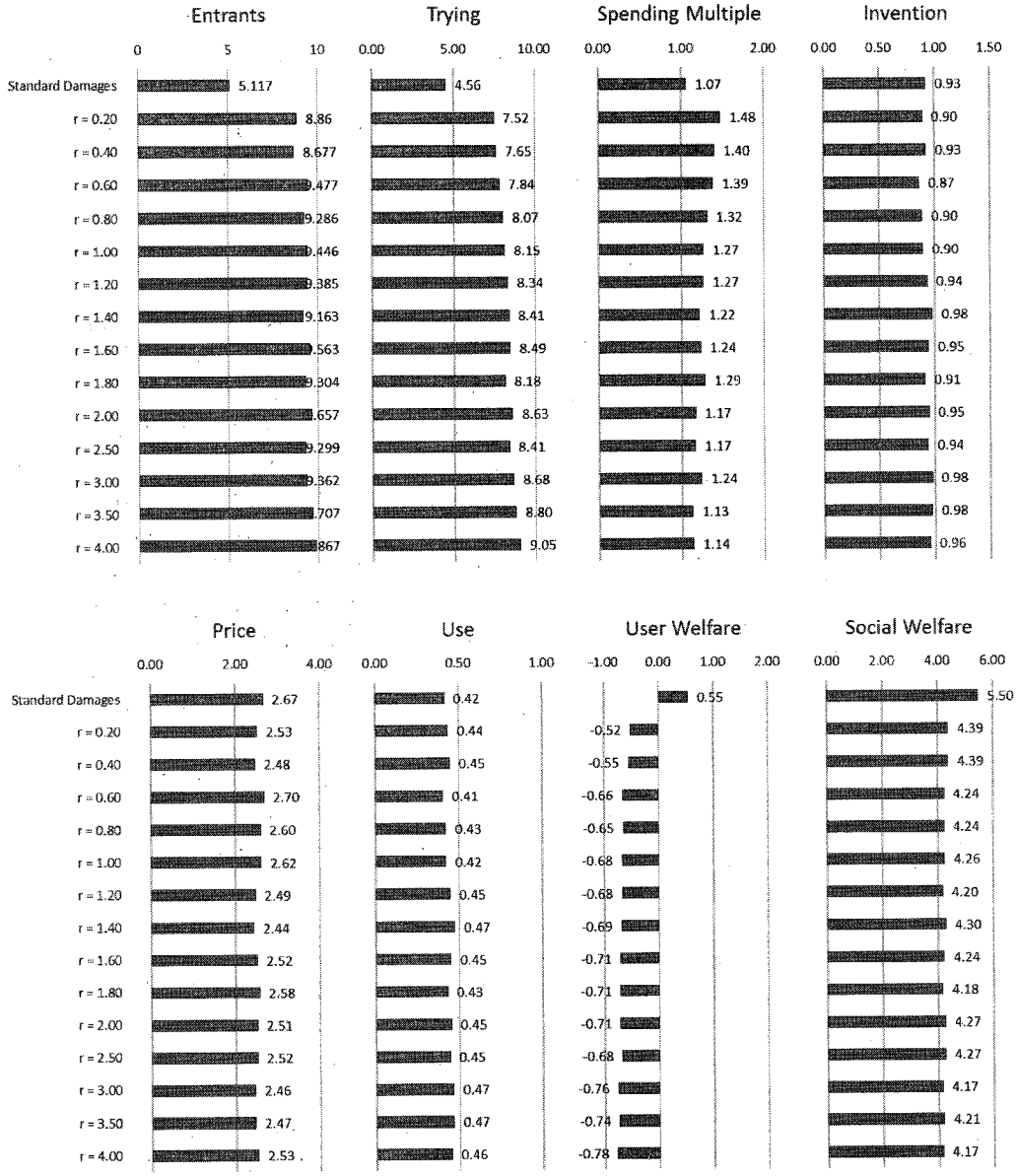


Figure 7. Inadvertent Infringement (Racing)



with standard damages is slight. This makes sense. If the damages the user must pay are tied to the court's estimate of the user's valuation of the invention, the user will suffer relatively little harm on average other than the cost of litigation. But if the user is responsible for paying risk-adjusted costs that may exceed the user's own valuation, users may end up much worse off. The result is much lower social welfare, despite the increase in the rate of invention. Thus, a cost-plus damages system would need to eliminate or greatly limit damages resulting from inadvertent infringement.

4. Modified Proposals

a. Hybrid Damages

We have assumed so far that the choice between cost-plus damages and standard damages is all-or-nothing. This is a useful assumption for assessing the potential effects of introducing cost-plus considerations into the patent damages calculus, but we can imagine a patent damages system in which risk-adjusted R&D levels are merely another factor in the calculus. Indeed, this is what Sichelman suggests. Figure 8 reports the result of a simulation that replicates the challenging circumstances represented in Figure 6—with high entry costs and a low probability of invention—but with hybrid damages. In particular, we assume that damages are the average of standard damages and the specified level of cost-plus damages. Importantly, the disastrous results that we saw in Figure 6, with low permitted rates of return, vanish. Entry occurs in all cases (though presumably if the rate of return were sufficiently low, it would not). Meanwhile, there are some benefits to user welfare, but more modest than in some of the simulations above. The social welfare results, meanwhile, are equivocal at best because of the reduced rate of invention once cost-plus damages are introduced. Nonetheless, this suggests that including risk-adjusted R&D as a factor in the patent damages calculus is unlikely to lead to major problems.

b. Combined Investments

One of the two major problems with cost-plus damages that this article identifies is the risk that inventors will gold-plate, spending excessively to pad their costs and increase the amount of damages. A potential solution for this is to seek to transform risk-adjusted R&D costs to be more of a measure of *expected* risk-adjusted R&D costs. We will consider below whether it may be feasible for courts to assess how much an invention *should* cost. But there is another possible mechanism. Courts might consider the R&D costs of *all competitors in the patent race*, rather than the R&D costs of the winner alone. With multiple entrants, this will be a higher amount, but the risk-adjusted amount will not necessarily be larger. The relevant probability becomes the probability that *someone* will succeed, not just

Figure 8. Hybrid Damages, High Cost of Entry, Low Probability of Invention

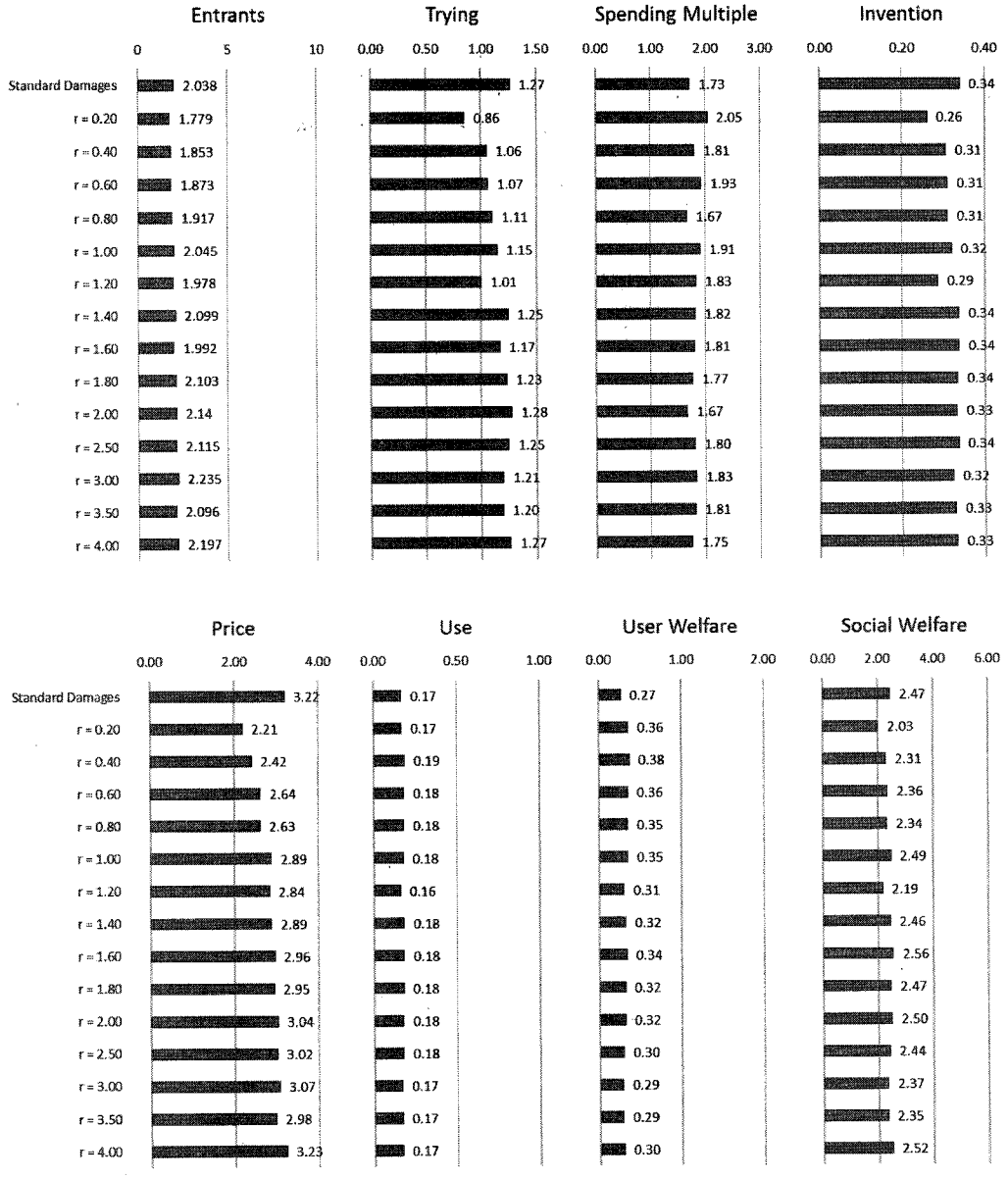
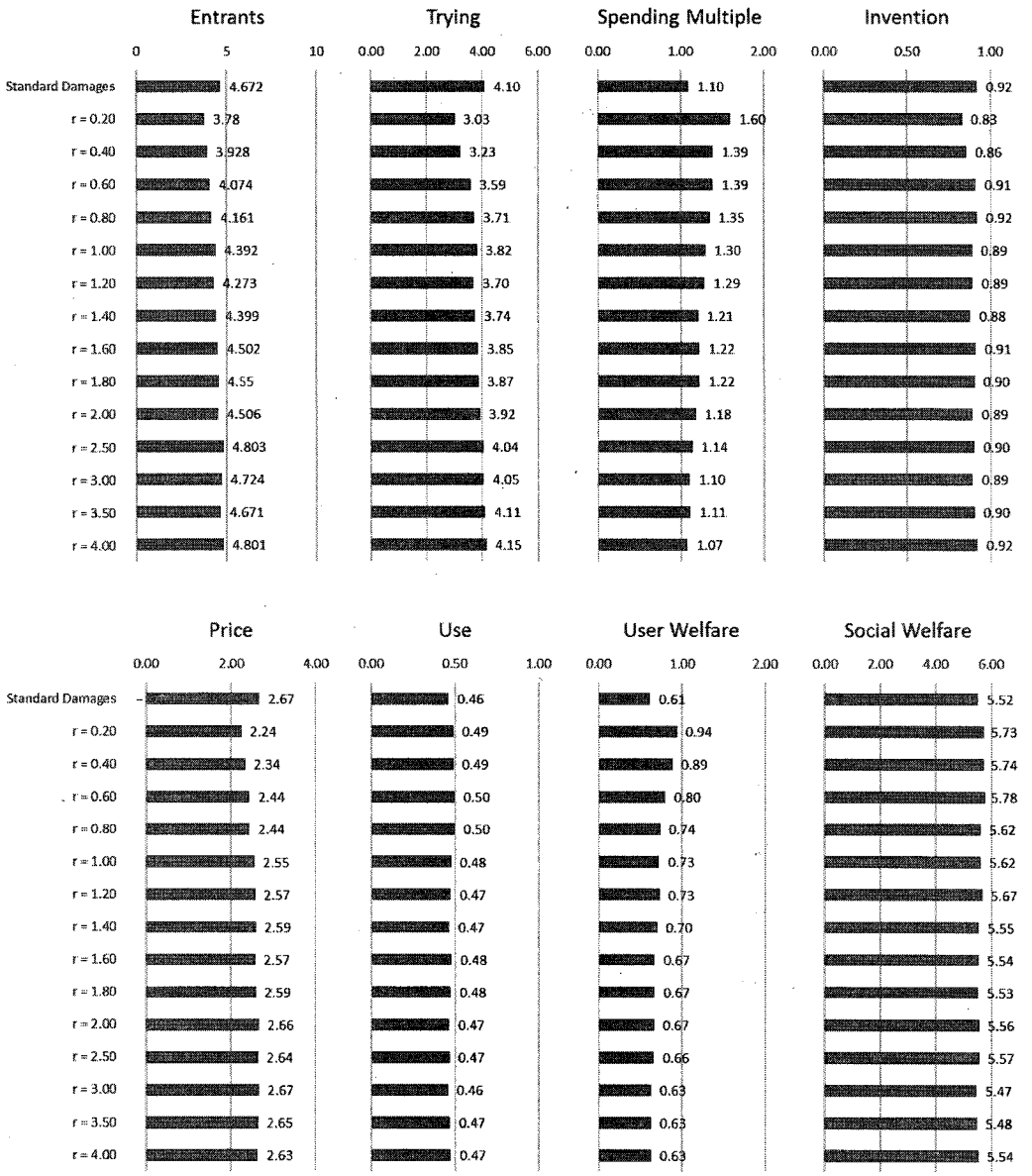


Figure 9. Combined R&D



the probability that the particular inventor will succeed. Placing aside for now questions about whether courts can measure combined R&D, how would this affect welfare?

Figure 9 reports the results from running the simulation in this way. The most noticeable change is in the spending multiple. Unsurprisingly, when other competitors' investments help determine the risk adjustment, one will spend less. But the overall welfare effects are equivocal. User welfare and social welfare are not much changed. One reason for this is that with combined investments, entry rises. With a lower optimal cost of invention, more firms will try to invent. Thus, the savings from lower investment in invention by an inventor is more or less balanced by additional costs from entry.

The ultimate welfare balance will depend on the specific parameters. If additional investment generated greater gains in the probability of invention for any particular inventor than is allowed here (remember that our probability curves are relatively flat), then basing cost-plus damages on the successful inventor is probably optimal. On the other hand, if multiple research efforts are likely to be duplicative because there is only one way to try to achieve the invention, then the entry that is generated by combining investments is wasteful.

V. Conclusion

Cost-plus damages are high beta: if problems could be addressed, this approach to damages could revolutionize patent law. It addresses a fundamental problem with patent law, the danger that an inventor will obtain rents that are too large to the detriment of consumers. Other patent law doctrines, such as nonobviousness, the patent term, patentable subject matter, and patent scope, can be seen as mechanisms designed to address the same fundamental problem. And so, if cost-plus damages worked, these doctrines could be either unnecessary or at least not so critical. Those who worry that the patent office grants too many bad patents need worry no more, for a bad patent is typically a trivial one, which deserves at most a small reward. Cost-plus damages provide that small reward and restrict the patentee from receiving more.

The problem is that cost-plus damages might be miscalibrated. It is likely to be impossible to allocate all investment expenses across all projects. The much more plausible approach is to allow the inventor to recover expenses devoted to a particular project plus some percentage. Even this is difficult, since a single project may lead to multiple patents, but the risk adjustment can in principle be applied to these patents in combination. If the permitted rate of return is too small, then many inventors who might have invented might choose not to invent at all, because they anticipate earning back less than their risk-adjusted returns. The percentage must at least be large enough so that even if the courts are infected with hindsight bias, inventors will still expect the probability estimates to be high enough so that they will expect to make a profit on inventions that increase social welfare. But even this is not the whole of the undercompensation danger. The permitted rate of return must

be high enough to allow businesses to recover the risk-adjusted costs of entry into those businesses. We have seen that even with seemingly low entry costs and seemingly high rates of return (as high as 80%), in some circumstances potential inventors will simply not enter the market and will never even consider invention. Miscalibrating permitted rates of return might have little effect in the short term, but in the long term could lead to greatly reduced entry.

A large permitted rate of return brings its own problems. This is especially true if there is a danger of inadvertent infringement. If cost-plus damages are to have any role in patent law, they would need to accommodate inadvertent infringers. For example, the law might provide that a good faith patent search provides immunity from liability. Or, less drastically, an inadvertent infringer might be allowed to opt for standard damages instead of cost-plus damages. This would reduce the incentive to invent for the purpose of mouse-trapping inadvertent infringers. Some of the criticisms of nonpracticing entities today suggest that they may seek to make their patents as inaccessible as possible in the hope of catching inadvertent infringers.[160] If these criticisms have any validity, the problem may become all that much more severe with cost-plus damages.

Even if the rate of return is set correctly, excessive spending by inventors will be a concern. The model of Part IV shows that in some conditions, cost-plus damages may improve social welfare even when inventors spend on invention many times more than they would spend in a world with patent damages. Nonetheless, if it were possible to discourage gold-plating, that could increase the attractiveness of cost-plus damages considerably. Perhaps the courts can simply determine how much the inventor *should* have spent on invention. But given that greater spending will generally increase the probability of invention, it will be difficult for the courts to do this with any accuracy, and shortchanging inventors may have the same adverse consequences as setting the rate of return unduly low.

Perhaps if the patent system was built entirely around cost-plus damages, some of these problems might be overcome. We have seen that spending declines markedly when the relevant spending is that of *all inventors*. In the present patent system, one doubts that it would be feasible for the courts to obtain data on all inventors. One could imagine a different system, however, in which inventors could receive risk-adjusted, cost-plus damages only on spending registered with the patent agency at the time of disbursement with clear indication of what the spending would be dedicated to. This data could be made public, so it could be used in intentional infringement litigation. Such a registry might also facilitate the calculation of risk. In principle, one could allow the public to make bets in prediction markets on the probability that the invention attempt would be successful.[161] This would provide

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[160] *See* Oskar Liivak & Eduardo Penalver, *The Right Note to Use in Property and Patent Law*, 98 CORNELL L. REV. 1437, 1448 (2013).

[161] *See generally* MICHAEL ABRAMOWICZ, PREDICTOCRACY xi-x (2007) (explaining how prediction markets work and how they could be used for public policy purposes).

the courts with contemporaneous evidence of risk-adjusted returns, saving the courts from the challenge of hindsight bias. One could even imagine such a registry being used to limit excessive entry, allocating rights to enter to inventors with a high chance of success and a willingness to accept a low rate of return.[162]

But this would be a patent system quite different from the one that we have now, introducing its own set of challenges. We cannot get to this patent system without at least some much more modest experimentation with cost-plus damages. For now, there is likely to be little danger in allowing cost-plus damages to be a small factor in the patent analysis. We have seen that the worst dangers of cost-plus damages do not emerge under some assumptions even when cost-plus damages are as much as half of the patent damages calculus. Such experimentation could allow assessment of how feasible it is to calculate risk-adjusted costs and perhaps to determine whether gold-plating is occurring. This would not be easy to measure, but a slight change in policy could provide a natural experiment that might make changes over time apparent. Should cost-plus damages prove relatively tractable, further experimentation might be warranted.

This analysis also gives some support to Brennan et al.'s eminent domain proposal. The proposal might make economic sense at least when cost-plus damages multiples seem especially large and high costs are thus unnecessary. As long as eminent domain is unlikely *ex ante*, it seems unlikely to lead to excessive spending. Yet it is important to be cautious here too. It is expensive and risky to create a pharmaceutical firm that subsequently might be in a position to complete an invention, and the costs of entry into the industry must be compensated (yet are very hard to allocate and calculate). The government ideally would focus not just on whether the returns seem high relative to investment, but also on whether the invention depended on an exogenous technological development that suddenly made a difficult problem relatively easy. These are the cases in which even if some patent incentive is necessary, the needed incentive might be much lower than it currently is. By contrast, if in principle the invention could have been developed earlier using much the same approach, we should assume that the full patent system was necessary, and eminent domain therefore would not be appropriate.

Returning to the patent system, we might someday follow an analogous approach. We might allow the defendant an option of choosing cost-plus damages. But this option would be limited in two ways. First, the defendant would need to establish that the invention is of marginal nonobviousness, at least when nonobviousness is interpreted in economic terms. Second, the applicable rate of return would be set with generous estimates of the risk and generous adjustments for the reality that entry costs are not easily allocable to particular projects. With these two rules, it might be possible to isolate cases in which patents are windfalls

[162] For a proposal that excessive entry sometimes might be limited by auctioning the right to attempt to invent in a particular area, see Michael Abramowicz, *The Uneasy Case for Patent Races over Auctions*, 60 STAN. L. REV. 803 (2007).

for trivial achievements. This would both discourage excessive entry in such cases and reduce prices paid by consumers. At the same time, it would minimize the risk that cost-plus damages might deter inventors from undertaking socially valuable projects because they expect their risk to be underestimated. Finally, because cost-plus damages would be the defendant's option, the tendency to spend excessively might be somewhat reduced.

Adjusting Patent Damages for Nonpatent Incentives

Lisa Larrimore Ouellette[†]

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Nonpatent innovation policies—including direct spending on grants and procurement, innovation prizes, and R&D tax incentives—are a significant part of innovation policy in practice and are attracting growing attention from legal scholars. When market-based patent incentives undervalue certain inventions, innovation is most efficiently incentivized by using these policies as complements, but in some cases, allowing researchers to claim nonpatent incentives in addition to patent rewards results in significant overcompensation. There are a few potential solutions to this reward-stacking problem, including limiting the patentability of inventions that have received significant alternative rewards, or conditioning nonpatent transfers on some relinquishment of patent rights. When the lost patent rewards are far more valuable than the nonpatent incentives, these solutions might

† Associate Professor of Law, Stanford Law School. Thanks to Rebecca Eisenberg, John Golden, Daniel Hemel, Mark Lemley, Glynn Lunney, Jonathan Masur, Doug Melamed, and Amy Proctor for helpful comments, and to Sam Goldstein for excellent research assistance. I received an honorarium for presenting this article as part of the 2017 Conference on Patent Damages at the University of Texas School of Law, but it was not in any way contingent on the views expressed in this article, which are solely my own.

be broader than the problem. This symposium contribution presents and evaluates an additional solution: reducing patent damages to account for the nonpatent rewards (including ex ante risk reduction) an invention has already received. Such an approach could improve not only the incentive side of innovation policy, but also the allocation side, by reducing deadweight loss while maintaining incentives to innovate. The ability of patent damages doctrine to help mediate between different bodies of innovation law is a benefit of recent proposals for patent damages reform that has thus far been overlooked.

I. Introduction

Although patent law historically has been the primary field in which legal scholars have thought about innovation policy,[1] in practice governments incentivize innovation and allocate access to knowledge goods through a wide variety of mechanisms, including direct spending on grants and procurement and tax incentives for research and development (R&D).[2] These state-sponsored nonpatent innovation policies have attracted significant recent interest from legal scholars.[3] In some cases, optimal innovation policy entails combining patent and nonpatent mechanisms.[4] But stacking policies can lead to two concerns: (1) overly large rewards on the incentive side, plus (2) the additional deadweight loss of relying on patents—and their attendant supracompetitive prices—to allocate access to the resulting knowledge goods.[5]

For example, the development of a new medical device—say, a wearable alcohol sensor—may well be most efficiently spurred through not just patent rights,[6] but also grants for speculative research ideas,[7] tax incentives to reduce capital costs and encourage entry by smaller firms,[8] and additional prizes to reward devices that

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1 *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1576 (2003) ("Patent law is our primary policy tool to promote innovation.").

2 *See generally* Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303, 315–26 (2013) (reviewing how patents, innovation prizes, direct R&D spending, and R&D tax incentives operate in the United States).

3 *See, e.g.*, Ian Ayres & Amy Kapczynski, *Innovation Sticks: The Limited Case for Penalizing Failures to Innovate*, 82 U. CHI. L. REV. 1781 (2015); Hemel & Ouellette, *supra* note 2; Amy Kapczynski, *The Cost of Price: Why and How to Get Beyond Intellectual Property Internalism*, 59 UCLA L. REV. 970 (2012). For more examples, see *infra* Section II.A. There are also incentives for innovation that are not facilitated by governments—such as first-mover advantage—but I use "nonpatent incentive" to refer to state-facilitated transfers from taxpayers to innovators.

4 *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Innovation Policy Pluralism*, 128 YALE L.J. (forthcoming), https://ssrn.com/abstract=3125784.

5 *See infra* Section II.B.

6 *See, e.g.*, U.S. Patent No. 8,078,334 cl. 1 (filed Jan. 23, 2008) (claiming a system including "a wearable device" that measures analytes including "alcohol").

7 *See, e.g.*, Jayoung Kim, *Noninvasive Alcohol Monitoring Using a Wearable Tattoo-Based Iontophoretic-Biosensing System*, 1 ACS SENSORS 1011, 1018 (2016) (reporting federal grant support from the NIH and the Defense Threat Reduction Agency).

8 *See Research and Development Tax Incentives for the Medical Equipment Industry*, ALLIANT GROUP, https://www.alliantgroup.com/index.php/industries/manufacturing/medical-equipment-

are undervalued by the market (due, for example, to positive externalities for third parties who are less likely to be harmed in alcohol-related accidents).[9] Yet allowing one firm to claim these nonpatent incentives in addition to full patent rents might lead to returns far in excess of what was needed to incentivize development efficiently. Furthermore, stacking patents on top of nonpatent rewards does nothing to capitalize on one of the main benefits of nonpatent mechanisms: reducing deadweight loss by funding the reward through broad-based taxation rather than proprietary pricing.[10]

There are a number of potential solutions to this reward-stacking problem, including limiting the availability of patent rights as a matter of patent doctrine in areas with significant nonpatent incentives, or conditioning receipt of nonpatent incentives on more limited patent rights.[11] This Article examines an additional solution: reducing patent damages to account for the nonpatent rewards that an invention has received, including the *ex ante* reduction of risk. The goal would be to reduce patent rents—and thus the corresponding loss to society—by either inducing efficient infringement or incentivizing the patentee to lower prices in order to preserve market share. This proposal could be implemented, for example, as part of recent proposals to base damages to some degree on an innovator's risk-adjusted R&D costs.[12] Incorporation of nonpatent rewards into this cost-based approach is a doctrinal tool for mediating between different bodies of innovation law that has thus far been overlooked.

To be sure, moving to an entirely cost-based system of patent damages would be a significant change from current practice, with numerous administrative difficulties.[13] For example, identifying the R&D projects that should be lumped together for purposes of calculating costs and nonpatent rewards would be an important boundary-drawing problem. Compared with the other costs and benefits

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manufacturer (last visited Jan. 19, 2017).

9 *See, e.g.*, Sean Hollister, *This Alcohol Monitoring Wristband Just Won a $200,000 Prize*, CNET (Jan. 18, 2017), https://www.cnet.com/news/bactrack-skyn-blood-alcohol-content-wristband.

10 Taxes funded through broad-based taxation—in which taxpayers cross-subsidize each other's knowledge-good consumption—generally impose less deadweight loss than IP. *See* Steven Shavell & Tanguy Van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 530 (2001). This efficiency gain disappears if the nonpatent incentives are funded through a concentrated tax. *See* Hemel & Ouellette, *supra* note 2, at 350.

11 *See infra* Section II.C.

12 *See* Ted Sichelman, *Innovation Factors for Reasonable Royalties*, 25 TEX. INTELL. PROP. L.J. 277 (2018) [hereinafter Sichelman, *Innovation Factors*]; Ted Sichelman, *Purging Patent Law of "Private Law" Remedies*, 92 TEX. L. REV. 517, 528 (2014) [hereinafter Sichelman, *Purging Patent Law*]; John M. Golden & Karen Sandrik, *A Restitution Perspective on Reasonable Royalties*, 36 REV. LITIG. 335 (2017); *see also* Hannah Brennan, Amy Kapczynski, Christine H. Monahan & Zain Rizvi, *A Prescription for Excessive Drug Pricing: Leveraging Government Patent Use for Health*, 18 YALE J.L. & TECH. 275, 310–12 (2016) (proposing a similar approach for calculating damages for government patent use under 28 U.S.C. § 1498); *infra* Section III.B.1 (reviewing this literature). For an economic analysis of these proposals, *see* Michael Abramowicz, *Cost-Plus Damages*, 26 Tex. Intell. Prop. L.J. 133 (2018).

13 *See, e.g.*, *infra* notes 135–136 and accompanying text.

associated with this shift, the ability to more easily account for nonpatent incentives may seem like a second-order concern. And such a policy would certainly not solve all stacking problems. For one thing, it would be inapplicable in cases in which patentees receive injunctions rather than damages—though perhaps the existence of extensive nonpatent funding should affect whether injunctions are available in a given technical field. The net welfare effect of shifting to cost-based damages is an empirical question that closely tracks whether R&D tax credits (a cost-based reward) or traditional patent remedies based on market exclusivity will provide more efficient transfers to knowledge-good producers, which I have discussed in prior work with Daniel Hemel.[14]

But the purpose of this Article is not to prove that this approach to patent damages is uniformly superior to either current damages doctrine or to other potential solutions to the problem of too many stacked innovation incentives. Rather, my modest goal is to show that there is not yet a satisfactory legal interface between patent and nonpatent innovation policies, and that patent damages doctrine is one viable policy tool to fill this gap. Importantly, one need not wholeheartedly embrace cost-based damages to adopt this approach. The same doctrinal hooks that support entirely cost-based damages could be used for a more modest intervention in which patent damages are reduced to account for nonpatent rewards no matter how those damages are initially calculated.

Below, Part II unpacks the problem of stacked innovation policies and explores the different policy levers for tackling this problem. Part III presents this Article's solution: adjusting patent damages to account for related nonpatent incentives. Finally, Part IV explains how this approach could be used not just for improving the mix of policies on the incentive side of innovation policy, but also on the allocation side. Economic theory indicates that despite the screening value that market power provides, somewhat reducing a patentee's market power without reducing innovation incentives is likely to be welfare enhancing.[15] Reducing patent damages while compensating patentees with nonpatent measures funded through broad-based taxation may well be administratively simpler than patent auctions and other proposals to accomplish the same goal.

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[14] *See* Hemel & Ouellette, *supra* note 2, at 328–31 (explaining why in certain circumstances, a system that relies more heavily on tax credits—or on a combination of tax credits and weak patents—could outperform a purely patent-based system).

[15] *See* 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, 989, 1031 (1999) (explaining that "the last increment by which an unconstrained patentee chooses to increase price hurts society much more than it helps the patentee" and proposing a duopoly auction); E. Glen Weyl & Jean Tirole, *Market Power Screens Willingness-To-Pay*, 127 Q.J. ECON. 1971 (2012) (explaining that innovation policy involves a trade-off between the screening benefit of market power and the resulting pricing distortion, such that neither pure monopoly nor pure open access is the optimal allocation regime).

II. Nonpatent Incentives and Overcompensation

This Part sets out the problem that this Article is attempting to solve. Section II.A describes how state-sponsored nonpatent incentives are already a significant part of U.S. innovation policy in practice and why they sometimes may be preferable to patents. Readers already familiar with this literature may wish to skip to Section II.B, which explains why the current legal framework for nonpatent policies can lead to supra-optimal transfers to innovators. If that point seems obvious, I suggest jumping directly to Section II.C, where I present a variety of possible responses to this problem aside from tackling it through patent damages doctrine.

A. Nonpatent Innovation Policies

The case for government intervention in the market for inventions and other knowledge goods is well established. Because knowledge goods are nonrivalrous, they benefit parties other than the producer, and because they are often only partially excludable, those third parties are difficult to exclude from the goods' benefits.[16] But rational producers will invest only to the point that *their* marginal benefit exceeds their marginal cost, which will be less than the socially optimal amount that includes others' benefits. The standard justification for patent laws is that they make knowledge goods more excludable, allowing the patentee to charge above-marginal-cost prices, which increases incentives for production.[17] Patents thus are analogous to a "shadow tax" on knowledge goods, with the revenues going directly to the knowledge-good producers.[18]

Patents are not the only way that the state can increase incentives for the production of knowledge goods: producers can also be rewarded using tools such as direct R&D spending (including grants, intramural research, and procurement), innovation prizes, and R&D tax incentives. In earlier work, Daniel Hemel and I developed a framework for comparing these policies, in which we argue that no one incentive mechanism is uniformly superior.[19] For example, while patents leverage private information about the costs and benefits of potential projects, they may be

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[16] *See generally* Daniel J. Hemel & Lisa Larrimore Ouellette, *Knowledge Goods and Nation-States*, 101 MINN. L. REV. 167, 168–70, 192–200 (2016) (explaining this basic principle in more detail and discussing the extent to which knowledge goods are global public goods).

[17] *See, e.g.*, 3 ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 143–44 (4th ed., London, W. Strahan & T. Cadell 1786) (bk. V, ch. 1, para. 119); PETER S. MENELL ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE: 2017, at 16–18 (2017).

[18] Hemel & Ouellette, *supra* note 2, at 312–14, 371–73.

[19] For the framework, see *id.* at 326–52. For a discussion of the circumstances in which each kind of policy might be optimal, see *id.* at 375–78. For some of the seminal papers our work built upon, see Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, *in* 2 INNOVATION POLICY AND THE ECONOMY 51 (Adam B. Jaffe et al. eds., 2002); Shavell & Van Ypersele, *supra* note 10; Joseph E. Stiglitz, *Economic Foundations of Intellectual Property Rights*, 57 DUKE L.J. 1693 (2008); Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691 (1983).

less efficient than government-set grants and prizes when market value is a poor proxy for social value or when the government has a comparative advantage in evaluating potential avenues for R&D spending.[20] And while *ex post* rewards like patents provide a strong incentive to success, their delayed and speculative nature means that for risky research with binding capital constraints, society may get more "bang for its buck" with *ex ante* rewards like grants and tax incentives.[21]

These nonpatent incentives are not merely of theoretical interest. In 2013, the federal government spent over $130 billion on direct R&D spending (including a small amount on prizes) and over $12 billion on the two general R&D tax incentives.[22] The patent shadow tax is more difficult to estimate because it is transferred directly from consumers to producers without passing through the government budget, but it is likely less than the amount transferred through nonpatent incentives.[23]

State-facilitated nonpatent incentives have long been a part of the real world of innovation policy, but they have lately attracted a surge of interest from IP scholars.[24] As just one example, while there is a long literature on how low-cost forms of cultural production can occur without IP,[25] it is only more recently that legal scholars have developed case studies of how nonpatent incentives have worked as a supplement or replacement for the patent system in more capital-intensive research fields such as fracking or vaccine development.[26] (Of course,

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20 Hemel & Ouellette, *supra* note 2, at 327–32.

21 *Id.* at 333–43.

22 *See id.* at 321 & n.75, 322–23 & n.85, 325 & n.103 (citing sources).

23 *See id.* at 372 & n.311.

24 *See, e.g.*, Ayres & Kapczynski, *supra* note 3, at 1782–83 (noting that while the innovation literature has focused on IP, "[r]ecent attention has also been given to additional mechanisms," and focusing on the role "innovation sticks" can play); Kapczynski, *supra* note 3, at 970 ("In the field of IP, I conclude, we should pay less attention to IP and more to the alternatives."). One marker of this recent interest is the large number of scholars who convened at Yale Law School in 2014 and 2015 for two conferences on "Innovation Law Beyond IP." For a description of the second conference, see Lisa Ouellette, *Innovation Law Beyond IP 2*, WRITTEN DESCRIPTION (Mar. 28, 2015), https://writtendescription.blogspot.com/2015/03/the-second-innovation-law-beyond-ip.html.

25 *See generally* Kal Raustiala & Christopher Jon Sprigman, *When Are IP Rights Necessary? Evidence from Innovation in IP's Negative Space*, *in* RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW (Peter Menell et al. eds., forthcoming 2019), https://ssrn.com/abstract=2838555 (reviewing this literature).

26 *See* John M. Golden & Hannah J. Wiseman, *The Fracking Revolution: Shale Gas as a Case Study in Innovation Policy*, 64 EMORY L.J. 955, 962 (2015) ("[P]atents appear to have been only bit players in the basic story behind the fracking revolution."); Amy Kapczynski, *Order Without Intellectual Property Law: Open Science in Influenza*, 102 CORNELL L. REV. 1539 (2017) (studying how the transnational public scientific network that develops flu vaccines operates without resource to conventional IP); Lisa Larrimore Ouellette, *Nanotechnology and Innovation Policy*, 29 HARV. J.L. & TECH. 33, 71 (2015) (concluding that the development of nanotechnology has involved substantial use of both patents and other state-facilitated transfers to innovators); Laura G. Pedraza-Fariña, *Constructing Interdisciplinary Collaboration: The Oncofertility Consortium as an Emerging Knowledge Commons*, *in* GOVERNING KNOWLEDGE COMMONS 259 (Katherine

these fields also benefit from nonpatent *market* incentives such as first-mover advantage; as noted previously, I am using "nonpatent incentives" to refer to state-facilitated transfers from knowledge-good consumers to knowledge-good producers.[27]) In sum, it now seems widely recognized among legal scholars that patent law is not the state's only—or even primary—tool to promote innovation. But what is less clear is how, if at all, this should change how patent law scholars should think about patent law.

B. The Reward-Stacking Problem

In practice, U.S. policy tends to offer nonpatent rewards as a complement to patent rights, not a substitute for them.[28] Under the Bayh–Dole Act, federal grant recipients may patent the results of their research,[29] and the Stevenson–Wydler Act sets similar technology transfer rules for researchers in federal laboratories.[30] By default, winners of innovation prizes from federal agencies retain their intellectual property rights.[31] And R&D tax incentives do not place any limits on the recipients' patent rights.[32]

Allowing producers to claim both patent and nonpatent rewards for the same knowledge good raises an obvious concern: Are we sometimes offering *too much* reward? Overcompensation is not merely an unnecessary wealth transfer; it also leads to deadweight loss from raising the funds. This is a problem for nonpatent incentives funded through general tax revenues, and—given the heightened inefficiencies of a concentrated tax—an even bigger problem for funding research on the same knowledge goods through the patent shadow tax.[33] Overly large rewards for knowledge-good producers might also lead to inefficient "racing" to claim the reward.[34]

Overcompensation can be a problem with patent incentives alone, even before

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Strandburg et al. eds., 2017) (studying the grant-funded oncofertility consortium and concluding that the role of patents was largely as an attributional device).

27 *See supra* note 3.

28 *See generally* Hemel & Ouellette, *supra* note 4 (examining when this makes sense from a theoretical perspective).

29 35 U.S.C. § 200–12 (2012).

30 15 U.S.C. § 3701–14 (2012).

31 *See* 15 U.S.C. § 3719(j)(1) (prohibiting the agencies from acquiring an intellectual property right in the invention without written consent).

32 *See generally* I.R.C. § 41, 174 (2012).

33 *See* Gallini & Scotchmer, *supra* note 19, at 54; Shavell & Van Ypersele, *supra* note 10, at 526–627 (2001).

34 *See* Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 185–87 (2003) (describing the "three related problems" with patent races: "excessive innovative activity," "duplicative" research, and reinforcement of "inefficient industrial structures"). *But see* Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 709 (2012) ("Patent racing cannot alone justify a patent system, but it may do more than any existing theory to explain how patents work in practice."). Whether patent races are in fact efficient, and whether nonpatent incentives can outperform patents in this regard, are empirical questions. *See* Hemel & Ouellette, *supra* note 2, at 360–61.

nonpatent incentives are added to the picture. The holder of a patent on a small component of a complex product may receive more than the social value actually added by that component by threatening an injunction against the entire product[35] or by bargaining in the shadow of an inflated damages award based on improper use of *ex post* considerations such as lock-in costs.[36] But even if patent damages were precisely calibrated to the marginal social value provided by an invention and there were no bargaining breakdowns, patents would still sometimes overcompensate inventors in those cases where the invention would still have been made for less than its social value.[37] Ted Sichelman suggests, quite plausibly, that excessive incentives are more likely for software than for pharmaceuticals.[38] But even in the pharmaceutical industry, producers generally do not need to receive what the market will bear for every drug. For example, a recent study at Yale concluded that the list prices for Gilead's new drugs for treating Hepatitis C approach $100,000 for a twelve-week regimen, resulting in $36 billion in earnings in the drugs' first twenty-seven months—likely around forty times the total cost of developing the drugs.[39] (Of course, patents may *under*compensate as well, including for pharmaceuticals, such that not all welfare-enhancing R&D projects are pursued.[40])

Adding nonpatent rewards to the mix exacerbates the overcompensation problem, though it can also ameliorate undercompensation. As noted above, total state-facilitated transfers from U.S. consumers to U.S. knowledge-good producers

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35 *See* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 1993 (2007). As Ted Sichelman emphasizes, Lemley and Shapiro's arguments against injunctions for minor components of complex products apply to any patentee, practicing or not. Sichelman, *Innovation Factors*, *supra* note 12, at 301–02.

36 *See* William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385, 413 (2016).

37 *See* Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 276 (2007) ("[I]nventors do not need to capture the full social value of their inventions in order to have sufficient incentive to create."); Hemel & Ouellette, *supra* note 2, at 329–31 (explaining why the patent reward may differ from the optimal transfer size to an innovator).

38 Sichelman, *Innovation Factors*, *supra* note 12, at 302–03.

39 Brennan et al., *supra* note 12, at 278, 328. For the argument that this is excessive and the calculation of a more appropriate reward, see *id.* at 328–30. This supracompetitive return is primarily due to a combination of patents and patent-like regulatory exclusivity provided by the FDA. *See* Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 UC IRVINE L. REV. 1115, 1130 (2015).

40 This can be due to the social value of the invention exceeding the value that can be appropriated through a twenty-year patent, or to inefficiencies in enforcement, such as undetected infringement or errors in adjudication. *See, e.g.*, Eric Budish, Benjamin N. Roin & Heidi Williams, *Do Firms Underinvest in Long-Term Research? Evidence from Cancer Clinical Trials*, 105 AM. ECON. REV. 2044, 2047 (2015) (finding R&D distortion away from drugs to prevent or treat early-stage cancers that require longer clinical trials and thus have shorter effective patent term); Michael Abramowicz, *A Unified Economic Theory of Noninfringement Opinions*, 14 FED. CIRCUIT B.J. 241, 249 (2004) (calling for enhanced damages to counteract undetected infringement, where "cost internalization requires that the damages multiplier be the inverse of the probability of detection"); Anup Malani & Jonathan S. Masur, *Raising the Stakes in Patent Cases*, 101 GEO. L.J. 637, 641 (2013) (noting that patents may undercompensate due to the risk that a valid patent will be mistakenly invalidated in litigation).

through nonpatent mechanisms may well be greater than transfers through the patent shadow tax.[41] The largest source of nonpatent rewards is direct spending on grants and government laboratories, so this problem directly connects to the debate over whether patents should be allowed on taxpayer-funded inventions through the Bayh–Dole and Stevenson–Wydler Acts.

As is well established in the Bayh–Dole literature, there are some cases in which even after an invention has been created through grant-funded research, an additional incentive (such as the exclusivity provided by a patent) is needed to commercialize that invention.[42] The prototypical example is a promising new drug compound, for which pharmaceutical companies generally will not undertake the expense of clinical trials without sufficient patent rights.[43] But as Mark Lemley has noted, "the validity of commercialization theory depends a great deal on the industry in question and the particular nature of the technology."[44] The widespread use of nonexclusive licenses for grant-funded inventions suggests that in many cases, exclusive patent rights are *not* needed to bring these inventions to market.[45] Numerous commentators thus have expressed concern that in many cases, Bayh–Dole patents force U.S. taxpayers to "pay twice" for patented products,[46] by which they presumably mean simply that the public is paying more than is needed to bring the invention to market efficiently. Overcompensation of grant-funded researchers through unnecessary patent rights can lead to substantial deadweight loss.[47]

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41 *See supra* notes 22–23 and accompanying text.

42 *See, e.g.*, Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1669 (1996).

43 *See* Benjamin N. Roin, *Unpatentable Drugs and the Standards of Patentability*, 87 TEX. L. REV. 503, 503 (2009).

44 Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 622–23 (2008); *see also* Mark A. Lemley & Robin Feldman, *Patent Licensing, Technology Transfer, and Innovation*, 106 AM. ECON. REV.: PAPERS & PROC. 188, 189 (2016) (reviewing the literature on the ways patents can help commercialization, and noting that "there is increasing evidence that [non-practicing entities that assert patents] are *targeting* successful commercializers rather than facilitating new commercialization").

45 *See* Ian Ayres & Lisa Larrimore Ouellette, *A Market Test for Bayh–Dole Patents*, 102 CORNELL L. REV. 271, 275–76 & n.16 (2017) (noting that over sixty percent of university inventions are licensed nonexclusively and arguing that "a nonexclusive license is prima facie evidence that the invention ought not to have been patented at all"). *But see* Daniel J. Hemel & Lisa Larrimore Ouellette, *Bayh–Dole Beyond Borders*, 4 J.L. & BIOSCIENCES 282 (2017) (suggesting an overlooked benefit of Bayh–Dole patents).

46 *See, e.g.*, Rochelle Cooper Dreyfuss, *Collaborative Research: Conflicts on Authorship, Ownership, and Accountability*, 53 VAND. L. REV. 1161, 1194 (2000); Rebecca S. Eisenberg, *Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research*, 82 VA. L. REV. 1663, 1666 (1996); Bhaven N. Sampat & Frank R. Lichtenberg, *What Are the Respective Roles of the Public and Private Sectors in Pharmaceutical Innovation?*, 30 HEALTH AFF. 332, 333 (2011); *cf.* Bd. of Trs. of Leland Stanford Jr. Univ. v. Roche Molecular Sys., 131 S. Ct. 2188, 2201 (2011) (Breyer, J., dissenting) (arguing that there must be some compensating benefit of Bayh–Dole because otherwise, "Why should the public have to pay twice for the same invention?").

47 *See supra* note 33 and accompanying text. One prominent example is the $255 million in nonexclusive patent license fees that Stanford received for the Cohen–Boyer patents on early

C. Potential Solutions

The prior literature suggests at least two classes of solutions to the reward-stacking problem described in Section II.B aside from reducing patent damages. First, the patentability of inventions that have received significant nonpatent incentives could be limited, such as through patentable-subject-matter or nonobviousness doctrines.[48] Second, nonpatent incentives could be conditioned on some relinquishment of patent rights, such as through limits on the ability to patent or exclusively license the results of federally funded research. This Section explains these possibilities in turn.

One possible doctrinal avenue for limiting patents on inventions that have received sufficient nonpatent incentives is to consider such inventions not within the judicially created limits on patentable subject matter under § 101.[49] The Supreme Court justifies its limits on patenting laws of nature, natural phenomena, and abstract ideas based on the concern that "'[m]onopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it,' thereby thwarting the primary object of the patent laws."[50] As I have previously explained, for those who think patentable-subject-matter boundaries should be based on an explicit economic balancing of incentives, this balancing must account for widespread use of nonpatent incentives.[51] For example, Katherine Strandburg suggests that subject matter ought to be defined based on whether patent law is the best institutional mechanism for rewarding innovations of that type, or whether an alternative approach is more effective.[52] A difficulty with widespread use of such an approach, however, is that subject-matter boundaries would vary as the state adds or removes incentives.[53] Defining how broadly such boundaries should be drawn would also be challenging.[54]

The nonobviousness requirement of § 103 may be a more promising policy lever for the fact-intensive inquiry of whether a given invention has already received sufficient state-facilitated support.[55] A number of commentators have

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recombinant DNA technology. *See* Ayres & Ouellette, *supra* note 45, at 275.

48 *Cf.* Benjamin N. Roin, *The Case for Tailoring Patent Awards Based on Time-to-Market*, 61 UCLA L. REV. 672, 700–01 (2014) (criticizing "glaring oversights in the standards of patentability [that] routinely allow firms to patent many inventions that they would have developed anyway" by ignoring factors such as "R&D costs").

49 35 U.S.C. § 101 (2012).

50 Alice Corp. Pty. v. CLS Bank Int'l, 134 S. Ct. 2347, 2354 (2014) (quoting Mayo Collaborative Servs. v. Prometheus Labs., Inc., 132 S. Ct. 1289, 1293 (2012)).

51 Ouellette, *supra* note 39, at 1143–44.

52 Katherine Strandburg, Patentable Subject Matter from First Principles (July 24, 2015) (unpublished manuscript) (on file with author).

53 Ouellette, *supra* note 39, at 1144.

54 For example, is funding for dynamically crosslinked hydrogels for drug delivery an incentive for biomaterials, drug delivery, medicine, or just the narrow category of dynamically crosslinked hydrogels for drug delivery?

55 35 U.S.C. § 103 (2012).

suggested that the test for whether an invention is obvious under § 103 should be explicitly based on economic considerations, with the possible doctrinal hook of the Supreme Court's admonition in *Graham v. John Deere* that the nonobviousness requirement is meant to limit patents to only "those inventions which would not be disclosed or devised but for the inducement of a patent."[56] Michael Abramowicz and John Duffy note that this test might "be viewed as establishing too stringent of an obviousness standard where the nonpatent inducements for innovation are especially powerful."[57] But this seems like a valuable feature of this approach, not a bug.

A second category of solutions is to tackle stacking not through patent doctrines, but rather through conditions on nonpatent incentives. For example, the government (or any private firm or foundation) could condition a grant or a prize on acceptance of some limitation on patent rights, including forgoing patenting altogether. While a *mandatory* requirement to use only nonpatent rewards for a given technology would require an overhaul of the Patent Act and would violate U.S. obligations under the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS),[58] an *opt-in* nonpatent reward system poses no legal problems.[59]

For example, the Bayh–Dole Act already imposes some limitations on the patent rights of federal grant recipients, at least in theory.[60] (In practice contractors

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56 Graham v. John Deere Co., 383 U.S. 1, 11 (1966); *see* Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L.J. 1 (1992); Glynn S. Lunney, Jr., *E-Obviousness*, 7 MICH. TELECOMM. & TECH. L. REV. 363 (2001); Tun-Jen Chiang, *A Cost-Benefit Approach to Patent Obviousness*, 82 ST. JOHN'S L. REV. 39, 105 (2008); Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1590 (2011). Abramowicz and Duffy explain that this standard cannot mean "would not ever be disclosed" or "would not immediately be disclosed" but must mean "would not have been disclosed or devised for a substantial period of time" (such that the benefits of granting the patent outweigh the costs). Abramowicz & Duffy, *supra*, at 1599.

57 Abramowicz & Duffy, *supra* note 56, at 1623.

58 *See* 35 U.S.C. § 101 (2012); Agreement on Trade-Related Aspects of Intellectual Property Rights art. 27, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299, 33 I.L.M. 1197 [hereinafter TRIPS] ("[P]atents shall be available for any inventions, whether products or processes, in all fields of technology . . . .").

59 *See generally* WILLIAM W. FISHER III & TALHA SYED, *Prizes*, *in* INFECTION: THE HEALTH CRISIS IN THE DEVELOPING WORLD AND WHAT WE SHOULD DO ABOUT IT 37 (forthcoming 2018).

60 The agency that sponsored the grant is entitled to "a nonexclusive, nontransferable, irrevocable, paid-up license" to the patents, and any U.S. patent application must specify "that the Government has certain rights in the invention." 35 U.S.C. § 202(c)(4), (6); 37 C.F.R. § 401.14(a), cl. (b). The agency may also "require periodic reporting on the utilization" of the invention, 35 U.S.C. § 202(c)(5); 37 C.F.R. § 401.14(a), cl. (h), and may exercise "march-in" rights to issue additional licenses to the invention if the contractor is not taking "effective steps to achieve practical application" or "to alleviate health or safety needs," 5 U.S.C. § 203(a); 37 C.F.R. § 401.6, 401.14(a), cl. (j). Exclusive licensees of Bayh–Dole patents must agree "that any products embodying the subject invention or produced through the use of the subject invention will be manufactured substantially in the United States" unless domestic manufacture is infeasible. 35 U.S.C. § 204; 37 C.F.R. § 401.14(a), cl. (i).

often fail to satisfy their reporting obligations and agencies have never exercised so-called march-in rights.[61]) A number of scholars have proposed limits on Bayh–Dole patent rights to help better align the patent reward with the socially optimal transfer.[62] There have also been proposals for innovation prize systems in which the prizes are conditioned on relinquishing traditional patent rights.[63]

Of course, the solutions described above are not mutually exclusive: we can use the nonobviousness doctrine to limit patents on inventions that would be created without the inducement of the patent system due to strong nonpatent incentives *and* condition some nonpatent rewards on curtailment of patent rights. And these possibilities do not exhaust the entire solution space for the reward-stacking problem. The following Part turns to a different solution, which could be used in conjunction with or as an alternative to the ones already described.

III. Accounting for Nonpatent Incentives Through Patent Damages

As explained in Part II, although nonpatent incentives are ubiquitous in practice, they may lead to supra-optimal transfers to knowledge-good producers in some cases. This Part presents an alternative solution to those described in Section II.C: accounting for nonpatent incentives in patent damages awards. Before turning to any practical details, note that an important policy choice is what happens with the money saved through the reduced award: is it paid by infringers and then returned to the public fisc by the patentee, or is each infringer's liability reduced? Although taxpayers may seem to be more deserving recipients than infringers, as discussed below, the choice is not so straightforward, even as a theoretical matter.

Section III.A briefly describes the first option, in which patentees reimburse the government for relevant nonpatent funding out of patent rewards from litigation or licensing, and explains why this is not necessarily superior. Section III.B then discusses how patent damages might be reduced to account for nonpatent transfers, either as part of the broader "cost-plus" damages framework that other scholars have advocated or as a more modest adjustment to the current damages approach.

A. Repaying Nonpatent Rewards from Patent Damages

Requiring patentees to repay nonpatent transfers out of patent revenues is perhaps the simplest solution to the reward-stacking problem, at least if Congress were willing to pass the necessary legislation (a not insignificant hurdle). This solution could not be implemented as a matter of current patent doctrine, but it

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61 *See* Arti K. Rai & Bhaven N. Sampat, *Accountability in Patenting of Federally Funded Research*, 30 NATURE BIOTECHNOLOGY 953, 954–55 (2012); Ryan Whalen, Note, *The Bayh–Dole Act & Public Rights in Federally Funded Inventions: Will the Agencies Ever Go Marching in?*, 109 NW. U. L. REV. 1083 (2015).

62 Ayres & Ouellette, *supra* note 45.

63 *See, e.g.*, AIDAN HOLLIS & THOMAS POGGE, THE HEALTH IMPACT FUND: MAKING NEW MEDICINES ACCESSIBLE FOR ALL (2008), http://healthimpactfund.org/wp-content/uploads/2015/12/hif_book.pdf.

could be statutorily required under the Patent Act or under legislation that allocates tax revenues toward nonpatent incentives such as grants, prizes, or tax credits. For example, rather than restricting Bayh–Dole patent rights, one could give federal grant recipients complete freedom to exploit any resulting patents for the maximum patent rents through licensing and litigation, but with the condition that the initial grant be repaid to the Treasury.

The amount of nonpatent funding an entity has received should be relatively easy to determine from government records, although there still would be challenges in deciding whether rewards should be partitioned among different projects and whether the government should receive an additional return based on the risk reduction the entity received. For nonpatent funding that is intended to address undercompensation through the patent system—such as for environmental research or other projects with significant positive externalities beyond the normal spillovers from innovation—the relevant agency could waive the payback requirement.

Given the relative simplicity of this approach compared with a policy of having excess rewards reduced from each infringer's bill (discussed in the following Section), having patentees repay nonpatent rewards might seem clearly superior. But reimbursing taxpayers has an important downside: it does not allow nonpatent rewards funded through broad-based taxation to reduce the deadweight loss of knowledge-good allocation. The choice of what happens to the money saved through the reduced patent damages award is a choice about *who pays* for the relevant knowledge good. When excess rewards are returned to the Treasury, those rewards are paid by infringers, which means they are ultimately paid by consumers of the knowledge good through the patent shadow tax. When excess rewards are subtracted from the damages awards that infringers must pay, those rewards are paid by all taxpayers, such that they cross-subsidize each other's knowledge-good consumption.

This *who pays* question has obvious distributive implications, and one's views on whether the costs of knowledge-good production should be concentrated on users of those goods likely varies by context.[64] For example, for most readers, cross-subsidization probably seems more attractive for research on life-saving medicine than yachts. But the choice is not merely distributive; it is also inextricably connected with economic efficiency. As I will explain in Part IV, the most efficient allocation mechanism for a given knowledge good is likely neither pure user-pays, with the transfer paid only through the patent shadow tax, nor pure cross-subsidization, with the transfer paid only through general tax revenues and goods allocated at marginal cost. Suffice it to say for now that any such efficiency gain would not be realized if all incentives funded through general tax revenues had to be repaid.

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[64] *See* Hemel & Ouellette, *supra* note 2, at 350.

There may be some cases, of course, in which a repayment requirement would not lead to purely user-pays allocation: such a requirement would likely deter patentees from pursuing only low-value infringers, since they might then have to forfeit the entire damages reward. This is probably a net benefit of the policy rather than a cost, given the high transaction costs of litigation and licensing. If the total market value of the invention that can be recovered through exploiting the patent is less than the nonpatent funding the patentee has received, then enforcing the patent would simply result in a transfer from knowledge-good users to all taxpayers. This wealth transfer in *who pays* would not lead to any additional incentive for the patentee, and it would come with the transaction costs of patent enforcement, so avoiding enforcement is likely to be salutary. But note that this benefit is present whether the patentee must repay nonpatent rewards or simply cannot recover as large of patent rewards in the first place. The latter option is explored in depth in the following Section.

B. Reducing Patent Damages Based on Nonpatent Rewards

The remainder of this Part examines how patent damages awards could be reduced based on the nonpatent funding a patentee has already received. While this approach raises logistical complications beyond those of the repayment option described in Section III.A, such as how this benefit should be allocated among multiple infringers, it has the practical advantage of being implementable through judicially developed patent doctrine, as well as the allocative efficiency benefit described in more detail in Part IV. Before turning to nonpatent rewards in particular, I begin by reviewing the growing literature suggesting that patent damages should be more heavily based on the patentee's risk-adjusted R&D costs.

1. Calculating Damages Based on the Patentee's Costs

The Patent Act entitles successful patent plaintiffs to "damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer."[65] In over two-thirds of cases, damages are based only on this floor of a "reasonable royalty."[66] According to the Lex Machina database of patent lawsuits filed beginning in 2000, district courts have awarded a total of $17.9 billion patent damages in 537 cases, of which $14.1

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[65] 35 U.S.C. § 284 (2012). While the focus of this Article is on damages, patentees may also receive injunctions, *id.* § 283, which will be discussed in more detail below, *see infra* notes 117–121, as well as treble damages for willful infringement and attorney's fees "in exceptional cases," 35 U.S.C. §§ 284–85; *see* Halo Elecs., Inc. v. Pulse Elecs., Inc., 136 S. Ct. 1923 (2016) (enhanced damages under § 284); Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749 (2014) (attorney's fees under § 285).

[66] *See* PRICEWATERHOUSECOOPERS, 2015 PATENT LITIGATION STUDY: A CHANGE IN PATENTEE FORTUNES (2015), https://www.pwc.com/us/en/services/forensics/library/patent-litigation-study-2015.html (reporting that from 2005 to 2014, 81% of patent damage awards were based on reasonable royalties, 31% were based on lost profits, and 2% were based on price erosion, with totals exceeding 100% because some litigants receive damages under both lost profits and reasonable royalties).

billion in 471 cases was for reasonable royalties, while $3.9 billion in 166 cases was for the patentee's lost profits (with 66 cases involving an award of both).[67] While Lex Machina does not report whether these awards were modified on appeal, these figures are likely a vast understatement of the impact of patent damages awards. Many patent royalties are efficiently negotiated without resort to the court system, and most patent lawsuits are settled before judgment, with these private settlement values being based on the parties' expectations of the outcome in the courts, including the expected damage award.[68] Additionally, the possibility of large damages deters some firms from entering some patent-protected markets at all, and thus affects pricing in these industries.

While there are accepted nonexclusive multi-factor tests for calculating patent damages—namely, the fifteen-factor *Georgia-Pacific* test for reasonable royalties[69] and the four-factor *Panduit* test for lost profits[70]—patent damages law has faced a barrage of criticisms and seems far from settled.[71] John Golden has summarized the confusion: "We really have little specific sense of what the value of remedies for patent infringement generally is or should be. And it seems unlikely that we will develop a precise idea anytime soon."[72] The summary of a recent expert workshop at Berkeley calls damages "one of the most contentious topics in this field" of patent law.[73]

Commentators have made a host of suggestions for improving patent damages law, including in many of the articles prepared for this conference, the relative merits of which are beyond the scope of this article.[74] In the remainder of this section, I summarize one approach that has been proposed recently by some prominent scholars: basing patent damages awards more heavily on the patentee's costs of invention, including adjustments for risk and opportunity costs. While these proposals have different doctrinal foundations, they are each based on the same

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67 *See* LEX MACHINA, https://lexmachina.com (search conducted Jan. 19, 2017).

68 *See, e.g.*, John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1780 (2014) (reporting that of patent lawsuits filed in 2008 and 2009, fewer than ten percent resulted in a merits decision); Robert D. Cooter & Daniel L. Rubinfeld, *Economic Analysis of Legal Disputes and Their Resolution*, 27 J. ECON. LIT. 1067, 1075 (1989) (reviewing the literature on settlement).

69 *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009) (citing Georgia–Pac. Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970)).

70 *See* Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1545 (Fed. Cir. 1995) (en banc) (citing Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152 (6th Cir. 1978)).

71 *See, e.g.*, Lee & Melamed, *supra* note 36; Mark A. Lemley, *The Ongoing Confusion over Ongoing Royalties*, 76 MO. L. REV. 695, 704 (2011); Jonathan S. Masur, *The Use and Misuse of Patent Licenses*, 110 NW. U. L. REV. 115 (2015). For a thoughtful diagnosis of the underlying problem, see Tun-Jen Chiang, *The Information-Forcing Dilemma in Damages Law* (George Mason Univ. Law & Econ. Research Paper No. 16-37, 2016), https://ssrn.com/abstract=2829179.

72 John M. Golden, *Principles for Patent Remedies*, 88 TEX. L. REV. 505, 508 (2010).

73 Stuart Graham, Peter Menell, Carl Shapiro & Tim Simcoe, *Final Report of the Berkeley Center for Law & Technology Patent Damages Workshop*, 25 TEX. INTELL. PROP. L.J. 115 (2017).

74 *See generally* John M. Golden, *Foreword: Patent Damages: Working Within Limits*, 36 REV. LITIG. i (2017) (introducing the twelve articles from the first round of this conference).

premise: patent law should provide remedies only to the extent necessary to encourage innovation.

Ted Sichelman described cost-based damages in general terms in 2014, arguing that rather than focusing on making the patentee whole, remedies should be determined "on the basis of innovation incentives per se" with a test that considers R&D costs as well as a variety of related factors.[75] More recently, he argues that such a test could be operationalized by adding "innovation" factors to the *Georgia-Pacific* test for reasonable royalties based on the patentee's R&D, commercialization, and opportunity costs.[76] He suggests using as a cost measure the sum of R&D costs and commercialization costs, multiplied by an internal rate of return to account for opportunity costs.[77] This figure would "set a range of 'reasonable royalties' in view of additional evidence relating to the other factors of the *Georgia-Pacific* test" in the short term,[78] and would become the sole measure of damages in the long term.[79]

John Golden and Karen Sandrik have also advocated consideration of the patentee's R&D costs, though from the perspective of restitution law.[80] In particular, they note that section 42 of the *Restatement (Third) of Restitution and Unjust Enrichment* provides that a restitution remedy should be available for infringement of IP rights and gives several potential measures for monetary relief, one of which is "the cost to the claimant [i.e., the patentee] of conferring the benefit."[81] They argue that "the cost of the relevant processes of invention and innovation undertaken by the original inventor or patent holder" thus "might sensibly play [a] more prominent role[]," and that its omission from the *Georgia-Pacific* factors is "surprising."[82] R&D costs could be used as "a sporadic factor" in the analysis, in setting a ceiling on damages, or as a more significant factor (with some limitation that costs be "objectively reasonable").[83]

Finally, Amy Kapczynski and three Yale Law students have noted that a similar approach to patent damages is already used in a narrower context.[84] Under 28 U.S.C. § 1498, the federal government may use patents without license as long as it pays "reasonable and entire compensation for such use and manufacture," with the sole remedy in the Court of Federal Claims.[85] This provision "is regularly used by the government in other sectors, including defense," and was relied on

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75 Sichelman, *Purging Patent Law*, *supra* note 12, at 567.
76 Sichelman, *Innovation Factors*, *supra* note 12, at 280, 307–11.
77 *Id.* at 310.
78 *Id.*
79 *Id.* at 323.
80 Golden & Sandrik, *supra* note 12.
81 *Id.* at 363 (quoting RESTATEMENT (THIRD) OF RESTITUTION AND UNJUST ENRICHMENT § 49(3)(b) (2011)).
82 *Id.* at 371–72.
83 *Id.* at 372.
84 Brennan et al., *supra* note 12.
85 28 U.S.C. § 1498(a) (2012).

"numerous times to procure cheaper generic drugs in the 1960s."[86] Based on their synthesis of the case law, they explain that § 1498 awards are not equivalent to what would be awarded in district court: injunctions are not allowed, lost profits are disfavored, and cases have expressed concern with "excessive compensation" to the patent owner.[87] Adjustments to § 1498 royalties have been made based on risks and expenses incurred by the patentee in developing and creating a market for the products, and to account for "reasonable" profits,[88] so the authors advocate awarding pharmaceutical patentees in § 1498 actions their risk-adjusted R&D costs plus average industry returns (perhaps a 10-30% bounty).[89]

As noted above, all of these proposals are motivated by the goal of providing patent damages only to the extent necessary to encourage innovation, and it is hard

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86 Brennan et al., *supra* note 12, at 275. The federal government has relied on § 1498 to use patented technologies including electronic passports, genetically mutated mice, and software for detecting fraudulent checks. *Id.* at 302. It is difficult to determine the overall frequency of government patent use. Searching the U.S. Department of the Treasury's Judgment Fund website (which lists final money judgments against the United States that have no other available source of funds) and then searching those case dockets revealed twenty-one § 1498 patent awards from fiscal year 2006 through 2016 with a total payment amount of almost $60 million. *See Judgment Fund Payment Search*, U.S. DEP'T OF THE TREASURY, https://jfund.fms.treas.gov/jfradSearchWeb/JFPymtSearchAction.do (last visited Jan. 27, 2017) (download payment data for each fiscal year, search for § 1498 actions, and then search dockets to eliminate § 1498 copyright suits) (data available upon request). But these are not all § 1498 awards, presumably because some are not paid through the Judgment Fund. *See, e.g.*, Honeywell Int'l Inc. v. United States, 114 Fed. Cl. 637 (2014) (entering a stipulated judgment of $75 million against the United States for use of patented night-vision goggle technology). These cases have produced relatively few published damages analyses, so most § 1498 damages case law is relatively old, though it presumably still informs settlement values. Twenty of the twenty-one Judgment Fund cases since 2006 were settled with stipulated judgments before trial. *See* BLOOMBERG LAW, https://www.bloomberglaw.com/dockets (searched docket numbers from Judgment Fund website on Jan. 28, 2017). The outlier is a judgment for Boeing that settled for $20 million while on appeal to the Federal Circuit. *See* Boeing Co. v. United States, 86 Fed. Cl. 303 (2009) (calculating appropriate reasonable royalty); Boeing Co. v. United States, 374 F. App'x 955 (Fed. Cir. 2009) (granting motion to remand case in light of settlement agreement).

87 Brennan et al., *supra* note 12, at 311–12; *see, e.g.*, W.L. Gore & Assocs., Inc. v. Garlock, Inc., 842 F.2d 1275, 1283 (Fed. Cir. 1988) ("Though injunctions may seem to say that making for and selling to the government is forbidden, injunctions based on patent rights cannot in reality do that because of § 1498(a)."); Tektronix, Inc. v. United States, 552 F.2d 343, 351 (Ct. Cl. 1977) ("[O]nly a reasonable, not an excessive, royalty should be allowed where the United States is the user—even though the patentee, as a monopolist, might be able to exact excessive gains from private users."). *See generally* Leesona Corp. v. United States, 599 F.2d 958, 964 (Ct. Cl. 1979) (en banc) ("The theory for recovery against the government for patent infringement is not analogous to that in litigation between private parties.").

88 *See, e.g.*, *Leesona*, 599 F.2d at 978 (testing reasonableness of royalty rate by comparing it to "the expense incurred by [patentee] in developing its invention, less any compensation received from defendant in its pre-1969 development contracts," plus a "reasonable profit"); *Tektronix*, 552 F.2d at 350–51 (adjusting royalty rate upward from 7.65% to 10% because patentee "took the risks and bore the expense of developing the [infringing products] and creating a market for them").

89 Brennan et al., *supra* note 12, at 315.

to quibble with this goal in theory.[90] But there may be significant problems with implementing this approach in practice, as Michael Abramowicz has nicely illustrated in his symposium contribution.[91] He notes, however, that there is "likely to be little danger in allowing cost-plus damages to be a small factor in the patent analysis," and that even making cost-plus damages "as much as half of the patent damages calculus" should avoid "the worst dangers" of this approach.[92] As noted in the Introduction,[93] my goal is not to unequivocally defend cost-plus damages as a general matter, but experimenting with the approach seems worthwhile,[94] especially as related to nonpatent innovation rewards.

2. *Incorporating Nonpatent Rewards into the Damages Calculation*

The application of cost-based patent damages to the reward-stacking problem should at this point be obvious. By simply recognizing that nonpatent rewards should be a factor in calculating the patentee's costs, any of the approaches described in the previous section can be easily adapted to prevent overcompensation through multiple rewards. This does not mean that cost-based damages are easy to calculate in the first place—as discussed below, there are numerous administrative difficulties—only that it is relatively easy to add nonpatent rewards into this calculation.

Incorporating nonpatent rewards into the cost calculation is particularly straightforward because nonpatent rewards are almost always received before patent damages are likely to be calculated. Direct government R&D spending, whether through grants, national labs, or procurement, is awarded *ex ante* for prospective projects or as research costs arise.[95] R&D tax credits can usually be claimed in the same year in which qualifying R&D costs are incurred.[96] Innovation inducement prize competitions can be structured in a wide variety of ways, including in stages, but the prize is typically awarded no later than shortly after the invention at issue is completed.[97] (There are proposals for market-based or performance-based prizes

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90 *See, e.g.*, Mark A. Lemley, *Taking the Regulatory Nature of IP Seriously*, 92 TEX. L. REV. SEE ALSO 107, 110 (2014) ("At a theoretical level Sichelman is surely right. Patents are government interventions in the marketplace designed to achieve social policy ends. Government distortion of the free market is justified only if necessary to achieve those ends—anything beyond that is social waste. If private law remedies, justified in the name of property, give the patentee more than it needs to encourage it to invent, that extra payment interferes with the free market and may actually interfere with innovation.").

91 Michael Abramowicz, *Cost-Plus Damages*, 26 Tex. Intell. Prop. L.J. 133, 148–51 (2018).

92 *Id.*

93 *See supra* note 14 and accompanying text.

94 *See id.*; *see also* Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. 65 (2015) (advocating greater experimentation with patent doctrine).

95 *See* Hemel & Ouellette, *supra* note 2, at 333.

96 *See id.* at 334.

97 *See* Abramowicz, *supra* note 34, at 189–90; Michael J. Burstein & Fiona E. Murray, *Innovation Prizes in Practice and Theory*, 29 HARV. J.L. & TECH. 401 (2016). *But see* Jonathan R. Siegel, *Law*

that blend the merits of traditional fixed prize competitions and patents, but these are typically proposed as alternatives rather than complements to patents.[98]) In contrast, to get to the stage at which patent damages are awarded, the inventor needs to first have an invention that is ready for patenting such that an application can be filed,[99] then prosecute that application through the U.S. Patent & Trademark Office (which takes over two years on average),[100] and then file and litigate a patent lawsuit to the damages stage (which typically takes over two years).[101]

The feasibility of this approach is illustrated by the fact that in the § 1498 context, courts have *already* considered nonpatent incentives in patent damages calculations. For example, in *Leesona Corp. v. United States*, the patentee had developed and patented new rechargeable batteries, in part with the assistance of development contracts from the U.S. Marine Corps.[102] After the government procured the batteries from a cheaper supplier, the patentee sued under 28 U.S.C. § 1498.[103] The en banc Court of Claims concluded that the trial judge's damages award was "largely excessive."[104] A proper base for the award was "the expense incurred by [patentee] in developing its invention, *less any compensation received from [the United States] in its pre-1969 development contracts*," to which should be added "a reasonable profit."[105] In other words, the amount the patentee received in nonpatent rewards through procurement contracts was sensibly subtracted out of its costs before damages were calculated.

This approach could be translated to private infringement suits brought under Title 35. For example, Ted Sichelman provides a simple example of how his proposal might work, which is very similar to the *Leesona* approach:

> In simplest form, suppose an innovative firm invests $10 million in R & D and patent-driven commercialization costs over a set of successful and unsuccessful projects to

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and Longitude, 84 TUL. L. REV. 1, 17–32 (2009) (describing how the Board of Longitude initially refused to award John Harrison the promised £20,000 prize for his clock-based method of determining longitude within 30 nautical miles because the Board was seeking an astronomical solution).

98 *See* Hemel & Ouellette, *supra* note 2, at 318–19 & nn.59–62, 332.

99 *See* Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 67 (1998) (describing the "ready for patenting" condition).

100 *See Traditional Total Pendency: Last Two Years*, U.S. PATENT & TRADEMARK OFFICE, https://www.uspto.gov/corda/dashboards/patents/kpis/kpiOverallPendency.kpixml (last visited Jan. 27, 2017) (showing the average number of months from filing date to the date an application reaches a final disposition, excluding applications in which a request for continued examination has been filed).

101 For patent cases filed between 2000 and 2015, the median time to trial was 815 days, and more than a quarter of cases took over three years to reach trial. *See* LEX MACHINA, https://lexmachina.com (search conducted Jan. 27, 2017).

102 Leesona Corp. v. United States, 599 F.2d 958, 963 (Ct. Cl. 1979) (en banc).

103 *Id.* at 964.

104 *Id.* at 962.

105 *Id.* at 978 (emphasis added). The actual award in the case was limited by the patentee's failure to present relevant evidence on these figures. "[T]he party having the burden of proof must suffer if a scantiness of record fails to support a fully informed and reasoned determination." *Id.* at 979.

> acquire the patents-in-suit. If that firm requires an internal rate of return of 30% to perform such projects over time, then in a very rough sense, patent damages should roughly be $13 million.[106]

My argument simply makes explicit that any such calculation should include any nonpatent rewards the firm has received. For a simple example, suppose the cost of the project is still $10 million, that it is sure to succeed, and that we still want a 30% rate of return (such that an *ex ante* investment of $10 million should yield an *ex post* return of $13 million). And suppose the firm received a $1 million state or federal commercialization grant,[107] plus $1 million worth of R&D tax incentives for this set of projects, plus a $1 million prize for its successful invention. Its net initial investment is then only $8 million (the $10 million cost minus the grant and tax credit), which we want to yield an *ex post* return of $10.4 million (i.e., 1.3 x $8 million). The firm received a $1 million *ex post* prize, so patent damages should roughly be $9.4 million.

In practice, of course, courts will not be presented with a neat set of related successful and unsuccessful projects, so the risk of failure will have to be accounted for in valuing *ex ante* rewards for successful projects. For example, a $1 million grant for a project with a 1-in-10 chance of success is equivalent to $10 million in patent rents (or other *ex post* rewards) for successful projects.[108] Amy Kapczynski and her students at Yale illustrate how cost-based damages might work in practice for an actual pharmaceutical product, using realistic numbers.[109] Their calculation could be adapted to account for the significant nonpatent incentives that biomedical inventions receive.[110]

3. *Implementing the Cost-Based Approach*

If this cost-based approach to patent damages eventually becomes accepted as at least an aspirational goal—which is beyond what I hope to accomplish with this Article—there are still potential hurdles to implementing this approach as a matter of both legal doctrine and practical administrability.[111] This Section briefly

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106 Sichelman, *Innovation Factors*, *supra* note 12, at 310.

107 *See generally* Camilla A. Hrdy, *Commercialization Awards*, 2015 WIS. L. REV. 13, 52–56 (2015) (describing these programs).

108 For a simple example to illustrate this point, see Hemel & Ouellette, *supra* note 2, at 310–12.

109 Brennan et al., *supra* note 12, at 328–30.

110 *See generally* Ouellette, *supra* note 39, at 1128–37 (describing nonpatent incentives for biomedical inventions in the United States).

111 One other concern might be that even if courts could implement cost-based damages both legally and practically, they have little incentive to do so. Having just one appellate court for patent law limits the opportunity for doctrinal percolation, though perhaps the Supreme Court will intervene in favor of greater district court discretion than the Federal Circuit's doctrine currently allows—as it has in many other areas—encouraging more experimentation at the district court level. *See* John M. Golden, *The Supreme Court as "Prime Percolator": A Prescription for Appellate Review of Questions in Patent Law*, 56 UCLA L. REV. 657, 720 (2009); Ouellette, *supra* note 94, at 110–11 (explaining the different ways in which district courts could experiment with and improve patent law, including by testing the administrability of a standard); *see, e.g.*, Octane Fitness, LLC v.

addresses these concerns in turn, though I do not think nonpatent incentives raise any special additional implementation concerns beyond those associated with cost-based damages more generally.

If a sympathetic policymaker is convinced by the merits of a cost-plus approach to patent damages, there are a variety of ways it could be implemented in practice. Of course, Congress could amend the Patent Act to mandate such an approach. But as this Section explains, courts could also shift damages calculations toward this approach in the same way that current damages law has evolved: as a matter of case-by-case doctrinal development.

First, to the extent the federal government chooses to make wider use of § 1498 for procurement of patented technologies such as generic pharmaceuticals, it does not seem as if this statute would need to be amended to explicitly consider nonpatent rewards in the cost-based approach advocated by the group at Yale. Indeed, as noted above, the en banc Court of Claims (the predecessor to the Court of Appeals for the Federal Circuit) used such an approach in *Leesona Corp. v. United States*.[112] To be sure, § 1498 case law is "far from pellucid,"[113] and courts do use the *Georgia-Pacific* factors in calculating reasonable royalties.[114] But as the court in one such case noted, they are "neither constrained by [the factors] nor required to consider each one where they are inapposite or inconclusive."[115] The statute simply says that patentees are entitled to "reasonable and entire compensation."[116] Compensating the patentee for incurred costs—including the risk and opportunity cost—plus a reasonable profit would seem to make the patentee whole.

Could such an approach be adopted for patent damages more generally, in private suits under Title 35? First, it is worth noting that while injunctions are not allowed under § 1498, they have traditionally been the norm for private patent litigation,[117] with damages calculated only for past infringement. Even after the Supreme Court limited the presumptive availability of injunctive relief in *eBay v. MercExchange*,[118] courts have still granted motions for permanent injunctions about three-quarters of the time.[119] I am not advocating any significant change in this

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ICON Health & Fitness, Inc., 134 S. Ct. 1749, 1755 (2014) (rejecting the Federal Circuit's approach to attorney's fees as "unduly rigid" and "impermissibly encumber[ing]" district courts' discretion).

112 *See supra* notes 102–105 and accompanying text.

113 Brennan et al., *supra* note 12, at 311; *see also supra* note 86 (explaining that most § 1498 cases settle before a court is asked to calculate damages).

114 *See, e.g.*, Liberty Ammunition, Inc. v. United States, 119 Fed. Cl. 368, 386 (2014), *aff'd in part, rev'd in part on other grounds*, 835 F.3d 1388 (Fed. Cir. 2016).

115 *Id.*

116 28 U.S.C. § 1498 (2012).

117 *See* eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 395 (2006) (Roberts, C.J., concurring) ("From at least the early 19th century, courts have granted injunctive relief upon a finding of infringement in the vast majority of patent cases.").

118 *Id.* at 391 (majority opinion).

119 *See* Thomas F. Cotter & John M. Golden, *Empirical Studies Relating to Patents—Remedies, in*

practice.[120] But it does seem that when patentees have already received substantial nonpatent rewards such that full patent rents are more likely to be excessive, this counsels against injunctive relief under each of the four factors of the *eBay* framework.[121]

A more challenging doctrinal hurdle arises in cases in which the patent owner proves lost profits by showing that but for the infringement, it would have made additional profit.[122] Once a patent plaintiff shows "that there was a reasonable probability that the sales would have been made 'but for' the infringement . . . it has sustained the burden of proving entitlement to lost profits."[123] In such cases, it seems difficult under current precedent to deny plaintiffs these lost profits, even if there is strong evidence that the plaintiff has already received sufficient rewards to have spurred its development of the technology at issue. Thus, while cost-based damages could be applied under § 1498 for *government* use of a pharmaceutical patent for generic procurement, it is unlikely to be effective for *private* use by a generic pharmaceutical company, even if the lost-profits award seems excessive.[124]

But the issue of whether lost-profits rewards should ever be denied in private litigation can be tabled for now. As noted above, over two-thirds of private patent damages rewards are currently based solely on the reasonable royalty calculation.[125] And in cases in which courts are faced with a reasonable royalty damages calculation, commentators have generally concluded that considering the patentee's R&D costs is within courts' discretion under the current damages statute, 35 U.S.C. § 284, and precedent such as *Georgia-Pacific*. I see no reason why adding nonpatent rewards to the calculation would affect this conclusion.

For example, Ted Sichelman argues that no statutory amendment is needed to add his "innovation factors" to the *Georgia-Pacific* framework for reasonable

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RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW, *supra* note 25, https://ssrn.com/abstract=2665680 (manuscript at 8) (reviewing empirical studies).

120 On the cases in which property rules are likely to outperform liability rules, *see generally* Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

121 *See eBay*, 547 U.S. at 391 ("A plaintiff [seeking a permanent injunction] 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.").

122 *See generally* Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1545 (Fed. Cir. 1995) (en banc) (describing the standard for proving lost profits).

123 *Id.*; *see also* Versata Software, Inc. v. SAP Am., Inc., 717 F.3d 1255, 1265 (Fed. Cir. 2013) (noting that a "wide variety of reconstruction theories" are allowed as long as they are "supported with sound economic proof").

124 *Cf.* Brennan et al., *supra* note 12, at 312, 328 (explaining why lost profits are not allowed in § 1498 cases, and arguing that when a company receives profits of around forty times the development cost in under two and a half years, "[e]ven adjusting for risk, and factoring in reasonable profit, society has already vastly overpaid for the drugs").

125 *See supra* notes 66–67 and accompanying text.

royalties, at least when they are used to help ground the current standard.[126] Similarly, John Golden and Karen Sandrik do not propose a statutory amendment; rather, they think courts should look to the *Restatement* as a policy matter.[127] Judge Posner explicitly did so in *Apple v. Motorola*, although he was reversed for his decision to exclude damages evidence.[128] While others have not followed suit, Golden and Sandrik argue that "such an embrace is not necessary for restitutionary principles to offer guidance on how to assess the recoverable portion of value obtained from nonconsensual use—a category of value into which reasonable royalty damages comfortably fall."[129]

Dan Burk, in his comments on Sichelman's original cost-based damages proposal, expresses an even more expansive view of the patent damages statute.[130] He proposes that courts consider remedies even further from current practice, such as rules based on put options.[131] And he suggests that incorporating the public interest into patent remedies as Sichelman suggests "requires perhaps some reorientation of judicial attitudes, but not necessarily a reorientation of remedial patent doctrines," given that "many of the needed tools are already available."[132] While Sichelman does not read the patent damages statute quite as broadly as Burk,[133] they both agree that courts may safely incorporate cost considerations into the reasonable royalty analysis.[134]

The larger concerns that have been raised about implementation of cost-based damages relate not to whether they are legally feasible under current doctrine, but rather to whether they are practically feasible for courts to implement. For example,

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[126] Sichelman, *Innovation Factors*, *supra* note 12, at 322. In particular, he writes that "to the extent that the innovation factors could be used to improve the accuracy of the current 'hypothetical negotiation' standard of *Georgia-Pacific* . . . then these factors could clearly be added without transgressing statutory authority." *Id.* As courts became more accustomed to applying these factors, however, he proposes a statutory amendment so that these factors would become the focus of the damages test. *Id.* at 323.

[127] *See* Golden & Sandrik, *supra* note 12.

[128] Apple, Inc. v. Motorola, Inc., 869 F. Supp. 2d 901, 916 (N.D. Ill. 2012) (Posner, J., sitting by designation) (quoting RESTATEMENT (THIRD) OF RESTITUTION AND UNJUST ENRICHMENT § 42 (2011)), *aff'd in part, rev'd in part*, 757 F.3d 1286 (Fed. Cir. 2014).

[129] Golden & Sandrik, *supra* note 12, at 360.

[130] *See* Dan L. Burk, *Means and Meaning in Patent Remedies*, 92 TEX. L. REV. SEE ALSO 13, 15 (2014) ("The metric of 'making whole' . . . is never fixed, and instead shifts with judicial purpose.").

[131] *Id.* at 21–23.

[132] *Id.* at 23.

[133] *See* Ted Sichelman, *Meaning Is in the Mind of the Reader: A Rejoinder to Burk, Cotter, and Lemley*, 93 TEX. L. REV. SEE ALSO 15, 22 (2014) ("I mainly disagree with Burk that the current statutory and doctrinal framework can properly yield such exotic reforms.").

[134] In addition to being consistent with the U.S. patent damages statute and precedent, this approach raises no difficulty under TRIPS, which merely requires that "[t]he judicial authorities shall have the authority to order the infringer to pay the right holder damages adequate to compensate for the injury the right holder has suffered because of an infringement . . . . " TRIPS, *supra* note 58, art. 45.

Mark Lemley called Sichelman's 2014 proposal "a perfectly correct statement of aspirations, but nothing that could ever be operationalized without perfect knowledge,"[135] and Tom Cotter was "skeptical that such a system could ever work in the real world."[136]

One concern is evidentiary.[137] Determining the patentee's risk-adjusted costs or an appropriate return on investment are certainly not easy, though Sichelman's latest paper goes into considerable detail on these practicalities.[138] But the question is not whether there will be errors in such calculations—surely there will—but rather whether the incentives provided by a patent system in which damages are calculated this way will be on net more socially optimal than the incentives provided by the current patent system. And here, it is worth noting that in addition to both over- and under-compensating innovators in many cases,[139] the current system also has remarkable evidentiary challenges. The current approach to calculating a reasonable royalty is based on a *counterfactual ex ante* hypothetical negotiation between the parties, so courts are forced to draw inferences from notoriously problematic evidence such as comparable licenses.[140]

Another concern is that the socially optimal patent reward should ideally be shared across all users of the patented technology—including willing licensees—and not just the first party to be sued.[141] One potential solution would be to adopt Bernard Chao's proposal for contribution in patent law, allowing an infringer to implead other users of the technology and ask them to share in the judgment.[142] Michael Meurer has expanded on this idea to explore how patent litigation risk can be spread across supply chains.[143] Ted Sichelman has also suggested that accused infringers can marshal evidence of other infringing use, and that damages should be capped at disgorgement of profits stemming from the infringement, which would reduce unfairness to the first infringer.[144] Of course, the ease of identifying other

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135 Lemley, *supra* note 90, at 112.

136 Thomas F. Cotter, *Make No Little Plans: Response to Ted Sichelman, Purging Patent Law of "Private Law" Remedies*, 92 TEX. L. REV. SEE ALSO 25, 26 (2014).

137 *See* Lemley, *supra* note 90, at 112 ("How are we to know how much incentive a patentee would require to invent? We could ask them, I suppose, but that doesn't seem calculated to produce an accurate number.").

138 Sichelman, *Innovation Factors*, *supra* note 12, at 311–16.

139 *See supra* Section II.B.

140 *See, e.g.*, Chiang, *supra* note 71 (manuscript at 15); Lee & Melamed, *supra* note 36, at 412; Masur, *supra* note 71, at 121.

141 *See* Lemley, *supra* note 90, at 113 ("The value sufficient to incent a patentee must be measured across all suits, not just one.").

142 Bernard Chao, *The Case for Contribution in Patent Law*, 80 U. CIN. L. REV. 97 (2012). Chao argues that when patent infringers have sought a right of contribution, district courts have erroneously concluded that contribution is preempted by 35 U.S.C. § 271(c), which reflects a misunderstanding of the distinction between contribution and contributory infringement. *Id.*

143 Michael J. Meurer, *Allocating Patent Litigation Risk Across the Supply Chain*, 25 TEX. INTELL. PROP. L.J. 251 (2018).

144 Sichelman, *Innovation Factors*, *supra* note 12.

infringers will vary by technology, with greater difficulty for method claims.

In sum, while there are certainly many details of cost-based damages proposals that need to be worked out in practice, none of these administrability concerns seem so significant as to doom cost-based damages proposals.[145] I thus think that scholars should continue to investigate whether such proposals will succeed in better aligning patent rewards with the socially optimal amount, including by accounting for nonpatent incentives.

IV. Using Cost-Based Patent Damages to Improve Allocation

Thus far, this Article has focused on the incentive side of innovation policy. That is, I have focused exclusively on the following question: can the amount transferred from the public to innovators through both nonpatent rewards and the patent shadow tax be more closely aligned with the socially optimal reward? But as I emphasize in a forthcoming article with Daniel Hemel, *Innovation Policy Pluralism*, the incentive question—how much should be transferred—can be largely decoupled from the allocation question of who should pay for this transfer.[146] Here, I briefly explain why cost-based patent damages may be a simpler way to achieve nonpatent access allocation than prior proposals to accomplish the same goal.

In general, nonpatent rewards are funded by all taxpayers, including those who do not benefit from the resulting knowledge goods, whereas patent rewards are funded by users of the patented products who pay supracompetitive prices for such use.[147] If one defines an access allocation regime based on the number of firms (n) with the right to supply the relevant knowledge good, the possibilities range from a pure monopoly ($n = 1$) to an open-access regime ($n = \infty$), though the patent system and tax-funded rewards only approximate these extremes.[148]

As economists Glen Weyl and Jean Tirole have explained, allocation based on market power (i.e., patents) has the cost of increased deadweight loss, but the benefit of selecting high social surplus projects by screening for willingness-to-pay.[149] Simply looking to the quantity of knowledge goods distributed under an open-access regime will not distinguish between high-value projects and those that

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[145] *See generally* Ouellette, *supra* note 39 (arguing for greater experimentation with patent law, including greater district court discretion to test proposals whose administrability is in question).

[146] Hemel & Ouellette, *supra* note 4. The incentive question tracks the first two dimensions of our framework of innovation policies—*reward size* (government-set vs. market-set) and *reward timing* (*ex ante* vs. *ex post*)—while the allocation question tracks the third dimension, *who pays* (user-pays vs. cross-subsidization by nonusers). Hemel & Ouellette, *supra* note 2, at 348 fig.2.

[147] These general observations are subject to caveats, such as that the costs of the patent shadow tax are sometimes spread to non-users through insurance markets. *See* Hemel & Ouellette, *supra* note 2, at 346 & n.191.

[148] *See* Hemel & Ouellette, *supra* note 4 (manuscript at 18). Patents are effective only to the extent they offer some form of market power, although in practice, the link between patents and markets is often attenuated, so n will rarely equal 1. Similarly, n can never really be ∞. But allocation via patents and nonpatent rewards will result in real variation in n with important allocative effects.

[149] Weyl & Tirole, *supra* note 15.

offer only an incremental improvement. They argue that the optimal solution is never pure monopoly ($n = 1$) or pure open access ($n = \infty$); rather, it lies in the intermediate range.[150] Daniel Hemel and I explain the intuition behind this result as follows:

> [T]he first bit of market power increases deadweight loss only trivially, while the last bit of market power (moving from near monopoly to full monopoly) also yields only trivial screening benefits. That is, the marginal deadweight loss from an additional increment of market power is increasing and the marginal informational benefit from an additional increment of market power is decreasing. The optimal arrangement entails an interior solution, not a corner solution.[151]

There are numerous ways to achieve these intermediate solutions. For example, Ian Ayres and Paul Klemperer have proposed a duopoly auction system ($n = 2$): "A patent would give the holder two entitlements: the right to be only one of two producers of the product, and the right to receive the proceeds from the auction selecting the second producer of the product."[152] This proposal could be adapted for any n.[153]

An alternative that is perhaps more politically and administratively feasible would be to allow patentees to choose a shorter patent term in exchange for the ability to pay reduced taxes on patent-related income, with revenues lost through this "patent box" offset by general tax revenues.[154] But this is suboptimal as compared with proposals that result in reduced market power over a longer term. As Ayres and Klemperer have explained, holding the patentee's profits constant, consumers are better off with oligopolistic pricing over a longer period compared to monopoly pricing over a shorter period.[155]

The cost-based patent damages approach described in Part III offers an overlooked solution to this problem. Reducing patent damages while compensating patentees through nonpatent rewards funded through general tax revenues can reduce deadweight loss while maintaining the same effective innovation incentive. Implementing this proposal to the extent advocated so far—as a modification to the *Georgia-Pacific* reasonable royalty test—seems far more likely and feasible than an n-opoly auction.

If this initial foray into cost-based damages is successful, it could be extended more broadly, perhaps to include tax-based nonpatent rewards that are keyed to patent damages. For example, if a patentee receives a $10 million damages reward, this could be automatically reduced by some factor (say, ten percent), and the

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150 *Id.* at 1974.

151 Hemel & Ouellette, *supra* note 4 (manuscript at 19). We also note conditions under which pure monopoly or pure open-access regimes might be justified. *Id.* (manuscript at 20).

152 Ayres & Klemperer, *supra* note 15, at 1031.

153 *See* Hemel & Ouellette, *supra* note 4 (manuscript at 11). For a more detailed analysis of this and other auction proposals, see Abramowicz, *supra* note 34, at 229–34.

154 *See* Hemel & Ouellette, *supra* note 2, at 331–32, 347.

155 Ayres & Klemperer, *supra* note 15, at 991.

patentee could receive a tax credit to offset the loss (in this case, $1 million). From the perspective of many patentees, there would be no change in compensation, so this would not greatly affect innovation incentives.[156] Rather, the effect would be to shift some of the cost from users of the patented technology (through the damages paid by the infringer) to all taxpayers, with the resulting efficiency gain explained above.[157] Of course, such a reform would require legislative change, so I will add it to the list to be considered with Ted Sichelman's long-term goals.[158]

V. Conclusion

While much of my focus in this article has been on how nonpatent incentives could be incorporated into patent damages calculations through cost-based approaches, I want to conclude by emphasizing that one need not be convinced by the broadest versions of these proposals in order to think that it is worth experimenting with factoring nonpatent incentives into patent damages awards. My primary goal is simply to convince readers that there is not yet a satisfactory interface between patents and nonpatent innovation incentives, that there ought to be, and that one of the potential policy levers for filling this role that has not been recognized is patent damages. This lever may ultimately be inferior to the other options described in Section II.C, but I hope readers are at least convinced that adjusting patent damages for nonpatent incentives has some benefits that ought to be considered in scholars' analyses of how patent damages should be calculated.

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[156] The exact impact may vary depending on the patentee's business model and the effect on the licensing market.

[157] For a discussion of the distributive consequences of user-pays versus cross-subsidization of R&D costs, see Hemel & Ouellette, *supra* note 2, at 345–52.

[158] *See* Sichelman, *Innovation Factors*, *supra* note 12, at 322–23.

Should Courts Award Pain and Suffering Damages in Patent Infringement Cases?

Ronen Avraham[†]

Table of Contents

I. Introduction

After inventing the intermittent windshield wiper, Robert Kearns tried to interest the "Big Three" automakers in licensing this technology.[1] After rejecting his proposal, these companies all began using his patent without his permission and installing intermittent wipers on their cars.[2] When Kearns filed suit against Ford in 1978 for patent infringement, he did not have a lawyer. Although he had no legal background, he represented himself with help from his family. In response, Ford did

† Senior Lecturer, University of Texas School of Law. I thank John Golden, Sam Bray, Melissa Wasserman, Sean Williams, and participants of the 2016 University of Texas Drawing Board Lunch Forum as well as of the 2017 PatDam2 Conference at the University of Texas School of Law for their very helpful comments. I thank Adam Livingston and Benjamin Brown for their excellent research assistance. I also thank S. Horowitz Institute for Intellectual Property in memory of Dr. Amnon Goldenberg, at Tel Aviv University, Faculty of Law for financial support. Please do not cite, quote, or distribute.

1 Bruce Berman, *Kearns' Son Still Fuming Over Wiper Blade Fight*, IP CLOSEUP (July 26, 2011), https://ipcloseup.com/2011/07/26/kearns-son-still-fuming-over-wiper-blade-fight/.

2 *Id.*

what many companies do in patent cases: it began stalling in the hopes that Kearns would run out of money.[3] The lawsuit against Ford became Kearns' life—he poured all of his time and every penny he had into it even though the case would not go to trial until 1990, twelve years after the suit was filed.[4] He was not interested in money, but in getting his justice. Eventually Kerns settled with Ford for $10.2 million, yet the fight with Ford and other companies over their infringement took a toll on his mental health, leading to a nervous breakdown and strained relationships with his family.[5] Kearns' story of a solo inventor being robbed of his invention by a large corporation and then suffering mental distress, even if less prevalent now simply because solo inventors are less common than they once were, is by no means unique.[6]

It can cost the average individual inventor far more than their wealth to successfully defend a patent, which they may often have to do before they receive any monetary benefit from their invention.[7] By contrast, a large corporation may only have to pay a small fraction of their annual revenue to litigate a patent's validity, and so only might need to weigh the inventor's ability to fund legal representation when determining a royalty rate to offer.[8] These circumstances frustrate the patent system, and one can see how they could cause someone like Robert Kearns to lose their sanity.

The emotional harm to the solo inventor might be caused by two different wrongs—the original infringement, especially if intentional or reckless, and the nasty litigation tactics that might follow the infringement. The harm from the latter has recently been recognized as an independent harm by the North Carolina legislature.[9] The harm from the former wrong has largely been forgotten and is not considered a legitimate component of the "damages adequate to compensate for the

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3 John Seabrook, *The Flash Of Genius*, THE NEW YORKER, Jan. 11, 1993, at 38, http://www.newyorker.com/magazine/1993/01/11/the-flash-of-genius [hereinafter *The Flash of Genius*].

4 *Id.*

5 *Id.*

6 Consider as another example twenty-one year old Philo Farnsworth, who invented and patented the television in 1927. Farnsworth turned down an offer by Radio Corporation of America (RCA) in favor of a partnership with another radio company. RCA did not take the rejection lightly and began a lengthy series of court cases against Farnsworth in an attempt to invalidate his patents. Finally, a dozen years later RCA agreed to pay royalties on Farnsworth's patents, but at that point the struggle had taken a toll on Farnsworth and he suffered from a nervous breakdown. Erik Gregersen, *Philo Farnsworth: American Inventor*, ENCYCLOPAEDIA BRITANNICA (Apr. 10, 2015), https://www.britannica.com/biography/Philo-Farnsworth.

7 Jeff A. Ronspies, Comment, *Does David Need a New Sling?*, 4 J. MARSHALL REV. INTELL. PROP. L. 184, 185–186 (2004).

8 *Id.*

9 Since 2013, several states have enacted laws regulating Abusive Patent Assertions. The North Carolina Legislature uniquely stated that it intended to also protect *inventors* from delayed litigation and abuse. Abusive Patent Assertions act, N.C. Gen. Stat. §§ 75-140–45 (2014).

infringement" that courts are required to award under § 284 of the United States Patent Act.[10]

In this article, I argue that courts *should* award damages to solo inventors for non-economic harm resulting from patent infringement. Indeed, while 91.6% of patent infringement cases brought by non-practicing entities (NPEs) are brought by patent assertion entities that buy up patents originally issued to others, a non-negligible portion (5%) of cases are still brought by solo inventors who invested their toil, tears, and sweat into their inventions.[11] Nikola Tesla, the great inventor, described the solo inventor as "the lone worker who follows the fleeting inspiration of a moment and finally does something that has not been done before."[12] And yet, despite being designed to protect the solo inventor,[13] patent law jurisprudence in the United States does not recognize the emotional harm inflicted upon these solo inventors as cognizable in court.

I also argue that there is room for cognizable non-economic harm in patent-infringement cases, at least for solo inventors like Kearns. Pain and suffering harm should be considered part of the "adequate compensation" that § 284 of the Patent Act requires awarding victims of patent infringement. First, I argue that pain and suffering should be considered as part of the total harm caused by infringement. Building on my previous work on pain and suffering damages in torts, I show that from an economic perspective, which is the dominant theory of patent law in the U.S., non-economic harm should be compensated in order to incentivize would-be infringers to internalize the full social harm of their conduct. Moreover, undercompensating solo inventors for their emotional harm from infringement will dilute their incentives to *commercialize* their invention, even if not their incentives to invent.

A common critique against awarding pain and suffering damages is that it is hard to quantify and therefore should be ignored. I expose the analytical problems with this argument and demonstrate various ways by which emotional harm is routinely quantified by courts around the world.

Second, drawing from Hegel's personality theory as refined by Radin, I join others who have applied this theory to patent law. I argue that, on a spectrum between bodily harm, where courts routinely award pain and suffering damages, and property harm, where they routinely do not, patent infringement falls closer to bodily harm. This is because much of the person's intellect and personhood is

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10 35 U.S.C.A. § 284 (West 2017).

11 *2015 Patent Dispute Report,* UNIFIED PATENTS (Dec. 31, 2015), https://www.unifiedpatents.com/news/2016/5/30/2015-patent-dispute-report.

12 *See* Seabrook, *supra* note 3 (quoting Nikola Tesla).

13 Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 709 (2012) ("[P]atent law betrays its individual-inventor bias at various points, from the requirement that patents always issue to individuals rather than to companies to the traditional rule that the first to invent, not the first to file, is entitled to the patent.").

involved in the invention process, and infringing on that person's intellectual property rights might foreseeably lead to mental harm.

Whereas courts routinely award pain and suffering damages for bodily injuries, such damages are not usually awarded for mere property losses. The word "intellectual" in the phrase "intellectual property" suggests that the intellect, the personhood, and the soul of the inventor are involved in the property infringed and yet are not given any legal weight when it comes to compensation. In short, patent infringements are treated as a mere property loss. In the third part of this paper, I show that even if one rejects the personality theory in patent law, courts can still draw inspiration from some classes of property and contract cases where pain and suffering damages *are* awarded. I argue that similar rationales that lead courts to award pain and suffering damages in those contract and property cases are relevant and even apply more strongly in intellectual property cases, even if we assume that on the spectrum between bodily harm and property harm infringements of patents lie closer to property harm.

Fourth, I argue that even if courts believe that non-economic harm is *not* cognizable and therefore damages for it should not be part of the § 284 "adequate compensation" requirement, there is still a way to compensate solo inventors for their non-economic loss via the enhanced damages option presented in another part of § 284 of the Patent Act. Section 284 of Patent Act allows courts to award "enhanced damages," which are three times the amount of the actual damages.[14] In the past, courts have awarded enhanced damages for "expense and trouble,"[15] which could be interpreted as including non-economic harm. Modern courts, however, award enhanced damages to deter intentional infringement, similar to the role of punitive damages in tort law. They do not take into account the non-economic or emotional damage that inventors like Kearns may suffer, however—at least not explicitly. Yet, as I will show, the enhanced damages clause can serve as a doctrinal hook for courts to account for the pain and suffering solo inventors experience as a result of infringement and subsequent litigation, for non-economic damages are an important element in assessing the magnitude of the punitive damages defendants should bear.

The rest of the article is organized as follows: in Part II, I will briefly present the role of solo inventors in the world's technological progress. In Part III, I will present the current doctrine relating to non-economic harm in patent infringement cases both in the U.S. and Europe. In Part IV, which is the crux of this article, I will explain why the law should recognize pain and suffering harm in patent infringements cases as part of § 284's "adequate compensation" clause. Part IV.A discusses this argument from a law and economics perspective, while Part IV.B presents Radin's personhood theory perspective. Part IV.C then argues that patent

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[14] 35 U.S.C.A. § 284 (West 2017).

[15] *See, e.g.*, Clark v. Wooster, 119 U.S. 322, 326 (1886) (recognizing that, when calculating damages for patent infringement, it may be appropriate to account for plaintiff's inconvenience).

infringement cases often present similar rationales to some classes of contract and property cases where courts do award damages for non-economic harm. Finally, in Part V, I discuss how courts can use the § 284 "enhanced damages" clause, which is analogous to punitive damages, as a doctrinal hook for awarding pain and suffering damages. Part VI concludes.

II. The role of solo inventors in the world's technological progress

The solo inventor is the heart of American ingenuity, or at least this is the myth around which patent law was designed.[16] Ever since this country's founding, individual men and women have devoted their lives to innovation and advancement, propelling the United States to the cutting edge of global technology. It has historically been these individuals, and not large corporations, who have achieved the most groundbreaking inventive success—often without reaping any of the benefits.[17]

For example, Eli Whitney, America's first famous inventor, revolutionized the cotton gin and thereby introduced the idea of mechanized farming.[18] Thomas Edison held a record number of patents (1,093), and galvanized innovations such as the phonograph, incandescent light bulb, and motion picture camera.[19] Alexander Graham Bell was the first to design and patent a practical method for transmitting the human voice via electric current—the telephone.[20] These technological giants represent only a few of the innovators who changed the course of history with their individual inventive efforts.[21]

The expansive role of solo inventors, additionally, persists into the future, as studies show that individuals and small firms generate a growing amount of the country's research and development.[22] In 2015, as was the case in the twenty years before it, solo inventors filed over 19,000 patent applications.[23]

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16 Lemley, *supra* note 13, at 709.

17 *See, e.g.*, Eugene Kim, *The Guy Who Invented USB Didn't Make a Dime off of It—But Here's Why He's OK With That*, BUSINESS INSIDER (Nov. 15, 2015, 12:02 PM), http://www.businessinsider.com/ajay-bhatt-usb-creator-interview-2015-11 (presenting the story of Ajay Bhatt, the inventor of the USB, who gained no profit from his invention).

18 Lemley, *supra* note 13, at 718.

19 *Thomas Edison*, HISTORY.COM, http://www.history.com/topics/inventions/thomas-edison.

20 *Alexander Graham Bell*, HISTORY.COM, http://www.history.com/topics/inventions/alexander-graham-bell.

21 *See* Donald Grant Kelly, *America's Inventors Have Arrived (And We Thought They Were "Invisible.")*, 80 J. PAT. & TRADEMARK OFF. SOC'Y 601, 606 (1998) ("From 1998 through the year 2000, U.S. independent investors and small business concerns will file nearly 200,000 patent applications.").

22 Robert M. Hunt & Leonard I. Nakamura, *The Democratization of U.S. Research and Development after 1980* (Sept. 2010) (unpublished manuscript) (on file with author).

23 *Independent Inventors by State by Year*, U.S. PATENT AND TRADEMARK OFFICE, https://www.uspto.gov/web/offices/ac/ido/oeip/taf/inv_utl.htm, (last visited May 7, 2017).

III. The current doctrine related to non-economic harm in patent infringement cases

A. The United States

35 U.S.C. § 284 provides that "the court may increase the damages up to three times the amount found or assessed."[24] However, treble damages are "almost impossible to obtain."[25] A study from 1999 to 2000 found that only 2.1% of patent cases resolved willfulness, and that only eight percent of those that resolved willfulness actually increased the damages award.[26] The Act itself does not provide a standard for applying enhanced damages, but the Federal Circuit has articulated that it shall apply "where the infringement is willful."[27] But that has not always been the case. In the late 19th century, the Supreme Court explicitly stated that increased damages could serve a compensatory purpose. In *Clark v. Wooster,* the Court, when discussing royalty damages, held that "[t]here may be damages beyond this, such as the expense and trouble the plaintiff has been put to by the defendant; and any special inconvenience he has suffered from the wrongful acts of the defendant . . . ."[28]

However, the current rule is that enhanced damages are not compensatory but rather punish a defendant's culpability.[29] Yet, at times the Federal Circuit has presented other rationales for awarding enhanced damages, even stating that they provide the "secondary benefit of quantifying the equities as between patentee and infringer."[30] This reasoning was also used in cases where the court was evaluating a willful infringement test.[31]

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24 35 U.S.C.A. § 284 (West 2017).

25 EDWARD F. O'CONNOR, INTELLECTUAL PROPERTY LAW & LITIGATION: PRACTICAL & IRREVERENT INSIGHTS § 2.29 (2009).

26 *Id.*

27 *E.g.*, Read Corp. v. Portec, Inc., 970 F.2d 816, 826 (Fed. Cir. 1992) ("While no statutory standard dictates the circumstances under which the district court may exercise its discretion, this court has approved such awards where the infringer acted in wanton disregard of the patentee's **patent** rights, that is, where the infringement is willful." (emphasis added)).

28 Clark v. Wooster, 199 U.S. 322, 326 (1886).

29 Beatrice Foods Co. v. New Eng. Printing & Lithography Co., 923 F.2d 1576, 1579 (Fed. Cir. 1991) (reversing a district court that found damages "compensatorily trebled," emphasizing that enhanced damages "may be awarded only as a penalty for the infringers increased culpability . . . .").

30 SRI Int'l, Inc. v. Advanced Tech. Labs., Inc., 127 F.3d 1462, 1468 (citing S.C. Johnson & Son, Inc. v. Cater-Wallace, Inc., 781 F.2d 198, 201 (Fed. Cir. 1986)).

31 *Id.* In *Read Corp. v. Portec Inc.*, the Federal Circuit laid out a nine-step test for determining willful infringement that both accounts for mental state and uses equitable factors to calculate damage enhancement. Read Corp. v. Portect, Inc., 970 F.2d 816, 826–27 (Fed. Cir. 1992). Factors such as defendant's financial size, litigation misconduct, and concealment arguably do not delve into the defendant's state of mind, but they were included in the Federal Circuit's test. *Id.* at 826–27. Other factors considered by the 9th Circuit include: infringer intent, whether the infringer investigated the scope of the patent in question, the strength of the case for willful infringement, the duration of the defendant's misconduct, remedial action by defendant, defendant's motivation for harm, and whether the defendant attempted to conceal their misconduct.

Most recently, however, in *Halo Electronics Inc. v. Pulse Electronics Inc.*, the Supreme Court ruled that courts should be awarded more discretion in awarding enhanced damages.[32] There is no language in the statute that provides an "explicit limit or condition on when enhanced damages are appropriate," Chief Justice Roberts wrote, adding that it was not clear why an objective reckless standard was required.[33] The Court also stated that "Section 284 permits district courts to exercise their discretion [to award enhanced damages] in a manner free from . . . inelastic constraints . . . ."[34] The Court, however, also noted that "such punishment should be generally reserved for egregious cases typified by willful misconduct".[35]

While *Halo* has altered the test for enhanced damages in a way that is still evolving, early cases show that, post-*Halo*, enhanced damages are easier to obtain yet still often awarded as punitive sanctions only.[36] Indeed, some commentators believe that *Halo* will have a significant impact on how often enhanced damages will be awarded and will consequently change how patent companies approach infringement.[37] Chances are, however, that they will remain primarily punitive.

B. The European Union

While U.S. law seems to move towards more easily awarding enhanced damages, it does not seem to allow it as a way of recognizing the inventor's emotional harm. In contrast, Europe protects moral rights beyond purely-economic rights. The exact definition of moral rights differs among countries, however, and

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[32] Halo Elecs. Inc. v. Pulse Elecs. Inc., 136 S.Ct. 1923, 1932 (2016). Halo was a reaction to *In re Seagate Tech.*, 497 F.3d 1360, 1371 (Fed. Cir. 2007). In *In re Seagate*, the court set forth a two-part test for willful infringement, holding that a patentee must show that the infringer acted "despite an objectively high likelihood that its actions constituted infringement of a valid patent" (which has been interpreted as a standard of objective recklessness), and that the risk was "either known to the accused infringer or so obvious that it should have been known to the accused infringer." This test seems to refocus the willful infringement standard, while also accounting for the "reasonableness of the [possible infringer's] actions taken in the particular circumstances." *Id.*

[33] *Halo Elecs. Inc.*, 136 S.Ct. at 1930. The court in *Halo*, mentioned the concern that the requirement for clear and convincing evidence to show objective recklessness could increase the chances that NPEs, mainly "trolls," would be awarded enhanced damages. *Id.* at 1934. Justice Roberts wrote that such fears "cannot justify imposing an artificial construct . . . on the discretion conferred under Section 284." *Id.* at 1935.

[34] *Id.* at 1933–34.

[35] *Id.* at 1934.

[36] *See, e.g.*, Stryker Corp. v. Zimmer, Inc., 837 F.3d 1268, 1279 (Fed. Cir. 2016) (remanding the question of enhanced damages to the district court); Imperium IP Holdings (Cayman), Ltd. v. Samsung Elecs. Co., Ltd., 203 F.Supp.3d 755, 763 (E.D. Tex. Aug. 24, 2016) ("[A]n analysis focused on 'egregious infringement behavior' is the touchstone for determining an award of enhanced damage rather than a more rigid, mechanical assessment."). *See* Finjan, Inc. v. Blue Coat Sys., Inc., 2016 WL 3880774, *17 (N.D. Cal. 2016) (using the *Read* test to find that the defendant did not act egregiously); *see also* Trustees of Boston Univ. v. Everlight Elecs. Co., Ltd., 212 F. Supp. 3d 254, 257 (D. Mass. 2016) (instructing that the *Read* factors are helpful, but that the main question is of egregious conduct by the defendant).

[37] Yen-Shyang Tseng. *Willful Patent Infringement And Enhanced Damages After* Halo Electronics, Inc. v. Pulse Electronics, Inc., ORANGE COUNTY LAW., Dec. 2016, at 38.

includes the right of integrity (the right that the work not be mutilated or distorted), the right of attribution (the right to be acknowledged and prevent others from naming anyone else as the creator), and the right of disclosure (the right to decide when and in what form the work will be presented to the public).[38] Examples of non-economic damages include injury to the rightholder's reputation, emotional distress, and suffering caused by an infringement.[39] Whereas in general the distinction between economic and moral harm is preserved, some experts consider economic harm to also include moral or non-economic damage.[40]

Copyright legislation of the European Union includes ten directives, the most relevant of which is Directive 2004/48/EC of the European Parliament and of the Council of 29 April 2004 on the enforcement of intellectual property rights. According to article 13, the judicial authorities should take into account "elements other than economic factors, such as the moral prejudice caused to the rightholder by the infringement."[41]

Because damage to reputation is difficult to quantify, "many national courts opt for awarding the rightholder 'lump sum' damages in some cases (e.g. Denmark, Greece, Netherlands), as foreseen by the IPRED. Some appear to make a lump-sum calculation designed to approximate lost profits (e.g. Luxembourg) or 'moral' damages (e.g. Belgium)."[42] Yet, "[a]s a general rule, moral damages are rarely awarded for IPR infringements or, when awarded, tend to be nominal (e.g. Estonia)."[43] In addition, "[i]n some countries, moral damages are available only in cases of intentional or negligent infringements" (e.g. Finland).[44] Conversely, in Slovenia moral damages may be granted even if no material damages have been suffered.[45] A more expansive recognition of moral rights can be found also in the laws of Germany and the Netherlands.[46]

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38 Monica E. Antezana, *The European Union Internet Copyright Directive As Even More Than it Envisions: Toward a Supra-EU Harmonization of Copyright Policy and Theory*, 26 B.C. INT'L & COMP. L. REV. 415, 422–23 (2003).

39 EUROPEAN OBSERVATORY ON COUNTERFEITING AND PIRACY, *Executive Summary*, *in* DAMAGES IN INTELLECTUAL PROPERTY RIGHTS, at 4 [hereinafter DAMAGES IN INTELLECTUAL PROPERTY RIGHTS].

40 *Id.* at 3.

41 Directive 2004/48/EC, of the European Parliament and of the Council of 29 April 2004 on the enforcement of intellectual property rights, 2004 O.J.(L 157). For more information regarding European adjudication of patent infringement, see Article 68(3) of the Unified Patent Court Agreement. This article asserts that the Unified Patent Court will consider: (1) negative economic consequences of an infringement; (2) unjust enrichment by the infringer; and (3) non-economic factors such as moral prejudice.

42 *Analysis, Recommendations and Best Practices*, *in* DAMAGES IN INTELLECTUAL PROPERTY RIGHTS, *supra* note 39, at 3.

43 *Id.*

44 DAMAGES IN INTELLECTUAL PROPERTY RIGHTS, *supra* note 39, at 4.

45 *Id.*

46 Antezana, *supra* note 38, at 431–33.

However, very few cases address compensation for moral damages stemming from patent infringements.[47] In one recent case from the Court of Appeal of Madrid, a patent owner sought damages under article 66 ("moral damages . . . even if the existence of an economic damage has not been proven") and article 68 ("loss of prestige of the patented invention") of the Spanish Patent Act.[48] On appeal, the court reversed a judgment for moral damages in the amount of €20,000, concluding that the patent owner had not proven the facts alleged (which may include distress, shock, sorrow, fear, or anxiety).[49] On the other hand, the court affirmed a judgment in the amount of €12,500 for loss of prestige (the infringing products were of lower quality and presented in simple cardboard boxes).[50]

In sum, many European countries recognize de-jure non-economic harm stemming from infringements of intellectual property. Yet, relatively few actually award significant awards for non-economic harm in patent infringement cases.

IV. Why the law should recognize pain and suffering harm

In this section I advance three arguments, one based on economic analysis of law, one on personality theory, and one of analogies to current jurisprudence in similar cases.

A. The law and economics of non-emotional harm

The main purposes of tort law are to compensate victims and deter tortfeasors—and pain and suffering damages are an essential instrument of both.[51] The law, ideally, should disincentivize tortfeasors by forcing them to internalize the full extent of the harm they create, including the non-economic harm they create.[52] The legal system, however, under-deters wrongdoing.[53] Plaintiffs are often precluded from accessing the judicial system due to a number of logistical barriers, including a dearth of lawyers due to the risk or even unprofitability associated with some types of suits, difficulty identifying wrongdoing, and daunting litigation costs.[54] In addition, even when they do award pain and suffering damages, courts often deflate these by disallowing certain types of evidence or arguments.[55]

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47 Thomas F. Cotter, *Damages for Moral Prejudice in Spain and Elsewhere*, COMPARATIVE PATENT REMEDIES (June 20, 2016), http://comparativepatentremedies.blogspot.com/2016/06/damages-for-moral-prejudice-in-spain.html.

48 *Id.*

49 *Id.*

50 *Id.*

51 *See* Ronen Avraham, *Does the Theory of Insurance Support Awarding Pain and Suffering Damages in Torts?*, *in* RESEARCH HANDBOOK ON THE ECONOMICS OF INSURANCE LAW 94, 97–98 (arguing that tort law, without pain and suffering damages, under-deters tortfeasors).

52 *Id.* at 96.

53 *Id.* at 97.

54 *Id.*

55 *Id.* at 98.

Tortfeasors, consequently, often escape suit or avoid paying significant damages, reducing the expected costs of their malfeasance and increasing the incidence of tortious conduct, including patent infringement.[56] Higher levels of infringement, in turn, deter innovation by disincentivizing solo inventors from commercializing their products, if not from actually exerting the effort to invent. Inventors will not invest time and money in creating or at least commercializing new technologies if their intellectual property is not sufficiently protected.

One way to correct this imbalance, however, is the implementation of pain and suffering damages, which will restore the expected costs of infringement to its real social harm. This would reduce the profitability of infringement, bolster patent security, and encourage inventors to innovate and commercialize their invention.

A common critique against awarding pain and suffering damages is that they are hard to quantify and therefore should be ignored. In a recent work, I exposed several analytical problems with this argument.[57] First, opponents claim that studies show that pain and suffering awards vary widely and therefore horizontal inequity is violated. But what looks like wide variation to the econometrician might simply reflect the fact that judges and jurors tailor their judgements to the unique circumstances of each case, which are unobservable to the econometrician. Such tailoring may actually be desirable.[58] Every person experiences pain differently, and the law, consequently, must afford a wide latitude for these determinations.[59] Pain and suffering damages, additionally, are not any more difficult to quantify than economic damages.[60] In the context of bodily injuries, lost wages, future medical expenses, and other "traditional" awards are often fraught with speculation and gross miscalculations.[61] In the context of patent infringement cases, economic loss is often measured by a "reasonable royalty," which has been a subject of great controversy regarding the proper way to estimate it.[62] Additionally, concerns regarding fictitious and exaggerated claims can be assuaged by courts' keen ability to determine the veracity of alleged pain and suffering.[63] Finally, courts may also use several proven methods to quantify these damages that have been developed over decades of common law adjudication.[64]

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56 *Id.*

57 Ronen Avraham, *Estimated Pain-and-Suffering Damages*, *in* 2 THE OXFORD HANDBOOK OF LAW AND ECONOMICS 98 (2017).

58 *Id.*

59 *Id.*

60 *Id.*

61 *Id.*

62 *See* Wesley Kobylak, Annotation, *Factors to be Considered in Determining a "Reasonable Royalty" for Purposes of Calculating Damages for Patent Infringement Under 35 U.S.C.A. § 284*, 66 A.L.R. Fed. 186, § 2(a) (1984) (describing the legal fiction that is the "reasonable royalty").

63 *Id.* Further, courts have been adjudicating these cases for centuries, and now have the benefit of medical technology that can better evaluate both physical and emotional pain. Avraham, *supra* note 51, at 98.

64 These include: (1) the "Golden Rule" jury instruction, which asks jurors to place themselves in the shoes of the plaintiff and estimate the amount of money which would satisfy them had they

B. The property bodily-harm spectrum

Refining Hegel's personality theory, Margaret Radin made the case in "Property and Personhood" that at least some conventional property rights in society ought to be recognized and preserved as personal.[65] "The premise underlying the personhood perspective is that to achieve proper self-development—to be a person—an individual needs some control over resources in the external environment."[66] If an object is bound with the holder, such that its loss causes pain that cannot be relieved by the object's replacement, then the object has a significant relationship with that person's personhood.[67] For example, a wedding ring that is stolen from a wearer is much harder to replace than one stolen from a jeweler due to its sentimental value.[68]

One view is that what is important in personhood is the ability to express one's character through property, such as connecting property to memories or to plan to use property in future projects.[69] The expectation of continuing control over property seems to be one strong reason that someone would tie their personhood to property.

Radin argues that where we can ascertain that a property right is personal, that right should be protected to some extent from cancellation by conflicting fungible property claims of other people.[70] This is especially true when the claimants' opportunities to become fully-developed persons would be destroyed or seriously lessened without the claimed protection of the property as personal.[71]

While Radin's theory has been subject to various criticisms, it has been applied to intellectual property—particularly patents.[72] In Kearns' case, the money he received from his settlement with Ford offered little solace because it did not recognize that his intellectual property was a part of his personhood, nor that his plan to use the property in the future meant that his development as a person depended on the realization of that expectation. In other words, the settlement ignored Kearns' expected use of his property as part of his identity as a person, and

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endured the plaintiff's injuries; (2) a per diem approach, in which a jury calculates the value of pain and suffering by the day, minute, or hour, and then multiplies this by the victim's remaining life expectancy; and (3) multiplying medical costs by some factor to estimate pain and suffering. And more. Avraham, *supra* note 51, 100–03.

65 Margaret Jane Radin, *Property and Personhood*, 34 STAN. L. REV. 957, 1014 (1982).

66 *Id.* at 957.

67 *Id.* at 959.

68 *Id.*

69 *Id.* at 968 ("If an object you now control is bound up in your future plans or your anticipation of your future self, and it is partly these plans for your own continuity that make you a person, then your personhood depends on the realization of these expectations.").

70 *Id.* at 1014–15.

71 Radin, *supra* note 65, at 1014–15.

72 Ofer Tur-Sinai, *Beyond Incentives: Expanding the Theoretical Framework for Patent Law Analysis*, 45 AKRON L. REV. 243, 274–81 (2012) (discussing criticisms of Radin's theory as well as applications to patent law by various scholars).

that losing this right could inflict emotional harm, perhaps no less than the emotional distress caused by a lost wedding ring.[73]

Put differently, infringing on a solo inventor's intellectually property is analogous to injuring the solo inventor's body. Courts routinely award pain and suffering damages in bodily injury cases where the pain and suffering harm exists in addition to the physical harm. If Radin is correct, courts should award pain and suffering damages in patent infringement cases as well.

C. Cognizable non-economic harm in property and contract cases

As the previous section has demonstrated, there are good reasons to consider patent infringement cases, at least in solo inventor cases, as similar to bodily injury cases. In this section, I show that pain and suffering damages are also sometimes awarded in mere property and contract cases. I argue that similar rationales to those applied in such cases apply also to patent infringement cases.

1. Property Cases

Even if one rejects my analysis in previous sections and believes that patent infringements are closer to the property end of the spectrum, Kearns' emotional harm may still be cognizable under U.S. law. Generally emotional damages are not recoverable as an element of property damage.[74] Yet, a solo inventors' harm is very similar to the distress a plaintiff may suffer from the defective construction of her dream home.[75] In *Salka v. Dean Homes Inc.*, repairs on the plaintiff's home took seven years to complete, during which time the plaintiff was forced to live in a rental apartment and was subject to distress and inconvenience.[76] Most courts would not allow recovery for non-economic damages stemming from the homebuilders' negligence because they would not recognize a duty owed to the plaintiff to avoid inflicting emotional distress.[77] In *Salka,* however, the court found a preexisting relationship between the parties that created a duty owed to the plaintiff, and found

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[73] Another area where a person may be compensated the fair market value of property taken, but this might not reflect the value of the property to them, is eminent domain cases. Compensation based on fair market value systematically undercompensates condemnees because their property often holds a higher value to them than it does to the market. Brian Angelo Lee, *Just Undercompensation: The Idiosyncratic Premium in Eminent Domain*, 113 COLUM. L. REV. 593, 595 (2013). Market prices are determined by other people—buyers and sellers who have created the market by participating in transactions—and thus will not reflect an individual owner's sentimental value. Tur-Sinai, *supra* note 72, at 275. Similarly, Farnsworth rejected RCA's offer to buy his patent because he was *not* looking to sell his patent rights. Eventually, though, he was forced to accept royalties at market value even though they did not meet his personal valuation of his patent.

[74] Barry A. Lindahl, *Emotional Injury as Element of Tort Damages*, 4 MODERN TORT LAW: LIABILITY AND LITIGATION § 32:2 (2d ed. 2017).

[75] *See* Salka v. Dean Homes of Beverly Hills, Inc., 22 Cal. Rptr. 2d 902, 906 (Cal. Ct. App. 1993), *overruled by* Salka v. Dean Homes, 864 P.2d 1037 (1993).

[76] *Id.*

[77] Leslie Benton Sandor & Carol Berry, *Recovery for Negligent Infliction of Emotional Distress Attendant to Economic Loss: A Reassessment*, 37 ARIZ. L. REV. 1247, 1249 (1995).

that the emotional distress claim was foreseeable. In the *Salka* example, it is easy to see how distress naturally flowed from negligent behavior in building the house—homes are a natural part of family life and as integral to personhood as property can be.[78] But if foreseeability is the test, then emotional trauma is also arguably foreseeable when a corporation forces an inventor to litigate their patent for years, despite their inferior legal resources.

In another case addressing damage to a plaintiff's home, *Rodrigues v. State,* the Hawaii Supreme Court upheld an award for $2,500 in emotional damages by recognizing an independent legal protection from the negligent infliction of serious mental distress.[79] The Rodrigues' dream home that had just been completed was flooded, causing extensive damage that could have been prevented if the State had done timely maintenance of a nearby culvert that was clogged with sand.[80] The court was not persuaded by the normal considerations that preclude recovery for negligent infliction of emotional distress—the primary concern was that courts will be flooded by fraudulent claims and that defendants may be exposed to unlimited liability for all emotional disturbances.[81] The court reasoned that courts and juries may look to "the quality and genuineness of proof and rely to an extent on the contemporary sophistication of the medical profession" in order to weed out false claims and find proof of serious mental distress.[82] Also, by limiting emotional damages to serious mental distress which is not trivial or transient, and by applying a "reasonable man" standard, courts can limit defendant liability.[83] The court consequently proposed a standard for negligent infliction of serious mental distress similar to that adopted by the Restatement.[84]

Other courts have also allocated emotional distress damages for the negligent loss of property. In *Jarchow v. Transamerica Title Ins. Co.*, the plaintiffs were awarded $50,000 each for emotional distress for the negligent failure of a title insurer to list a prior-recorded deed in a preliminary title report.[85] The court held that "[i]t was entirely foreseeable that plaintiffs would suffer mental anguish and distress when they were appraised of the defendant's negligence since they relied on the preliminary report before purchasing the property."[86] Also, in *Windeler v. Scheers Jewelers*, the defendant negligently lost jewelry entrusted to it by the plaintiff, who had emphasized the jewelry's sentimental value.[87] Upon learning of

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78 *Id.* at 1250.
79 Rodrigues v. State, 472 P.2d 509, 520 (Haw. 1970).
80 *Id.* at 513.
81 *Id.* at 519.
82 *Id.* at 519–20.
83 *Id.* at 520.
84 *Id.*
85 Jarchow v. Transamerica Title Ins. Co., 48 Cal. App. 3d 917, 917 (Cal. Ct. App. 1986), *overruled* by Soto v. Royal Globe Ins. Corp., 184 Cal. App. 3d 420.
86 *Id.* at 939.
87 Windeler v. Scheers Jewelers, 8 Cal. App. 3d 844, 844 (Cal. Ct. App. 1970).

the loss, the plaintiff suffered arguably-foreseeable emotional distress.[88] The appellate court held that the jury could properly award the plaintiff $4,000 in money damages to compensate for emotional distress.[89]

Foreseeability is also the organizing principle in contract cases, as the next section demonstrates.

2. Contract Cases

The Restatement (Second) of Contracts states the general rule that: "Recovery for emotional disturbance will be excluded unless the breach also caused bodily harm or the contract or the breach is of such a kind that serious emotional disturbance as a particularly likely result."[90]

One example is *Sullivan v. O'Connor,* wherein the plaintiff brought suit for failed plastic surgery of her nose, claiming that she suffered both bodily and emotional harm.[91] The court distinguished this case from contract cases for goods and merchandise by reasoning that the psychological injury was more foreseeable as a probable consequence of the breach, because psychological injury is a more foreseeable result of a negligent operation.[92]

Sullivan might be an unusual example because it involved bodily injuries. Other situations where courts have allowed pain and suffering damages for breach of contract have been in cases that involve expulsions of guests from hotels, or expulsions of passengers from trains, or refusal of admittance to ticket holders in places of public resort or entertainment.[93] While these cases may have a personal element, they hardly seem to involve severe emotional distress. An exception might be in breaches of contracts for funeral arrangements, as severe emotional distress is probably more likely than in the other cases.[94]

Perhaps more to the point is a case when an insurance claim is denied. Often in such cases the insured will feel the need to sue the insurer not just for economic damages, but also for the tort of wrongful denial of coverage. Some courts have found that when a breach of contract is wanton or reckless, an action for distress damages may be appropriate. In *Giampapa v. American Family Mutual Insurance Co.*, the Colorado Supreme Court held that non-economic damages were available in such a case.[95] Here, the insured suffered severe injuries from an automobile accident, and despite purchasing a "deluxe" insurance policy, the insurance

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88 *Id.* at 849.

89 *Id.* at 854.

90 RESTATEMENT (SECOND) OF CONTRACTS § 353 (1981).

91 Sullivan v. O'Connor, 296 N.E.2d 183, 184 (Mass. 1973).

92 *Id.* at 188–89.

93 CHARLES T. MCCORMICK, CASES AND MATERIALS ON THE LAW OF DAMAGES 593 (1935).

94 Hirst v. Elgin Metal Casket Co., 438 F. Supp., 906, 908 (D.Mont. 1977); Yochim v. Mount Hope Cemetery Ass'n, 623 N.Y.S.2d 80, 83 (N.Y. Ct. Cl. 1994); Lamm v. Shingleton, 55 S.E.2d 810, 813-14 (N.C. 1949).

95 Giampapa v. Am. Family Mut. Ins. Co., 64 P.3d. 230, 234 (Colo. 2003).

company failed to pay some medical bills, paid others late, and refused to pay for in-home therapy equipment that the insured's physicians had recommended, resulting in substantial side effects.[96] The jury found that the insurance company willfully and wantonly breached its contract with Giampapa and awarded him $125,000 solely for mental anguish.[97]

So far I have assumed that complete compensation implies damages for non-economic harm. The next section assumes that court will not recognize non-economic harm in patent law as a separate cognizable harm. It therefore explores the use of § 284 which, as we saw above, was interpreted as a tool to impose *punitive* damages, as a doctrinal hook to award *pain and suffering* damages.

V. Section 284 enhanced damages as a doctrinal hook

Punitive, or "exemplary," damages in tort law are assessed against a defendant for flagrantly violating a plaintiff's rights. They may be awarded for conduct that is outrageous due to malice or reckless indifference to the rights of others.[98] Courts award these damages to punish the defendant for their outrageous conduct, as well as to deter other defendants from similar conduct in the future.[99] In this section I show that despite the focus on defendant's egregious behavior, courts do consider plaintiff's pain and suffering when they award punitive damages.

When courts award punitive damages in tort cases they consider various factors. Determinative factors for punitive damage awards vary among states, but they can generally be reduced to three main considerations: 1) the character of the defendant's act; 2) the nature and extent of the plaintiff's injuries; and 3) the defendant's wealth.[100] As the second consideration above indicates, the jury is often instructed to consider the nature and extent of the plaintiff's injury so that there is a relationship between the damages and the injury.[101] The nature of the plaintiff's injury of course includes the emotional component. In fact, one of the most famous punitive damages cases of all times deals with emotional distress. In *State Farm Mutual Auto. Ins. v. Campbell*, the Supreme Court held that punitive damages were warranted to punish State Farm's misconduct.[102] Representing the Campbells (State Farm's insureds) against a tort lawsuit, State Farm insisted on taking the case to trial despite indicators that the Campbells were at fault for the subject incident, and refused to settle with the plaintiff in the underlying lawsuit for the $50,000 policy

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96 *Id.* at 234–35.

97 *Id.* at 236.

98 *See generally* RESTATEMENT (SECOND) OF TORTS § 908 cmt. b (1977).

99 *Id.* at § 908(1).

100 *See id.* at § 908(2) & cmts. b-e.

101 *See* TXO Prod. Corp. v. Alliance Res. Corp., 509 U.S. 443, 460 (1993) (citing Pacific Mut. Life Ins. Co. v. Haslip, 499 U.S. 1, 21 (1991)) (noting that in calculating punitive damages, juries may consider harm that may have resulted from defendant's actions as well as harm that actually occurred, but requiring reasonable relationship between harm and punitive damage award).

102 State Farm Mut. Auto. Ins. Co. v. Campbell, 538 U.S. 408, 413 (2003).

limit despite the possibility that a jury award would be significantly higher.[103] State Farm assured the Campbells that their assets were safe, but at trial the jury determined that Curtis Campbell was entirely at fault for the incident and issued a $185,849 judgement for the plaintiff.[104] State Farm refused to cover the $135,849 in excess liability, and the Campbells sued State Farm for bad faith, fraud, and the intentional infliction of emotional distress.[105] The trial court awarded the Campbells $1 million for emotional distress and an additional $145 million in punitive damages.[106] Other courts followed suit.[107]

The conclusion is simple. Even under current courts' interpretation of § 284, which as we saw above analogizes enhanced damages to punitive damages, court can still take into account the pain and suffering solo inventors suffer when they award punitive damages under § 284's enhanced damages.

VI. Conclusion

In sum, the current system of compensating patent infringements is inefficient and inadequate in protecting the interests of solo inventors. These individuals, considered to be the lifeblood of American innovation, are vulnerable due to frail legal protections that do not shield them from the intrusions of large, corporate infringers.[108] Courts may, however, rectify this imbalance in various ways, the easiest one is by reading § 284 of the Patent Act to include emotional distress damages as a relevant factor for the recovery for patent infringement.[109] Enhancing damages in this way would both compensate inventors for the fiscal and emotional toll of patent litigation, as well as better deter would-be infringers from violating the tenets of patent law.

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[103] *Id.*

[104] *Id.*

[105] *Id.* at 413-14.

[106] *Id.* at 415.

[107] *See, e.g.*, Spinks v. Equity Residential Briarwood Apartments, 90 Cal. Rptr. 3d 453, 493 (Cal. Ct. App. 2009) ("Punitive damages likewise are recoverable . . . for the infliction of emotional distress.").

[108] *See supra* subpart 3a (discussing how the current tort law regime under-deters tortfeasors).

[109] *See* 35 U.S.C.A. § 284 (West 2017) (providing that courts shall award damages "adequate to compensate for the infringement," allowing judges to consider a variety of recoveries including emotional distress damages).

Distinguishing Damages Paid from Compensation Received: A Thought Experiment

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[†] Professor of Law, UC Davis School of Law. My thanks to John Golden for organizing the Patent Damages 2 Conference at the University of Texas School of Law. Thanks to Michael Abramowicz, T.J. Chiang, Tom Cotter, John Golden, Glynn Lunney, and conference participants for providing helpful insights on this project. Special thanks to Bob Bone for providing extensive comments on an earlier draft of this paper. Thanks as well to Mark Bailey for excellent research assistance. I received an honorarium for writing and presenting this article at the University of Texas School of Law, but it was not dependent in any way on the views expressed in this article.

I. Introduction

The law of patent infringement damages is in need of reform.[1] Courts and commentators have argued that damages are uncertain,[2] difficult to determine,[3] divorced from economic rationales,[4] sometimes too low,[5] and frequently too high.[6] High damages awards may depress innovation, raise prices, and exacerbate what many commentators consider to be the greatest threat to the patent system: patent trolls.[7] Recent doctrinal reforms signal deep dissatisfaction with the current damages regime and a desire to improve it.[8] This Article proceeds in this spirit and offers a thought experiment to more closely tie damages calculations to the normative aims of the patent system.

This Article argues that the shortcomings of damages doctrine stem in part from the disparate and sometimes conflicting normative aims of this body of law. Patent damages serve multiple functions, and this Article focuses on two of chief importance. First, consistent with the overarching normative aim of the patent system, this Article argues that damages serve to enhance incentives to invent and commercialize new technologies. As the Supreme Court famously observed in *Graham v. John Deere*,[9] the patent system seeks to induce the creation of inventions

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1 *See* Stuart Graham et al., *Final Report of the Berkeley Center for Law & Technology Patent Damages Workshop*, 25 TEX. INTELL. PROP. L.J. 115, 116 (2017) ("The determination of patent damages . . . remains one of the most contentious topics in [patent law and policy].").

2 *See* John M. Golden, *Principles for Patent Remedies*, 88 TEX. L. REV. 505, 527 (2010) ("[E]ven as a theoretical matter, there seems to be no generally agreed value, or even a generally agreed way for determining value, for what patent holders should receive."); Ted Sichelman, *Innovation Factors for Reasonable Royalties*, 25 TEX. INTELL. PROP. L.J. 277, 287 (2018) (noting the "unwieldy and unpredictable" nature of reasonable royalty determinations).

3 Roger D. Blair & Thomas F. Cotter, *Rethinking Patent Damages*, 10 TEX. INTELL. PROP. L.J. 1, 2 (2001) ("[T]he rules courts have developed for estimating patent damages have been, all too often, both complex and contradictory."); Daralyn J. Durie & Mark A. Lemley, *A Structured Approach to Calculating Reasonable Royalties*, 14 LEWIS & CLARK L. REV. 627, 631 (2010) (exploring the difficulty of applying the *Georgia-Pacific* test for determining reasonable royalties).

4 *See, e.g.*, Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1336 (Fed. Cir. 2009) (insisting on greater economic justifications for damages awards).

5 *See* Ted Sichelman, *Purging Patent Law of "Private Law" Remedies*, 92 TEX. L. REV. 517, 564 (2014) (noting that challenges of calculating damages may lead courts to systematically undercompensate patentees).

6 Durie & Lemley, *supra* note 3, at 628 (citing commentary suggesting that damages routinely overcompensate patentees); Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2020–25 (2007) (describing several difficulties of calculating reasonable royalties that tend to exacerbate holdup problems).

7 *See, e.g.*, Oskar Liivak, *When Nominal is Reasonable: Damages for the Unpracticed Patent*, 56 B.C. L. REV. 1031, 1033 (2015).

8 *See, e.g.*, *Lucent Techs.*, 580 F.3d at 1301 (rejecting a reasonable royalty award as unsupported by the evidence); Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1314–15 (Fed. Cir. 2011) (rejecting the 25% "rule of thumb" approach to determining a reasonable royalty); *see also* John M. Golden & Karen Sandrik, *A Restitution Perspective on Reasonable Royalties*, 36 REV. LITIG. 335, 347 (2017) ("In the past decade, the U.S. Court of Appeals for the Federal Circuit has issued a raft of opinions tightening standards for proving reasonable royalty damages . . . .").

9 Graham v. John Deere Co., 383 U.S. 1 (1966).

that would not exist but for the availability of exclusive rights.[10] As Michael Abramowicz and John Duffy have fruitfully explored, this "inducement" standard provides compelling normative guidance for determining which inventions satisfy the nonobviousness requirement.[11] This standard also provides less appreciated normative guidance for the amount of incentive that the patent system should provide inventors, in part through the award of damages. An important component of the inducement standard is that the patent system should provide just enough incentive to induce invention and commercialization but nothing more.[12] While greater rewards create greater incentives, they come at a potentially significant cost of deadweight loss and static inefficiency,[13] and the patent system seeks to strike an appropriate balance between exclusivity and access to technology.

Second, the award of damages also serves the normative aim of deterring infringement and shunting would-be infringers into voluntary licensing negotiations with patentees.[14] This might be considered a secondary normative aim, for it essentially supports the primary objective of promoting incentives to invent and innovate. If damages are too low, then potential licensees will simply infringe and risk litigation, thus undermining incentives to invest in research and development as well as imposing other social costs. Put differently, patent law in general, and patent damages in particular, aims to ensure that market actors are no better off—and are usually worse off—by infringing a patent rather than licensing it.[15]

These two normative aims—providing just enough incentive to induce invention and commercialization while ensuring that infringement is not more profitable than licensing—may sometimes lead to conflicting conceptions of damages. For example, a patentee late in the patent term may have recovered its fixed costs and made a substantial profit based on exploiting a patent, thus satisfying the incentive to invent and commercialize. However, the market value of a patented article far exceeds the marginal cost of producing that article, and the patentee sues an infringer, seeking to wring even more profits from its exclusive rights. In the current damages framework, which provides so-called "make-whole"

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[10] *Id.* at 9 ("[A patent is intended to serve as] a reward, an inducement, to bring forth new knowledge.").

[11] Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1599 (2011).

[12] *See infra* Part I.A.

[13] *See* 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, 989 (1999) (explaining how the last increment by which patentees raise prices harms social welfare more than it motivates a patentee).

[14] David O. Taylor, *Using Reasonable Royalties to Value Patented Technologies*, 49 GA. L. REV. 79, 113 (2014); *see, e.g.*, Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1158–59 (6th Cir. 1978) (warning that simply equating damages with a foregone royalty would encourage infringement).

[15] *See* Blair & Cotter, *supra* note 3, at 9 (arguing that patent damages should encourage voluntary licensing by rendering a technology user no better off from infringing a patent than licensing it).

damages,[16] the patentee may recover lost profits or reasonable royalties (and potentially attorney fees and enhanced damages) based on the full market value of the infringer's use of the patented technology. However, receiving full, market-based compensation at this late point in the technology's lifespan may easily exceed the incentive to invent and commercialize the technology, thus maintaining static inefficiency with relatively little countervailing gain to dynamic efficiency. In such cases, there is reason to believe that damages (and the exclusivity they help enforce) are excessive.[17]

As an alternative, some commentators have suggested shifting the emphasis of damages calculations from the market value of a patented technology to the cost of developing that technology.[18] However, altering damages in this manner introduces a host of difficulties,[19] including incentivizing industry actors to engage in widespread infringement, encouraging patentees to inflate technological development costs, and increasing socially wasteful patent litigation. This is a two-pronged dilemma. If a court awards make-whole damages, those damages may overcompensate patentees.[20] However, awarding damages that only cover invention and commercialization costs (and a reasonable profit) may encourage widespread infringement and incur concomitant social costs.

This Article proceeds as a thought experiment centered around one major theoretical insight: it distinguishes the multiple normative ends served by patent damages by formally separating the amount of compensation that patentees receive from the amount of damages that infringers pay.[21] The current practice of awarding make-whole damages likely overcompensates patentees in many instances by providing more reward than necessary to invent and innovate (while making a reasonable profit). However, awarding damages to simply cover inducement costs falters for a number of reasons, notably by creating perverse incentives to infringe rather than license a patent. There is, in short, a difference between the amount that

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16 *See* Sichelman, *supra* note 5, at 517.

17 *Id.* at 555–56. *But see* John M. Golden, *"Patent Trolls" and Patent Remedies*, 85 TEX. L. REV. 2111, 2145–46 (2007) (disputing empirical assertions that patent damages awards are excessive); David W. Opderbeck, *Patent Damages Reform and the Shape of Patent Law*, 89 B.U. L. REV. 127, 130 (2009) (arguing that damages awards are widely and stochastically distributed and do not reflect a bias toward large awards).

18 *See, e.g.*, Sichelman, *supra* note 2; Golden & Sandrik, *supra* note 8; Hannah Brennan et al., *A Prescription for Excessive Drug Pricing: Leveraging Government Patent Use for Health*, 18 YALE J.L. & TECH. 275 (2016); *cf.* Lisa Larrimore Ouellette, *Adjusting Patent Damages for Nonpatent Incentives*, 26 TEX. INTELL. PROP. L.J. 187, 190 (2018).

19 *See, e.g.*, Golden, *supra* note 2, at 537–39.

20 This assumes that the market value of an invention exceeds a proportional amount of outstanding inducement costs borne by the infringer. Of course, patentees may also be undercompensated as well. *See* Sichelman, *supra* note 5, at 559. This Article, however, focuses on the more common scenario in which make-whole damages are likely to exceed proportional inducement costs.

21 This "decoupling" regime may not materialize in practice given that the patentee and infringer are likely to settle and thus divide any surplus between them. As discussed further below, this Article contends that such settlements are a beneficial attribute of this proposal. *See infra* Part III.E.

patentees should receive in compensation and the amount that defendants should pay as damages for infringement. This Article argues that patent doctrine should embrace this gap to further the purposes of the patent system rather than evading this gap or forcing damages into one box or the other.

This Article proposes an unorthodox but conceptually simple framework. Infringers should pay damages based on the current regime of awarding make-whole damages. However, courts should award compensation to a patentee based on the patentee's outstanding and projected costs of invention and commercialization, including a reasonable profit to account for risk and opportunity costs. Under this proposal, the traditional measure of damages would define a maximum amount of potential compensation. If outstanding development costs exceeded traditional damages, then the patentee would recover all of those damages, as in the current framework. However, if make-whole damages exceed outstanding development costs—perhaps because the patentee has largely recouped fixed costs through normal operating profits—a court would allocate a portion of traditional damages to cover outstanding fixed costs as well as marginal costs. Courts would grant any difference between the defendant's damages and the patentee's compensation (the "patent surplus") to government agencies to fund research and development, thus advancing the goals of the patent system.

This Article acknowledges the difficulties of implementing this proposal and addresses several anticipated objections. While this approach arguably deviates from the patent damages statute and would be difficult to implement, the statute exhibits significant flexibility, and placing the burden on patentees to prove compensation would substantially facilitate implementation. Although this proposal would reduce some incentives to invent and commercialize, it corrects a current framework that frequently overcompensates patentees, and it would actually increase incentives to develop some technologies. This regime would encourage more market entry relative to the status quo. While defendants would still face make-whole damages (and possible injunctions), patentees would have less incentive to enforce their patents, and settlements would generally fall below make-whole damages. Although such market entry reduces technological development incentives for patentees, it may be a net social positive if it reduces static inefficiency without unduly harming dynamic efficiency.[22] Furthermore, concerns over rampant infringement are mitigated by the availability of treble damages and attorney fees for willful infringement. Even if, as expected, a patentee and infringer settle in a manner that splits the patent surplus, this proposal will still generate greater market entry and access to patented technologies compared to the status quo. Finally, this proposal leverages probabilistic decision making[23] to protect against

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[22] *Cf.* Ayres & Klemperer, *supra* note 13, at 986 (arguing that limited infringement can enhance social welfare without substantially diminishing incentives to invent and develop technologies); *see id.* at 989 (explaining how the final increments of patent-inflated prices harm social welfare more than they encourage technological development).

[23] *Cf.* Glynn S. Lunney, Jr., *Patents, the Federal Circuit, and the Supreme Court: A Quiet Revolu-*

miscalculating patentee compensation and harming incentives to invent by imposing relatively high damages on defendants.

This proposal shares conceptual similarities with suggestions to "decouple" defendant payments from plaintiff recoveries in tort law,[24] though it deviates in important ways and is tailored specifically to patent law.[25] This Article also finds common cause with other proposals to shift patent damages toward a cost-recovery system.[26] However, while the majority of these proposals have sought to incorporate inducement costs in the traditional damages framework—notably, in the calculation of reasonable royalties[27]—this proposal seeks to achieve (or approximate) the appropriate incentives to invent and infringe by utilizing private ordering and probabilistic decision making. This Article thus provides an alternate account of cost-plus damages that, while facing some formidable challenges, offers some helpful insights.

This Article proceeds in three parts. Part I examines the normative aims of the patent system and patent infringement damages. It argues that the law of patent damages serves several functions, chiefly to provide (just enough) incentive to invent and develop new technologies while deterring infringement and encouraging voluntary licensing. Part II elaborates this proposal for differentiating the amount of compensation that patentees receive from the amount of damages that defendants pay. It highlights several benefits of this approach, including a tighter fit between damages doctrine and the normative aims of patent law. Part III addresses various objections to this proposal. Among other contentions, it argues that putting the onus on patentees to prove inducement costs can enhance the administration of this proposal and that existing doctrinal safeguards can adequately guard against rampant patent infringement.

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tion, 11 SUP CT. ECON. REV. 1, 72–73 (2004) (describing the probabilistic nature of the patent system).

24 *See, e.g.*, A. Mitchell Polinsky & Yeon-Koo Che, *Decoupling Liability: Optimal Incentives for Care and Litigation*, 22 RAND J. OF ECON. 562 (1991); Albert Choi & Chris William Sanchirico, *Should Plaintiffs Win What Defendants Lose? Litigation Stakes, Litigation Effort, and the Benefits of Decoupling*, 23 J. LEGAL STUD. 323, 346 (2004).

25 For instance, while Polinsky and Che's proposal aims to maintain status quo levels of deterrence by raising the defendant's liability as high as possible (while reducing the plaintiff's recovery), this Article's proposal caps the defendant's liability at make-whole damages and seeks to lower deterrence slightly, thus encouraging greater market entry. *See* Polinsky & Che, *supra* note 24, at 563.

26 *See, e.g.*, Brennan et al., *supra* note 18; Golden & Sandrik, *supra* note 8; Sichelman, *supra* note 2; *cf.* Ouellette, *supra* note 18.

27 *See, e.g.*, Golden & Sandrik, *supra* note 8, at 336–37 (suggesting applying restitution principles to consider invention costs in reasonable royalty calculations); Sichelman, *supra* note 2. Hannah Brennan and her co-authors offer a different proposal, advocating for the federal government's use of 28 U.S.C. § 1498 to utilize patents for reasonable compensation "where there are significant social gains to be had from bringing compensation in line with the risk-adjusted cost of developing a drug." Brennan et al., *supra* note 18, at 282.

II. The Normative Aims of Patent Law and Patent Infringement Damages

A. Normative Theories of the Patent System

In order to develop a normative theory of patent damages, one must first consider the overall normative aims of patent law. In a broad sense, it is virtually uncontested that patents are a policy tool aimed at promoting technological progress.[28] The Supreme Court, drawing upon the influential views of Thomas Jefferson, observed that "[t]he patent monopoly was not designed to secure to the inventor his natural right in his discoveries. Rather, it was a reward, an inducement, to bring forth new knowledge."[29] This is a broadly utilitarian conception of the patent system that focuses on promoting society-wide progress rather than rewarding individual inventive labor.[30] Contrary to natural-rights theories, there is no entitlement to a patent—or to any particular set of remedies arising from patent infringement. This view accords with accounts of the patent system highlighting its regulatory, rather than rights-based, nature.[31] While statutes and courts sometimes characterize patents as property rights for conceptual convenience,[32] commentators have roundly criticized the application of property rights theory and rhetoric to patents.[33] And the Supreme Court has emphasized that recognizing patents as a form of property does not imply any particular remedy for infringement.[34]

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28 *See* U.S. Const. Art. I, § 8, cl. 8 (authorizing Congress with the power to grant patents "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries"); Motion Picture Patents Co. v. Universal Film Mfg. Co., 243 U.S. 502, 510–11 (1917) ("Since Pennock v. Dialogue was decided in 1829, this court has consistently held that the primary purpose of our patent laws is not the creation of private fortunes for the owners of patents but is to promote the progress of science and useful arts."); *see also, e.g.*, Golden, *supra* note 2, at 509 ("I generally assume a utilitarian goal that is standard in modern accounts: the patent system should act to promote the development, disclosure, and use of new technologies, ideally in a way that maximizes social welfare."); Sichelman, *supra* note 5, at 529 ("In the United States, the overriding goal of patent law is to promote technological innovation.").

29 Graham v. John Deere Co., 383 U.S. 1, 9 (1966).

30 *But see* ROBERT P. MERGES, JUSTIFYING INTELLECTUAL PROPERTY (2011) (providing deontological justifications for patent protection).

31 *See, e.g.*, Shubha Ghosh, *Patents and the Regulatory State: Rethinking the Patent Bargain Metaphor After Eldred*, 19 BERKELEY TECH. L.J. 1315–16 (2004); *cf.* Kenneth J. Arrow, *Distributive Justice and Desirable Ends of Economic Activity*, *in* ISSUES IN CONTEMPORARY MACROECONOMICS AND DISTRIBUTION 134, 152 (George R. Feiwel ed., 1985) ("But property itself is a social contrivance and cannot be taken as an ultimate value."); *cf.* Ayres & Klemperer, *supra* note 13, at 1021 ("Instead of taking an essentialist view that the 'very nature' of property entails the right to exclude, we suggest that the nature of patents should entail offering sufficient rewards for innovation.").

32 *See, e.g.*, 35 U.S.C. § 261 (stating that "patents shall have the attributes of personal property" regarding ownership and assignment).

33 *See, e.g.*, Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031 (2005).

34 eBay v. MercExchange, 547 U.S. 388, 392 (2006) ("But the creation of a right is distinct from the provision of remedies for violations of that right."); *cf.* Robert G. Bone, *Mapping the Boundaries of the Dispute: Conceptions of Ideal Lawsuit Structure from the Field Code to the Federal Rules*,

Having established the broad, utilitarian nature of the patent system, it is important to further elaborate the specific normative function of patents. To that end, this Article draws upon Michael Abramowicz and John Duffy's conception that the aim of the patent system is to induce the creation of inventions that would not exist but for the availability of a patent.[35] This "inducement" principle arises directly from Supreme Court doctrine: in the seminal case of *Graham v. John Deere Co.*, the Court noted that "[t]he inherent problem was to develop some means of weeding out inventions which would not be disclosed or devised but for the inducement of a patent."[36] Although this statement directly addresses the nonobviousness requirement,[37] it provides broad normative guidance for why the government offers patents and why it may constrain those rights in some circumstances.[38]

Within this seemingly straightforward articulation of the normative aims of the patent system, it is important to unpack what it means to "devise" a new invention. This Article takes the conventional position that the patent system aims to induce the invention and commercialization of technologies that would not exist but for the patent system. While the objective of invention is fairly straightforward,[39] this Article also adopts the rather well-settled proposition that the patent system also aims to promote the commercialization of technologies.[40] As commentators have long recognized, developing a new invention into a commercial product can require significant time, effort, and resources.[41] Although commercialization-based theories of patents have proven controversial,[42] this Article argues that the normative aims of

89 COLUM. L. REV. 1, 14 (1989) (noting the modern conception that rights "are neither logically prior nor logically posterior to remedies. The terms 'right' and 'remedy' are just handy conventions for describing the form of protection that a court will provide to someone whose interests have been harmed. And the scope of that protection is not given in the nature of things, but is the product of community decision based on controversial value choices").

35 Abramowicz & Duffy, *supra* note 11, at 1594.

36 383 U.S. 1, 11 (1966); *see* Bristol-Myers Squibb Co. v. Teva Pharms. USA, Inc., 769 F.3d 1339, 1358 n. 10 (Fed. Cir. 2014) (citing same).

37 *See* 35 U.S.C. § 103; *see also* Bilski v. Kappos, 561 U.S. 593, 649 (2010) (Stevens, J., concurring) (citing the inducement principle of *Graham* in addressing patentable subject matter).

38 One caveat to this principle is that patents should induce the creation of an invention within a reasonable period of time relative to a world in which patents are not available. *See* Abramowicz & Duffy, *supra* note 11, at 1599.

39 *See* Rebecca S. Eisenberg, *Patents and the Progress of Science: Exclusive Rights and Experimental Use*, 56 U. CHI. L. REV. 1017, 1025–26 (1989) (discussing the incentive to invent).

40 *See, e.g.*, Abramowicz & Duffy, *supra* note 11, at 1600 (arguing that an inducement theory of nonobviousness should focus on "an earlier arrival of the commercialized invention, not merely the 'invention' in theory or on paper in a patent disclosure"); *see id.* at 1642–47; Liivak, supra note 7, at 1066.

41 *See, e.g.*, F. Scott Kieff, *Property Rights and Property Rules for Commercializing Inventions*, 85 MINN. L. REV. 697, 705 (2001).

42 *See* Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 266 (1977) (articulating the so-called "prospect theory" of patents); Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 872–75 (1990) (critiquing prospect theory and arguing that rivalrous competition offers the most efficient mechanism

patent law encompass inducing invention as well as post-invention development and commercialization.[43]

While describing the patent system's aims, this Article emphasizes one inherent but underappreciated caveat. Ideally, in any given instance, the patent system should provide *just enough* incentive to invent and commercialize a new technology and *nothing more*.[44] That is, the inducement approach to patent rights serves as both a floor and a ceiling. Inadequate exclusivity is problematic because it provides insufficient incentive to invent and develop new technologies. However, excessive exclusivity produces a host of well-recognized harms, such as allocative inefficiency, deadweight loss, and supracompetitive prices.[45] As Justice Brennan observed in his dissent in *Diamond v. Chakrabarty*, the exclusivity of patents comes at a cost, for "[t]he patent laws attempt to reconcile this Nation's deep seated antipathy to monopolies with the need to encourage progress."[46] The patent system tolerates a certain degree of static inefficiency to enhance dynamic efficiency.[47] However, excessive exclusivity may swallow the gains of dynamic efficiency and inhibit sequential innovation.[48] Furthermore, excessively rewarding patents can cause wasteful patent races and distort the allocation of resources toward patentable areas of technological development.[49] To strike the right balance, the overarching aim of patent law is "to give as little protection as possible consistent with encouraging innovation."[50]

B. Normative Theories of Patent Damages

The overarching inducement objective of the patent system helps inform the subsidiary normative aims of patent damages. Given that patent law rests not upon natural-rights theories or entitlements but a utilitarian commitment to society-wide technological progress, functional concerns should dictate the determination of

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to develop many technological prospects).

43 *But see* Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010) (arguing for separating the invention and commercialization function of patents).

44 *See* Lunney, Jr., *supra* note 23, at 5.

45 *See, e.g.*, Peter Lee, *Toward a Distributive Commons in Patent Law*, 2009 WIS. L. REV. 917, 931–32.

46 Diamond v. Chakrabarty, 447 U.S. 303, 319 (1980) (Brennan, J., dissenting).

47 Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights*, 60 STAN. L. REV. 863, 867 (2007).

48 *See* Blair & Cotter, *supra* note 3, at 46.

49 Golden, *supra* note 2, at 517; *cf.* Mark F. Grady & Jay I. Alexander, *Patent Law and Rent Dissipation*, 78 VA. L. REV. 305, 308–09 (1992) (arguing that one of the functions of the patent system is to minimize rent dissipation).

50 Lemley, *supra* note 33, at 1031; *cf.* Thomas F. Cotter, *Patent Holdup, Patent Remedies, and Antitrust Responses*, 34 J. CORP. L. 1151, 1154–55 (2009) (arguing that patent law should be "structured to maximize the surplus of cognizable social benefits over cognizable social harms," with the latter encompassing deadweight loss and other costs); Ayres & Klemperer, *supra* note 13, at 987 ("[E]fficient patent policy should strive to give patentees constrained market power . . . ."); Golden & Sandrik, *supra* note 8, at 371 ("[P]atent law should provide a reward that is just large enough to cover the pertinent costs, including opportunity costs, associated with innovation so that the socially optimal level of these activities are stimulated at the least expense to society as a whole.").

damages.[51] This Article argues that patent damages should aim to provide adequate incentives for invention and commercialization (without offering excessive compensation) as well as discourage infringement by rendering it less profitable than licensing.[52]

There are, of course, other normative aims that damages could theoretically advance. For instance, damages could prevent injustice associated with undercompensation.[53] To illustrate the wide range of potential conceptions of damages—and the need to tie damages to a normative theory of patent law—it is instructive to consider various kinds of damages that patent law has dismissed. For example, unlike copyright and trademark law, patent law does not provide for statutory damages or standard remuneration for disgorgement.[54] While the design patent statute contains a provision explicitly allowing a patentee to recover the "total profit" from an infringer, the utility patent statute lacks such a provision.[55]

1. Providing (Just Enough) Compensation to Induce Invention and Commercialization

Drawing on the central "inducement" rationale of the patent system, this Article argues that the central aim of damages should be to provide sufficient compensation to encourage invention and commercialization of new technologies and nothing more. In so doing, it draws upon Abramowicz and Duffy's central insight that the purpose of the patent system is to induce the development of technologies that would not exist but for the availability of a patent.[56] It is important to note that an inducement theory of damages would require not only compensating the costs of invention and innovation but also providing a reasonable profit to cover the risk and opportunity cost of developing a particular technology to the exclusion

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51 Golden, *supra* note 2, at 509.

52 *See* Blair & Cotter, *supra* note 3, at 88 (characterizing as "first principles" the notions that "we want to (1) preserve the patentee's incentive to invent, disclose, and (perhaps) commercialize, and (2) deter infringement by channeling would-be users into voluntary transactions").

53 Taylor, *supra* note 14, at 112; *see* Cincinnati Car Co. v. N.Y. Rapid Transit Corp., 66 F.2d 592, 595 (2d Cir. 1933) ("The whole notion of a reasonable royalty is a device in the aid of justice, by which that which is really incalculable shall be approximated, rather than that the patentee, who has suffered an indubitable wrong, shall be dismissed with empty hands.").

54 *Compare* Golden, *supra* note 2, at 514–15, *and* Golden & Sandrik, *supra* note 8, at 336–37 (describing the demise of the disgorgement remedy for patent infringement), *with* 17 U.S.C. § 504(b) (providing for recovery of infringer's profits in copyright law), 15 U.S.C. § 1117(a) (providing for recovery of infringer's profits in trademark law), Aro Mfg. Co. v. Convertible Top Replacement Co., 377 U.S. 476, 505 (1964) ("The purpose of the [statutory] change was precisely to eliminate the recovery of profits as such and allow recovery of damages only."), Mark A. Lemley, *Distinguishing Lost Profits from Reasonable Royalties*, 51 WM. & MARY L. REV. 655, 655 (2009), *and* Taylor, *supra* note 14, at 158.

55 35 U.S.C. § 289; *see also* Samsung Elecs. Co. v. Apple, Inc., 137 S. Ct. 429, 432 (2016).

56 Abramowicz & Duffy, *supra* note 11, at 1594 ("[I]f the innovation would be created and disclosed even without patent protection, denying a patent on the innovation costs society nothing . . . and saves society from needlessly suffering the well-known negative consequences of patents . . . .").

of other uses of capital.[57] An inducement approach to damages would encourage similar investments in technological development in the future while minimizing the deadweight loss associated with exclusive rights. Since the government lacks the requisite information to make these determinations *ex ante*, the patent system relies on proxies—make-whole damages and relatively strict rights to exclude—as well as probabilistic decision making to encourage invention.[58]

Notably, this normative conception of damages departs starkly from the prevailing view of damages, which seeks to return the patentee to the status quo ante as if the infringement had not occurred.[59] The traditional approach offers "make-whole" damages of foregone profits and royalties lost to infringement.[60] As Ted Sichelman observes, this approach is a "private law" model of remedies consonant with tort, property, and contract law,[61] and it has become so ingrained in patent law that courts and commentators often assume its propriety.[62] Ironically, even when scholars highlight patent law's significant deviations from private law fields like torts and real property, they still apply private law remedies to patent infringement.[63]

As Sichelman has argued, however, this drive to return the patentee to the

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57 *But see* Thomas F. Cotter, *Patent Damages Heuristics*, 25 TEX. INTELL. PROP. L.J. 159, 174 (2018) ("[I]f we want the patent system to induce the invention of economically valuable inventions, the better policy for both practical and economic reasons is to reward results, not effort, though presumably the two will often run in sync.").

58 *See* Ayres & Klemperer, *supra* note 13, at 1007–08 (noting that the patent system economizes on the government's need for information); Lunney, Jr., *supra* note 23.

59 *See* Yale Lock Mfg. Co. v. Sargent, 117 U.S. 536, 552 (1886) (characterizing damages owed to the plaintiff as "the difference between his pecuniary condition after the infringement, and what his condition would have been if the infringement had not occurred"); Livesay Window Co. v. Livesay Indus., 251 F.2d 469, 471 (5th Cir. 1958) ("Of course the question was how much had the Patent Holder and Licensee suffered by the infringement. And that question was primarily: had the Infringer not infringed, what would Patent Holder-Licensee have made?"); ResQNet.com, Inc. v. Lansa, Inc., 594 F.3d 860, 869 (Fed. Cir. 2010) ("At all times, the damages inquiry must concentrate on compensation for the economic harm caused by infringement of the claimed invention."); Thomas F. Cotter, *Patent Remedies and Practical Reason*, 88 TEX. L. REV. 125, 130 (2009); Opderbeck, *supra* note 17, at 173.

60 *See* Lemley, *supra* note 54, at 657 ("This traditional conception requires exclusivity; the value of a patent is accordingly commensurate with the value of the market or market niche it controls.").

61 Sichelman, *supra* note 5, at 518–19. However, even these are contested grounds, for private law scholars have argued for more public-oriented approaches to remedies in these fields. *See id.* at 532.

62 *See, e.g.*, Lemley, *supra* note 54, at 674 ("Patent damages are supposed to compensate patent owners for their losses, putting them back in the world they would have inhabited but for infringement."); Opderbeck, *supra* note 17, at 172 ("A tort-based measure of damages theoretically promotes economic efficiency because it deters over- and under-enforcement of the property right and thereby encourages Coasian bargaining."); Blair & Cotter, *supra* note 3, at 4 (applying traditional tort-law doctrines to patent damages).

63 Sichelman, *supra* note 5, at 535. Even beyond make-whole compensation, sometimes courts even award damages when patent infringement produces little to no economic harm. Liivak, *supra* note 7, at 1035 ("[R]easonable royalties are not a type of damages at all, but rather they are a guaranteed minimum reward akin to a type of statutory damages.").

status quo ante is inconsistent with the normative aims of patent law.[64] While make-whole damages repair individual harms, the patent system's normative outlook is decidedly macroscopic and utilitarian, focusing on society-wide technological progress.[65] Although awarding reasonable royalties based on the market value of an invention has intuitive appeal,[66] it is not necessarily congruent with the normative aim of providing just enough inducement to create new inventions.[67] For instance, make-whole damages based on the market value of patented products may easily exceed the amount of compensation necessary to promote invention and innovation, particularly in industries like software where technological development costs are relatively low.[68] This is particularly likely when a modest, inexpensive technological advance assumes significant market value because of luck or other reasons unrelated to the advance's merits.[69] An inducement approach to damages would focus on compensating invention, commercialization, and risk-adjusted opportunity costs rather than pegging damages to the market value of a patented technology. In most but not all cases, such an approach would provide patentees with far less than the full social value of their inventions, but it is routinely the case that private parties only capture a portion of the social value of their output.[70]

2. *Encouraging Licensing and Deterring Infringement*

Second, beyond providing adequate (and not excessive) incentives to invent and commercialize, this Article argues that another chief normative aim of patent damages is to shunt would-be infringers into licensing by rendering it economically preferable to infringement.[71] In some ways, this shunting is a secondary normative aim that undergirds the overarching objective of promoting technological progress. In short, damages have to be sufficient to deter infringement, or else market actors would infringe rather than license a patent (or design around it), thus undermining

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64 Sichelman, *supra* note 5, at 519. Others, of course, have critiqued the normative view of tailoring patent remedies to promote incentives to invent. *See, e.g.*, Paul J. Heald, *Optimal Remedies for Patent Infringement: A Transactional Model*, 45 HOUS. L. REV. 1165, 1172–73 (2008) (observing that there is little causal connection between patent law and R&D expenditures, disclaiming any principled manner for determining the optimal level of R&D that a firm should conduct, and arguing for structuring remedies to promote transactions).

65 Sichelman, *supra* note 5, at 531.

66 Durie & Lemley, *supra* note 3, at 637–38 (identifying a cluster of *Georgia-Pacific* factors that evaluates the added value of a patented technology).

67 *See* Sichelman, *supra* note 2, at 280 (proposing incorporating patentee costs in the calculation of reasonable royalties).

68 Sichelman, *supra* note 5, at 523–24.

69 *See* Amy L. Landers, *Patent Valuation Theory and the Economics of Improvement*, 88 TEX. L. REV. SEE ALSO 163, 165 (2009); *cf.* Abramowicz & Duffy, *supra* note 11, at 1600–01.

70 Mark A. Lemley & Carl Shapiro, *Reply: Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 2163, 2167 (2007); Golden, *supra* note 2, at 530.

71 *See* Cotter, *supra* note 50, at 1177 ("[A]warding damages that render the infringer no better off than it would have been absent the infringement reduces the incentive to infringe, as long as the expected cost of defending an infringement suit exceeds the expected cost of negotiating a license."). Interestingly, trade secret law more explicitly recognizes these two normative values. *See* Rockwell Graphics Sys., Inc. v. DEV Indus., Inc., 925 F.2d 174, 178 (7th Cir. 1991).

patentees' invention and commercialization incentives and imposing other costs on society. As Thomas Cotter describes, "both to preserve the patent incentive and to discourage infringement, the presumptive standard for awarding damages should be the greater of the patentee's lost profits or the royalty the parties would have agreed to ex ante."[72] Cotter's observations are true but somewhat overinclusive. Standard make-whole damages may effectively deter infringement, but as discussed above, they may do more than simply "preserve" incentives to invent and innovate; they may actually provide excessive compensation to patentees.

Currently, the patent system exhibits a strong normative concern for deterring infringement, as demonstrated in both the availability of injunctive relief[73] and the award of make-whole damages. In theory, a system where infringers did not face an injunction and had to compensate outstanding invention and commercialization costs (plus a reasonable profit) on a proportional basis could maintain the desired technological development incentives while minimizing deadweight loss. However, administering such a system is difficult,[74] and the downside risk of miscalculating inducement damages and thus encouraging infringement is substantial.[75] Although the prospect of facing an injunction provides a powerful incentive to not infringe, the availability of make-whole damages offers an important additional incentive, particularly given that injunctions only prevent prospective infringement and do not directly reach gains from past infringement. Eliminating this marginal incentive may change the calculus for would-be infringers; they may be more willing to forgo licensing and "roll the dice" on infringement. Such a system may result in a significant increase in infringement, substantially undermining incentives to invent if patentees did not enforce their rights or creating significant litigation costs if they did.

Relatively high, make-whole damages thus supplement injunctions in deterring infringement. Such deterrence helps shunt would-be infringers into voluntary licensing, which confers significant benefits. Valuing intellectual property is notoriously difficult, and well-established law and economics scholarship holds that private ordering via voluntary negotiations achieves more accurate valuations of patent rights than third-party adjudication.[76] The prospect of paying market-based,

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72 Cotter, *supra* note 59.

73 *See* eBay v. MercExchange, 547 U.S. 388 (2006) (holding that courts should apply a four-factor equitable test to determine the appropriateness of injunctive relief); Christopher B. Seaman, *Permanent Injunctions in Patent Litigation after* eBay*, An Empirical Study*, 101 IOWA L. REV. 1949, 1982 (2016) (finding that courts award permanent injunctions in 72.5% of cases and that operating companies are much more likely to obtain injunctions than nonpracticing entities).

74 *See infra* Part III.F.

75 Michael Abramowicz, *Cost-Plus Damages*, 26 Tex. Intell. Prop. L.J. 133, 156 (2018).

76 *See* Robert P. Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75, 99–100 (1994); Blair & Cotter, *supra* note 3, at 48. *But see* Jonathan S. Masur, *The Use and Misuse of Patent Licenses*, 110 NW. L. REV. 115, 121 (2015) (observing that licensing agreements reflect expected damages awards and noting circularity between court-determined damages and private negotiations).

make-whole damages may motivate a potential infringer to come to the negotiating table, where it and the patentee can utilize private information to value a technology and agree on an appropriate license. Alternatively, a party facing the prospect of paying high damages may choose to neither infringe nor license a patent but to develop a noninfringing technology. This advances another aim of the patent system: to encourage the development of new and alternative technologies that "design around" an existing patent.[77] Significantly, deterring infringement—whether it leads to licensing, designing around, or some other outcome—also serves the policy objective of avoiding litigation. Patent infringement litigation is long, complex, and costly,[78] and represents a drain on judicial and private resources that does not produce any innovation.

In elucidating this normative aim, it is important to distinguish mere deterrence of infringement from punitive measures. This Article argues that patent damages should deter infringement to the extent that it is economically preferable for a technology user to license a patent rather than infringe it. This is not to say that the patent damages statute should generally punish infringers with extremely high damages to express moral disapprobation for infringement.[79] Certainly, patent law can and properly does enhance damages for specific types of egregious conduct, such as willful infringement.[80] Similarly, in "exceptional cases," courts can award attorney fees—which are often substantial in patent litigation[81]—to serve a punitive function.[82] However, the general deterrence function of patent damages should simply aim to shunt parties into voluntary negotiations rather than mete out moral punishment.

III. Distinguishing Damages Paid from Compensation Received

This Article argues that some of the shortcomings of damages law arise because this body of doctrine serves more than one normative objective. On the one hand, patent damages law should aim to provide just enough compensation to induce invention and commercialization, avoiding excessive remuneration. On the other hand, it should encourage licensing over infringement by ensuring that a

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77 State Indus. Inc. v. A.O. Smith Corp., 751 F.2d 1226, 1236 (Fed. Cir. 1985) (noting that one aim of the patent system is to promote the "'negative incentive' to 'design around' a competitor's products, even when they are patented, thus bringing a steady flow of innovations to the marketplace").

78 *See* AM. INTELL. PROP. L. ASSOC., REPORT OF THE ECONOMIC SURVEY 2015, at 37 (2015) (reporting average patent litigation costs for matters worth $1-10 million at $2 million dollars); Gaia Bernstein, *The Rise of the End User in Patent Litigation*, 55 B.C. L. REV. 1443, 1485–86 (2014).

79 *See* Brian J. Love, *The Misuse of Reasonable Royalty Damages as a Patent Infringement Deterrent*, 74 MO. L. REV. 909, 911–12 (2009) (criticizing courts' inflation of reasonable royalties to serve a deterrent effect).

80 35 U.S.C. § 284 ("[T]he court may increase the damages up to three times the amount found or assessed."); Halo Elecs. Inc. v. Pulse Elecs., Inc. 136 S. Ct. 1923, 1935 (2016) (liberalizing the standard for awarding enhanced damages).

81 *See id.*

82 *Id.*; *see also* Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749, 1755 (2014) (liberalizing the standard for awarding attorney fees).

defendant must pay at least the market value of a patented technology upon a finding of infringement. This Part argues that distinguishing the amount of compensation that patentees receive from the amount of damages that infringers pay can resolve some of these tensions. Under this proposal, defendants would still be liable for make-whole damages to deter infringement and encourage licensing (or designing around) a patented invention. However, this traditional measure of damages would define a maximum amount of potential compensation; patentees would have to prove recoverable inducement costs based on their actual and projected expenditures and risk-adjusted opportunity cost of capital.[83] If outstanding inducement costs were sufficiently high, patentees would recover the full measure of make-whole damages, consistent with the present regime. However, if ordinary profits have already satisfied patentees' outstanding fixed costs of invention and commercialization, prevailing patentees should receive relatively low compensation to cover marginal costs of production. When available, courts and agencies should allocate any difference between these amounts to advance research and development in accordance with the normative objectives of the patent system.

A. Mechanics

For ease of exposition, this section will first describe how, under this proposal, courts would determine damages paid by a defendant. It will then address how courts would calculate compensation received by a prevailing patentee. Finally, it will describe how courts and agencies would allocate any potential difference between these amounts.

1. Damages Paid by a Defendant

The determination of damages paid under this proposal is fairly straightforward, as it simply accords with prevailing practice. Defendants would be liable for make-whole damages based on the market value of the use of patented technologies. There are two traditional measures of damages: lost profits and reasonable royalties.[84] Lost profits damages would be available where an infringer manufactures an infringing product and competes against the patentee. In most cases, a patentee seeking lost profits must prove: "(1) demand for the patented product, (2) absence of acceptable noninfringing substitutes, (3) his manufacturing and marketing capability to exploit the demand, and (4) the amount of profit he would have made."[85] In the alternative, and as a minimum "floor," a court can determine a reasonable royalty.[86] The actual task of calculating reasonable royalties

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[83] Furthermore, a court may award treble damages and attorney fees, as discussed below. *See infra* notes 99–102 and accompanying text.

[84] *But see* Lemley, *supra* note 54, at 656 (observing that the lines between lost profits and reasonable royalties are blurring, in part because of the strict evidentiary standards for establishing lost profits).

[85] Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1156 (6th Cir. 1978).

[86] *See* 35 U.S.C. § 284 (2012). Empirical research has shown that courts awarded reasonable royalties in 81% of patent cases awarding damages, lost profits in 31% of those cases, and price erosion in

has long bedeviled courts.[87] Courts have adopted several approaches, including an "analytical method" that starts with the defendant's profit projections from utilizing an infringing product and then subtracts "the infringer's usual or acceptable net profit from its anticipated net profit realized from sales of infringing devices."[88] However, the more common method for calculating reasonable royalties comes from an influential fifteen-factor test from *Georgia-Pacific Corp. v. United States Plywood Corp.*[89] Arguably, the most important consideration is factor fifteen, which contemplates a hypothetical negotiation between the defendant and the patentee prior to any infringement.[90] Although it represents the most common approach for determining reasonable royalties, *Georgia-Pacific* has engendered significant controversy for its rather long and convoluted list of factors.[91]

This proposal would adopt the current approach to determining the amount of damages that infringers must pay, modified by suggested reforms to reasonable royalty calculations. For instance, Daralyn Durie and Mark Lemley have advocated simplifying and clarifying the *Georgia-Pacific* test by focusing on related clusters of factors, such as the marginal advance of the patented invention over the prior art and the relative value of other inputs that contribute to an infringing product.[92] Furthermore, the Federal Circuit has recently demanded greater justification for comparable licenses[93] used to calculate a particular reasonable royalty.[94] Courts and commentators have also suggested more stringently applying the entire market value rule, which governs whether courts should base a reasonable royalty for an infringed component patent on the "entire market value" of an integrated product containing that component.[95] As Mark Lemley has described, this practice—which evolved in the context of lost profits analyses—has crept into the law of reasonable

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2% of those cases. (Percentages sum to more than 100% because courts sometimes awarded more than one type of damages.) PRICEWATERHOUSECOOPERS, 2015 PATENT LITIGATION STUDY: A CHANGE IN PATENTEE FORTUNES, 8 fig. 8 (2015), *available at* https://www.pwc.com/us/en/forensic-services/publications/assets/2015-pwc-patent-litigation-study.pdf.

87 Durie & Lemley, *supra* note 3, at 628 ("The calculation of patent damages has become one of the most contentious issues in all of intellectual property (IP) law."); Christopher B. Seaman, *Reconsidering the* Georgia-Pacific *Standard for Reasonable Royalty Patent Damages*, 2010 B.Y.U. L. REV. 1661, 1665 (noting how the *Georgia-Pacific* test "has become increasingly difficult for juries to apply in lengthy and complex patent trials, resulting in unpredictable damage awards"); *see also* Taylor, *supra* note 14, at 81 (describing several critiques of reasonable royalties doctrine).

88 Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1324 (Fed. Cir. 2009) (quoting TWM Mfg. Co. v. Dura Corp., 789 F.2d 895, 899 (Fed. Cir. 1986)); *see* Taylor, *supra* note 14, at 118; Opderbeck, *supra* note 17, at 133; Blair & Cotter, *supra* note 3, at 39.

89 Georgia-Pac. Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970) (articulating fifteen factors to guide the determination of reasonable royalties).

90 *See, e.g.*, *Panduit*, 575 F.2d at 1158.

91 *See, e.g.*, Durie & Lemley, *supra* note 3, at 628.

92 *Id.* at 629.

93 *See, e.g.*, *Georgia-Pac.*, 318 F. Supp. at 1120.

94 Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1332 (Fed. Cir. 2009).

95 Garretson v. Clark, 111 U.S. 120, 121–22 (1884).

royalties and increased damages,[96] particularly in component industries.[97] Courts have recently applied the entire market value rule more carefully, only allowing a broader royalty baseline in the rare case where the patented component drives consumer demand for the entire multicomponent product.[98] This Article's proposal would incorporate these reforms to help align the amount that infringers pay more closely with the market realities of infringement.

Also consistent with prevailing doctrine, courts may award enhanced damages and attorney fees. The governing statute for enhanced damages is rather open-ended, merely noting in pertinent part that "the court may increase the damages up to three times the amount found or assessed."[99] Historically, courts have generally reserved the award of enhanced damages for willful infringement. Recent Supreme Court doctrine has eliminated the Federal Circuit's rigid test for determining enhanced damages, emphasizing that district courts have discretion to award such damages based on the "particular circumstances of each case."[100] In similar fashion, the Supreme Court has also recently clarified that the decision to award attorney fees—which may be quite considerable—in "exceptional"[101] cases also falls within the discretion of district courts.[102] This proposal would preserve this (recently reformed) doctrinal framework for determining treble damages and attorney fees, which may vastly increase the damages paid by an infringer.

Under this proposal, infringers would pay lost profits or reasonable royalty damages, plus any multiplier based on willful infringement. Again, this simply applies current doctrine—which awards make-whole damages—along with recent and suggested reforms to better tie the calculation of damages to the market value of the use of a patented technology. Make-whole and enhanced damages would reflect the amount that an infringer would pay; it would also act as the maximum compensation available to the patentee to cover inducement costs, a point that will be more relevant later. Infringers may also be liable for attorney fees, if the court so determines, which the court would award to the patentee independent of

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96 Lemley, *supra* note 54, at 664.

97 *Id.* at 667. Lemley further observes, however, that cases like *Lucent Technologies* may signal a countervailing trend toward applying apportionment principles in reasonable royalty cases. *Id.* at 668.

98 *Lucent Techs.*, 580 F.3d at 1336.

99 35 U.S.C. § 284.

100 Halo Elecs. v. Pulse Elecs., 136 S. Ct. 1923, 1933–35 (2016) (*abrogating* In re Seagate Tech., LLC, 497 F.3d 1360 (Fed. Cir. 2007)); *see id.* (holding that awards of treble damages are subject to "abuse of discretion" review upon appeal).

101 *See* 35 U.S.C. § 285 ("The court in exceptional cases may award reasonable attorney fees to the prevailing party.").

102 *See* Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749, 1756 (2014) (holding that district courts have discretion to award attorney fees upon considering a totality of the circumstances); Highmark Inc. v. Allcare Mgmt. Sys., Inc., 134 S. Ct. 1744, 1749 (2014) (holding that all aspects of a district court's determination of an exceptional case should be reviewed for abuse of discretion).

inducement-cost analysis.[103]

This Article's proposal adopts the current framework for determining damages paid by an infringer because it serves an important normative objective: it deters infringement by rendering infringement less economically preferable than licensing a patent. Traditional make-whole damages attempts (with varying levels of success) to capture the market value of some unauthorized use of a patented invention and award that amount as damages paid by a defendant. Substantial deviations from such a regime may encourage significant numbers of market actors to simply forgo searching for, licensing, or designing around existing patents in favor of infringement, secure in the knowledge that damages may be much lower than the market value of the technology. Such widespread infringement reduces incentives to invent and commercialize, eliminates the accuracy benefits of voluntary licensing negotiations, and diverts scarce societal resources to non-innovation-producing litigation. To shunt would-be infringers into licensing, this Article's proposal largely adopts the prevailing system for calculating market-based, make-whole damages.

2. *Compensation Received by a Patentee*

Unlike determining damages paid by a defendant, calculating potential compensation received by a patentee would be radically different from prevailing practice. This Article argues for tailoring the amount of compensation received by patentees to the overarching normative objective of the patent system: to provide incentives to invent and commercialize new technologies but no more incentive than necessary. As this Article notes, a court would determine the infringer's damages as per prevailing practice based on make-whole and enhanced damages.[104] These calculations would define a maximum amount of money, and this proposal would put the onus on the patentee to prove how much of that maximum compensation it should receive based on its actual, projected, and risk-adjusted costs—including opportunity costs—of invention and commercialization.[105] By shifting the focus of a patentee's compensation away from the market value of a patented technology toward inducement costs, this proposal better aligns the law of patent damages with patent law's broader normative aims.

Critical to this proposal is distinguishing between fixed and variable costs. Most patented technologies face much higher fixed costs of invention and development compared to their variable costs of production. To apply a schematic from pharmaceuticals, empirical studies estimate the fixed cost of bringing a new FDA-approved drug to market at $2.87 billion.[106] Importantly, this figure includes

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[103] *See supra* notes 101–82, 101–102 and accompanying text.

[104] *See supra* Part II.A.1.

[105] This proposal thus departs starkly from Mark Lemley's suggestion that "a truly reasonable royalty is one that bases the patentee's damages on the merits of the incremental contribution of the patent." Lemley, *supra* note 54, at 670.

[106] Joseph A. Dimasi et al., *Innovation in the Pharmaceutical Industry: New Estimates of R&D Costs*,

out-of-pocket expenses of $1.86 billion as well as opportunity costs of capital in the form of expected returns that investors forgo during drug development.[107] Additionally, this figure incorporates the cost of navigating the long and expensive process of FDA approval (an important commercialization cost) and the cost of numerous failed research projects that yield one successful drug.[108] All told, these are fixed costs associated with bringing one pill to market. After these initial expenditures, the marginal cost of producing each additional pill is a comparatively trivial variable cost. If ordinary sales and profits have recouped $2.87 billion (for an average case), they largely cover inducement costs for the pharmaceutical firm, which suggests the firm would invest in similar research and development projects in the future. While additional profits would spur even more investment, a pharmaceutical company would pursue this economically profitable endeavor again even without those additional profits. Given that these sales have already satisfied incentives to invent and commercialize, additional exclusivity in the form of supracompetitive prices and high damages awards extends static inefficiency for comparatively little gain in dynamic efficiency.[109]

Under this proposal, if a pharmaceutical patentee had already recouped $2.87 billion to cover inducement costs, it would receive relatively low damages for subsequent acts of infringement. While $2.87 billion is certainly a large figure, successful patented drugs routinely exceed this amount over their lifetime. For instance, Merck's Januvia made $3.863 billion, $3.931 billion, and $4.004 billion in sales in 2015, 2014, and 2013, respectively.[110] Furthermore, Zetia made $2.526 billion, $2.650 billion, and $2.658 billion in 2015, 2014, and 2013, respectively.[111] Gilead made $36 billion from its new Hepatitis C virus medicines in a little over

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47 J. HEALTH ECON. 20, 31 (2016). This is likely a rather generous estimate, as critiques of previous studies by these authors have argued that pharmaceutical development costs are much lower. *See, e.g.*, Jerry Avorn, *The $2.6 billion Pill—Methodologic and Policy Considerations*, 372 NEW ENG. J. MED. 1877 (2015).

107 Dimasi et al., *supra* note 106; Press Release, Tufts Center for the Study of Drug Development, Tufts CSDD Assessment of Cost to Develop and Win Marketing Approval for a New Drug Now Published (March 10, 2016), *available at* http://csdd.tufts.edu/news/complete_story/tufts_csdd_rd_cost_study_now_published; *see* Sichelman, *supra* note 2, at 287 (discussing the calculation of opportunity costs in pharmaceutical research and development).

108 Dimasi et al., *supra* note 106, at 31; *see* Mark G. Edwards, *Biotechnology and Pharmaceutical Commercialization Alliances: Their Structure and Implications for University Technology Transfer Offices*, *in* INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURAL INNOVATION: A HANDBOOK OF BEST PRACTICES 1227, 1230 (A. Krattiger et al. eds., 2007) ("[T]op-selling pharmaceuticals (the so-called blockbusters) drive the overall profitability of major pharmaceutical companies.").

109 *See* Ayres & Klemperer, *supra* note 13, at 1019 (identifying the pharmaceutical industry, which features very high margins, as one where "the benefits of restricting market power are considerable"); *cf.* Brennan et al., *supra* note 18, at 279 (noting the "massive social 'deadweight' losses that stem from supra-marginal cost pricing.").

110 Merck & Co., Inc., Annual Report (Form 10-K), at 41 (Feb. 26, 2016).

111 *Id.*

two years on the market, vastly exceeding the cost of developing these drugs.[112] The average markup for a patented drug is nearly 400%.[113] For many of these medicines, ordinary sales and profits have likely far exceeded the incentive to induce invention and commercialization. Thus, under this proposal, courts would award relatively low damages to cover variable costs upon a finding of infringement. This is independent, of course, from the much higher amount of make-whole damages that infringers would have to pay.

This proposal is thus sensitive to the cost structure of technological research and development. For example, if a patentee has not recouped significant fixed costs of invention and commercialization, perhaps because infringement occurs early in the patent term, then a patentee would likely receive the entire amount of make-whole damages as compensation for infringement. If, however, ordinary sales and profits have largely satisfied inducement costs—for instance, if the patentee has successfully profited from a technology for a significant period of time—then the patentee would receive relatively low compensation to cover marginal costs of production. For situations between these extremes, a court would allocate the defendant's damages toward the patentee's inducement and variable costs until either those costs are covered or the infringer's damages are exhausted, whichever comes first. As mentioned, if applicable, courts would award attorney fees to the patentee (or infringer) independent of inducement-cost considerations, as per current practice.

Throughout the analysis, the guiding focus should be on maintaining appropriate incentives to invent and commercialize. Thus, relevant costs are those that the patentee has expended or can reasonably be expected to expend absent the infringement. For instance, if a firm infringes the patent of an operating company before the patentee can expend significant sums of money on commercialization, and the infringement (and associated price reductions) would materially harm the patentee's incentive to invest in commercialization, then a court should consider projected commercialization costs within the patentee's compensation. However, if the patentee is a nonpracticing entity with no intention or capacity to engage in commercialization, then a court should exclude projected commercialization costs (which would never materialize) as part of the compensation that the nonpracticing entity should receive. (It bears mentioning that the nonpracticing entity would likely only qualify for a reasonable royalty, which would serve as a cap on any claim for compensation.) The easiest case for applying this proposal would involve an operating company that has already brought a technology to market, in which case actual costs of invention and commercialization (as well as a reasonable profit) would count toward compensable inducement costs.

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[112] Brennan et al., *supra* note 18, at 278; *see id.* at 328 (observing that Gilead has made revenues valued at forty times the cost of developing the drugs).

[113] Dean Baker, *Financing Drug Research: What are the Issues?* 7 (Ctr. for Econ. & Pol'y Res., Issue Br., Sept. 22, 2004, *available at* https://perma.cc/DUP5-KHRX.

This is obviously an information-intensive inquiry, and this proposal would put the onus on the party with the most information about inducement costs: the patentee.[114] Essentially, this proposal defines a pot of money and asks the patentee to prove how much of that money it should receive. Tellingly, unlike copyright law, patent law does not award statutory damages,[115] and this proposal resuscitates older doctrine holding that patent damages "must actually be proved, and cannot be assumed as a legal inference."[116] Patentees would thus bear the burden of calculating inducement costs for a particular patented technology. As noted, this analysis would require separating fixed from variable costs. While this is a daunting task, the current *Panduit* framework already requires patentees to separate fixed from variable costs to determine the amount of profit that they would have made but for infringement.[117] Furthermore, many corporations maintain detailed internal accounts of fixed and variable costs for technological projects to assess return on investment.[118] While pharmaceutical companies maintain these internal metrics as trade secrets, it seems appropriate to compel patentees to articulate these costs in litigation to prove they actually spent (or plan to spend) the amount of compensation they are seeking. The lack of transparency in drug pricing has even spurred several attempts by state legislators to mandate R&D disclosure by pharmaceutical firms.[119]

In most cases, such calculations will necessarily involve some degree of uncertainty and projection. For instance, a defendant may infringe a patent early in its term, before the patentee or a licensee has expended significant resources to commercialize it. In such cases, parties can submit evidence of reasonable projections for commercialization costs based on similar instances of technological development and industry averages. While such approximations are not ideal, using comparable economic situations to calculate damages is a practice well established in patent law.[120] Furthermore, the exact scope of inducement costs is likely to engender significant debate. What proportion of electricity bills and rent can a patentee allocate to the development costs of a particular patented invention? To what extent should patentees receive compensation for marketing and advertising, which in the pharmaceutical realm exceed research and development costs?[121]

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[114] *Cf.* Brennan et al., *supra* note 18, at 317 ("[C]ourts can impose the burden on the patentee—who ought to be the cheapest provider of such information—to produce information about R&D expenditures, risk, reasonable profits, and worldwide market share.").

[115] 17 U.S.C. § 504(c).

[116] Seymour v. McCormick, 57 U.S. 480, 490 (1853).

[117] Panduit Corp. v. Stahlin Bros. Fibre Works, Inc., 575 F.2d 1152, 1157 (6th Cir. 1978).

[118] *See* DELOITTE, MEASURING THE RETURN FROM PHARMACEUTICAL INNOVATION 2014: TURNING A CORNER?, at 5 (2014); Sichelman, *supra* note 2, at 308.

[119] Brennan et al., *supra* note 18, at 320.

[120] *See, e.g.*, Lucent v. Gateway, 580 F.3d 1301, 1324 (Fed. Cir. 2009).

[121] Ana Swanson, *Big Pharmaceutical Companies Are Spending Far More on Marketing Than Research,* WASH. POST, Feb. 11, 2015, *available at* https://www.washingtonpost.com/news/wonk/wp/2015/02/11/big-pharmaceutical-companies-are-spending-far-more-on-marketing-than-research/?utm_term=.9799c970c327.

Given that marketing and advertising are important to technological development and dissemination, it seems appropriate to include them in inducement costs.

Particularly nettlesome is the challenge of whether, and to what extent, to include the costs of failed projects in the inducement costs for a successful patented invention.[122] Returning again to pharmaceuticals, given that hundreds of candidates often fail before the discovery of a single successful drug, it is appropriate to consider these failures when calculating inducement costs. Furthermore, the distinction between fixed and variable costs is somewhat misleading given that research and development can continue to tweak and refine a patented technology even after its initial market launch, perhaps based on consumer demand and competitor responses. Inducement calculations may create a morass of indeterminacy or intractable battles between the litigants' experts. This proposal does not offer a set of bright-line rules, and courts should exercise discretion to consider inducement to modify compensation, but only when the advantages of fidelity to policy outweigh the disadvantages of uncertainty.[123]

Accordingly, this proposal contains a valuable safety valve. If calculating and apportioning inducement costs becomes more trouble than it's worth, a court can simply allocate the full measure of make-whole damages to the patentee, leaving both parties no worse off than under the current status quo. To guard against patentees gaming the system by providing indeterminate estimates and then invoking this safety valve, courts should impose duties of good faith and full disclosure on patentees attempting to prove inducement costs. Furthermore, infringers would also play an important role in litigating patentee inducement costs. At first glance, it appears that infringers would have little incentive to argue for low inducement costs; after all, regardless of patentee compensation, infringers would be liable for make-whole damages. However, infringers do actually have such an incentive, as establishing low inducement costs enhances their leverage in potential settlement negotiations with patentees.

A significant challenge is the endogeneity problem of calculating a "reasonable profit."[124] In order to fully compensate a prevailing patentee's inducement costs, the patentee must receive not only out-of-pocket and projected expenses but also a reasonable profit based on its use of capital for technological development (rather than other ends). If compensation is not available for opportunity costs and risk, then patentees will not invest in similar technological development in the next round of innovation.[125] However, firms that expect to receive a significant patent

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[122] *See* DELOITTE, *supra* note 118.

[123] *Cf.* Golden, *supra* note 2, at 533–34 (advocating nonabsolutism and flexibility as guiding principles of patent remedies).

[124] *Cf.* Sichelman, *supra* note 2, at 314 (discussing the potential circularity involved in courts determining opportunity costs for patentees).

[125] *See id.* at 311; Brennan et al., *supra* note 18, at 316. *But see* Michael Abramowicz, *Cost-Plus Damages*, 26 Tex. Intell. Prop. L.J. 133, 150–51 (2018) (noting that *average* risk may be misleading because the risk of individual projects may differ considerably).

markup—reflected both in sales of patented items as well as make-whole damages—may view such a markup as a "reasonable profit" that they should receive upon a finding of patent infringement. In other words, patent-inflated profits and damages may be endogenous to the concept of a reasonable profit. For instance, if pharmaceutical firms expect to obtain profit margins in the neighborhood of 42%,[126] they could argue that such margins amount to a "reasonable profit" necessary to continue investing in drug development. This is a thorny issue that courts must navigate carefully, but here again the perfect should not be the enemy of the good. Courts can hear arguments and evidence regarding technological development expenses and profit margins in various high-tech industries to determine a reasonable profit without necessarily awarding the entire patent surplus to a patentee.[127] Furthermore, factors other than patents—such as human and physical capital—account for a significant proportion of return on investment in innovation in most industries, thus providing courts with more discrete factors to use in calculating opportunity costs.[128] Additionally, the cost of capital for a particular company or industry can also indicate a reasonable profit expectation.[129] Circularity is problematic in the current damages regime,[130] and courts applying this proposal should guard against inflated conceptions of reasonable profits.

Notwithstanding calculation difficulties, in some cases it will be relatively clear that a patentee has already recouped its invention, commercialization, and risk-adjusted opportunity costs, so awarding the full measure of make-whole damages would be excessive. Where information regarding inducement costs is relatively forthcoming, a court should consider it. As older cases like *Rude v. Westcott* and *Coupe v. Royer* have held, infringement alone does not give rise to compensable harm.[131] Conceptually, the relevant "harm" to the patentee is not to its full market expectations, but to its incentive to invent and commercialize; the two concepts are not necessarily coextensive. This proposal simply applies the basic principle that the patentee must prove the damages for which it seeks compensation. Within this framework, the emphasis should not be on awarding the full market value of a particular patented article but on maintaining dynamic efficiency by

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[126] Liyan Chen, *Best of the Biggest: How Profitable Are the World's Largest Companies?*, FORBES, May 13, 2014, *available at* https://www.forbes.com/sites/liyanchen/2014/05/13/best-of-the-biggest-how-profitable-are-the-worlds-largest-companies/#661785cf3a5e; *see also* Edwards, *supra* note 108 (noting that gross margins for pharmaceuticals regularly range from 75 to 95 percent for marketed drugs).

[127] Furthermore, as Michael Abramowicz points out, it may be beneficial for courts to simply apply a relatively high rate of return rather than customizing it for particularly inventive entities, thus reducing the risk of undercompensation. Abramowicz, *supra* note 125, at 153. *See also* Brennan et al., *supra* note 18, at 329 (applying a rough estimate of a 30% profit premium in pharmaceutical research and development to determine appropriate compensation for infringement).

[128] *See* Sichelman, *supra* note 2, at 314.

[129] *See, e.g.*, Dimasi et al., *supra* note 106, at 24.

[130] *See, e.g.*, Masur, *supra* note 76.

[131] Rude v. Westcott, 130 U.S. 152, 167 (1889); Coupe v. Royer, 155 U.S. 565 (1895); *see* Liivak, *supra* note 7, at 1048–53.

compensating inducement costs, including a fair return on capital.[132]

3. *Allocating the Patent Surplus*

One notable result of distinguishing the damages paid by a defendant from the compensation received by the patentee is that courts and agencies can put any difference between these amounts to productive use. This may strike some IP observers as objectionable, given that patentees will not receive "their" entire damages award. However, this view reflects a natural-rights conception of patent protection that courts have routinely rejected.[133] Patents, after all, are policy instruments used to provide adequate incentives to invent and commercialize new technologies, not entitlements to maximize profits. Of course, one predictable implication of this proposal is that patentees and infringers will settle and split the "patent surplus" between them, which this Article addresses below.[134] However, if this does not occur, this Article proposes several options for allocating the patent surplus in ways that advance the patent system's overall aim of promoting technological progress.

First, the government can allocate these funds to support general research and development. One option is to support academic research by funding agencies like the National Science Foundation and the National Institutes of Health. Funding such research is wholly consistent with patent law's goal of promoting technological progress, and indeed all patentees in some way build off of publicly supported research to develop their creations.[135] Alternatively, if policymakers seek a tighter fit between the allocation of patent surplus and the industry where patenting and infringement took place, a funding agency could direct the patent surplus to support academic (or commercial) research in that field. This redirection may, of course, indirectly benefit the infringer (assuming that it operates in the same industry as the patentee), but its proportional share of proceeds would likely be so small as to contribute negligibly to any incentive to infringe.

Second, the government could allocate the patent surplus to fund technological development that the patent system does not sufficiently induce. While the Constitution articulates the broad objective of promoting useful arts, the patent system relies on market mechanisms that incentivize some kinds of innovations

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[132] John Stuckey & David White, *When and When Not to Vertically Integrate,* MCKINSEY Q., Aug. 1993, *available at* https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/when-and-when-not-to-vertically-integrate.

[133] *See supra* Part I.B.

[134] *See infra* Part III.E.

[135] *See* Peter Lee, *Contracting to Preserve Open Science: Consideration-Based Regulation in Patent Law*, 58 EMORY L.J. 889, 907 (2009); John Golden, *Biotechnology, Technology Policy, and Patentability: Natural Products and Invention in the American System*, 50 EMORY L.J. 101, 110 (2001) (noting the "dominant role" played by federal funding in supporting biotechnology); PETER L. SINGER, INFO. TECH. & INNOVATION FOUND., FEDERALLY SUPPORTED INNOVATIONS: 22 EXAMPLES OF MAJOR TECHNOLOGY ADVANCES THAT STEM FROM FEDERAL RESEARCH SUPPORT (2014), *available at* http://www2.itif.org/2014-federally-supported-innovations.pdf.

over others.[136] Indeed, "[m]arkets select for innovations that are valued in markets."[137] Patents, prices, and markets tend not to encourage the development of innovations of high social value but relatively low private value, such as malaria medications or other treatments for neglected diseases. Given the aim of the patent system to promote technological progress generally, it seems reasonable to allocate the patent surplus to promote technologies that patents and markets tend to neglect. Sichelman has proposed a system where government actors could identify areas of socially valuable innovation where prevailing incentives (including damages) are insufficient and target those areas for public subsidy.[138] The current proposal creates a revenue source for such subsidy. Thus, funding agencies could allocate the patent surplus to finance research into treatments for neglected diseases, low-cost technologies of value to poor communities, or similarly socially valuable innovations.[139]

As a subset of this approach, to tie the patent surplus more tightly to the work of patentees, the government could also allocate these funds to compensate patentees when inducement costs outstrip patent damages, particularly for technologies for which social value significantly exceeds private value. While make-whole damages may exceed costs of invention and commercialization, this may not necessarily be the case. It is possible that inducement costs exceed what the patentee could get in damages (or licensing revenues). This may arise in situations of inefficient or misguided technological development, but it may also arise when a patentee devotes significant resources to developing a technology where social value substantially exceeds private value, such as therapies for rare diseases or assistive technologies for disabled persons.[140] Thus, as a narrower version of the previous option, courts and agencies could allocate accumulated patent surplus to patentees involved in litigation where market-based damages for the latter do not cover a significant proportion of inducement costs.[141] This approach would serve a "smoothing out" function by allocating resources for innovation more equitably across different domains of technology.

B. Benefits

Separating damages paid from compensation received for patent infringement offers several benefits. It provides a more normatively grounded approach to damages based on the overarching objectives of the patent system. Within the utilitarian ideal of patent law, damages should provide just enough (proportional) compensation to induce invention and commercialization without exacerbating the

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[136] *See* Kenneth W. Dam, *The Economic Underpinnings of Patent Law*, 23 J. LEGAL STUD. 247, 248–49 (1994) (extolling the virtues of market-based allocation of technological resources).

[137] Peter Lee, *Social Innovation*, 92 WASH. U.L. REV. 1, 6–7 (2014).

[138] Sichelman, *supra* note 5, at 559–60.

[139] *See generally* Lee, *supra* note 137.

[140] *See* Sichelman, *supra* note 5, at 560.

[141] *Cf.* Golden & Sandrik, *supra* note 8, at 337 (suggesting applying restitution principles to enhance reasonable royalties for patented inventions of high social value).

efficiency losses of exclusive rights. Furthermore, reducing expected compensation decreases a patentee's incentive to sue,[142] thus reducing litigation costs and increasing entry from infringers, which enhances access to a patented technology.[143] At the same time, a patent system where defendants only pay enough damages to cover invention and commercialization (in an amount proportional to their infringement) is subject to errors of calculation, and the implications of miscalculation—widespread infringement, depressed incentives to invent, and costly patent litigation—may be severe.[144] Maintaining make-whole damages (with modern reforms) ensures that infringement is not more economically favorable than licensing. This may produce a difference between damages paid and compensation received, and this Article proposes allocating those funds to support research and development, which further advances the objectives of the patent system.

While this proposal draws on Abramowicz and Duffy's argument for an inducement approach to nonobviousness, damages represents a superior doctrinal context for applying such a principle.[145] Whereas nonobviousness operates as a binary switch (an invention is either obvious or nonobvious), a damages award offers more granularity to calibrate compensation based on particular costs of technological development. Furthermore, considering inducement while determining damages offers certain timing advantages relative to nonobviousness analysis. Nonobviousness determinations are initially made by patent examiners during prosecution. At this early stage of the patent process, an invention does not have much of a track record, and detailed information about invention and commercialization costs may not exist.[146] However, litigation, which typically occurs long after a patented invention has been on the market, affords courts and litigants an opportunity to develop the factual record regarding the out-of-pocket, projected, and risk-adjusted opportunity costs of a patentee's development of a particular technology.[147] The passage of time and the involvement of motivated litigants promise more and better information about inducement costs, thus rendering damages determinations a superior stage to consider such costs relative to

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[142] Ayres & Klemperer, *supra* note 13, at 993 ("If the probability that the patent will be enforced is sufficiently low, entrants may find it profitable to produce the patented product."); *id.* ("Infringement during the patent's life will tend to expand industry output and decrease the market price.").

[143] This analysis assumes that infringers are relatively efficient and fixed costs of entry are relatively low. If, on the other hand, infringers face high entry costs or higher marginal costs than the patentee, then entry may simply convert some of the patentee's profits into additional social costs. Ayres & Klemperer, *supra* note 13, at 1015. Ayres and Klemperer suggest an alternative approach in which infringers pay less than make-whole damages, thus encouraging entry and the associated benefits of greater competition. *Id.* at 1028–29. This proposal achieves a similar result—encouraging entry—but by decreasing the likelihood of the patentee bringing suit and indirectly reducing the defendant's damages by encouraging settlement.

[144] *See infra* Part III.F.

[145] Abramowicz & Duffy, *supra* note 11, at 1597.

[146] *Id.* at 1655.

[147] *Cf.* Brennan et al., *supra* note 18, at 317 (noting the advantages of allowing courts to determine damages awards *ex post*).

patent prosecution.

It is also important to distinguish certain benefits of this proposal from previous suggestions to decouple defendant payments from plaintiff recoveries. As noted, commentators have argued in the tort context for decoupling damages paid from compensation received.[148] In Polinsky and Che's influential model, decoupling would produce the same level of care to avoid harm on the part of defendants (because the increase in damages paid would be offset by the lower probability of suit by plaintiffs) but with lower social costs because plaintiffs would be less likely to sue (due to lower expected recoveries).[149] The current proposal shares some commonalities with the decoupling approach, such as encouraging settlement rather than litigation, thus lessening social costs. However, this Article's proposal features some important differences. Polinsky and Che focus on the tort context, in which defendants' activities (such as car accidents or medical malpractice) are generally net welfare-diminishing activities that the legal system should discourage as long as it is cost-effective to do so (that is, without inducing wastefully excessive care). In the patent context, however, infringement can serve affirmatively beneficial social ends given that entry by nonpatentees diminishes deadweight loss, reduces prices, and increases access to a technology. As such, the current proposal does not seek to maintain the same level of deterrence as the status quo but actually encourages an uptick in infringement. It achieves this end both by reducing the likelihood of plaintiffs suing (because of decreased recovery) and capping the defendant's liability at make-whole damages. The current proposal thus differs in important ways from traditional "decoupling" strategies, which seek to raise defendants' liability as high as is practicable.[150] Furthermore, the current proposal deviates sharply from prior decoupling strategies in seeking to maintain a minimum level of recovery to patentees to maintain incentives to invent and innovate. This deviates from tort conceptions of decoupling, which posit the optimal plaintiff recovery as approaching zero.[151]

This proposal also ameliorates certain critiques of previous proposals for cost-plus recovery in patent law. As noted, several commentators have suggested reorienting patent infringement damages away from make-whole damages toward covering patentee costs.[152] These proposals would typically reduce damages paid by a defendant to cover a proportional share of the patentee's invention and commercialization costs. This Article contends, however, that such proposals are vulnerable to errors in undercompensating patentees, thus severely diminishing incentives to invent.[153] Another drawback of these proposals is that patentees would

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[148] *See* Polinsky & Che, *supra* note 24, at 569; Choi & Sanchirico, *supra* note 24, at 326.

[149] *See* Polinsky & Che, *supra* note 24, at 563.

[150] *Id.*

[151] *Id.*

[152] *See, e.g.*, Sichelman, *supra* note 2, at 304; Golden & Sandrik, *supra* note 8, at 371–73; Brennan et al., *supra* note 18, at 314–15.

[153] *See infra* Part III.F.

have incentives to inflate (or not care about economizing) invention and commercialization costs. After all, if a cost-plus regime compensates for such costs, along with some extra "kicker" to cover risk and uncertainty, it will tempt patentees to simply run up costs[154] or avoid socially beneficial low-hanging fruit that is inexpensive to develop.[155] However, the current proposal severely mitigates this incentive because patentee compensation would be capped at make-whole damages. Coupled with *ex ante* uncertainty regarding whether a firm's patents would be infringed and whether it would prevail in litigation, patentees would still have an incentive to economize on invention and development costs.

This inducement approach to calculating patentee compensation would have several practical results. It would most significantly impact patented technologies with the highest margins—that is, those technologies with the greatest difference between per-unit development costs and market price. This proposal would effectively transfer some of that producer surplus to society by allocating it toward research and development. Furthermore, transferring some patent surplus to other parties would increase incentives to perform research in areas of high social value but comparatively low private value. Additionally, this proposal would ameliorate certain instances of holdup and royalty stacking problems with multicomponent technologies.[156] Patentees of components derive significant leverage because the market value of their component is based in part on the "holdup value" of that component within an integrated product. By compensating patentees for inducement costs rather than the market value of their components, this proposal would reduce such leverage in many cases.

One benefit of this approach to compensation is that it would account for non-patent incentives for invention and commercialization.[157] One set of inventions where non-patent incentives play a critical role is those arising from federal funds. Under the Bayh-Dole Act, universities routinely take title to patents emerging from taxpayer-funded research.[158] For such technologies, public funding may satisfy a significant portion of the incentive to invent, thus requiring less compensation to induce full development and commercialization of the technology. For such inventions, lowering patentee compensation would seem to be particularly appropriate to avoid what Lisa Ouellette describes as the "reward-stacking problem."[159] Indeed, courts have considered federal funding in reducing patentee recovery in cases involving the government's unauthorized use of a protected

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[154] *See* Abramowicz, *supra* note 125, at 141 (warning that cost-plus recovery would encourage "goldplating" on the part of patentees); Sichelman, *supra* note 2, at 313.

[155] Golden, *supra* note 2, at 537–39.

[156] *See* Lemley & Shapiro, *supra* note 6, at 1992.

[157] *See* Ouellette, *supra* note 18; *cf.* Abramowicz & Duffy, *supra* note 11, at 1623–25.

[158] 35 U.S.C. §§ 200–212.

[159] Ouellette, *supra* note 18, at 193–95. On a related note, there have been proposals to enhance access to federally-funded patents based in part on the public's subsidy of those technologies. *See, e.g.*, Gary Pulsinelli, *Share and Share Alike: Increasing Access to Government-Funded Inventions Under the Bayh-Dole Act*, 7 MINN. J.L. SCI. & TECH. 393 (2006).

invention.[160] Of course, these would be highly factually intensive inquiries, as a federally subsidized invention may still require significant development costs to become a commercial product.[161] In general, however, where significant public funding or other non-patent subsidies cover invention and commercialization costs, courts should reduce patentee compensation accordingly.

IV. Objections and Responses

While it offers several benefits, this proposal for bifurcating damages paid and compensation received must address several objections. This Article has proceeded as a thought experiment, and a full response to all conceivable objections lies beyond its scope. Nonetheless, this Part provides some preliminary responses to likely counterarguments.

A. Statutory Compliance

First, critics may argue that bifurcating damages paid and compensation received, and adopting an inducement approach to the latter, is inconsistent with the patent damages statute. 35 U.S.C. § 284 states, in pertinent part:

> Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interest and costs as fixed by the court.
>
> When the damages are not found by a jury, the court shall assess them. In either event the court may increase the damages up to three times the amount found or assessed.[162]

Of course, given the rather drastic nature of this proposal, the most feasible way to implement it would be to reform the patent damages statute.[163] In particular, the statutory minimum of a reasonable royalty may seem to contravene this proposal's use of a cost-based approach to patentee compensation. However, there is significant flexibility in the current statute to accommodate this proposal.[164]

This Article argues that a plain reading of the statute does not bar application of this proposal. First, while the damages statute addresses the amount of damages awarded to a claimant, it is silent regarding how to calculate the amount of damages that an infringer must pay. While the statute implies, of course, that these amounts would be the same, it does not command it. Second, a plain reading of the statute is

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[160] *See, e.g.*, Leesona Corp. v United States, 599 F.2d 958, 964, 978 (Ct. Cl. 1979) (en banc); Ouellette, *supra* note 18, at 202–03.

[161] Dimasi et al., *supra* note 106, at 31 (estimating the total cost of bringing an FDA-approved drug to market as $2.87 billion).

[162] 35 U.S.C. § 284.

[163] It bears emphasizing that the patent damages statute has been the focus of heated congressional debate and is subject to change. For instance, damages reform was a principal element of proposed legislation that ultimately became the America Invents Act, though it was stripped out in part because of evolving Federal Circuit jurisprudence that modified damages doctrine. J. Jonas Anderson, *Patent Dialogue*, 92 N.C. L. REV. 1049, 1071–74 (2014).

[164] *Cf.* Dan L. Burk, *Means and Meaning in Patent Remedies*, 92 TEX. L. REV. 13, 15 (2014) ("[T]he metric of 'making whole' is never fixed, and instead shifts with judicial purpose.").

also compatible with an inducement theory of damages. The statute states that damages shall be "adequate to compensate for the infringement,"[165] which courts and commentators have interpreted as returning the patentee to the status quo ante as if the infringement had never occurred. If the aim of the patent system is to induce the creation of inventions that would not otherwise exist, however, then compensating for "the infringement" requires providing enough compensation to induce the underlying invention and commercialization as well as similar pursuits in the future.[166] Again, the relevant "harm" is not to the full, market-based profit expectations of the patentee, but to its incentive to invent and commercialize. Focusing on outstanding fixed costs as well as variable costs of production is a plausible way to determine a "reasonable royalty," which under this proposal would still relate to "the use made of the invention by the infringer."[167] In similar fashion, Sichelman argues, "infringement of a patent is not harmful per se; rather infringement is only harmful to the extent it denies the patentee an opportunity to be compensated an amount sufficient to induce it to engage in innovative activity."[168] This is admittedly a purposive interpretation of the statute, but it is consistent with the overarching objective of the patent system and infringement damages.

Furthermore, courts have shown significant flexibility in interpreting the damages statute in unexpected and sometimes counterintuitive ways. For example, in *Rite-Hite Corp. v. Kelley Co., Inc.*, the Federal Circuit held that lost profits can encompass lost sales of an item sold by a patentee that was not even covered by the patent in suit.[169] Although *Rite-Hite* reflected an expansive interpretation of patent damages, courts have also shown flexibility in interpreting damages more narrowly. For instance, courts have interpreted the patent statute to require apportionment of damages where the infringed patent covers a component that contributes relatively little to the overall value of some multicomponent product.[170] And the Federal Circuit has emphasized stringently applying the so-called entire market value rule, thus limiting instances where a court bases the royalty for a patented component on the entire market value of an integrated product including that component.[171] Recent Federal Circuit decisions have rejected rules of thumb that tend to inflate reasonable

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165 35 U.S.C. § 284.

166 *But cf.* Sichelman, *supra* note 2, at 322 (cautioning against "strained" readings of the damages statute, particularly in light of historical practice favoring make-whole damages).

167 35 U.S.C. § 284.

168 Sichelman, *supra* note 5, at 568–69.

169 Rite-Hite Corp. v. Kelley Co., 56 F.3d 1538, 1549 (Fed. Cir. 1995).

170 *See, e.g.*, Seymour v. McCormick, 57 U.S. 480, 491 (1853) ("[I]t is a very grave error to instruct a jury that as to the measure of damages the same rule is to govern, whether the patent covers an entire machine or an improvement on a machine.").

171 Brian J. Love, *Patentee Overcompensation and the Entire Market Value Rule*, 60 STAN. L. REV. 263, 270–71 (2007) (arguing that the entire market value rule was the exception that came to swallow the rule of apportionment); *see* Blair & Cotter, *supra* note 3, at 14–17 (discussing apportionment and the entire market value rule); *see, e.g.*, Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1339 (Fed. Cir. 2009).

royalties and demanded greater economic justification for damages awards.[172] In short, while statutory reform is the most prudent course of action, the damages statute may be sufficiently flexible to accommodate the current proposal.

B. Administrability

Administrability is a central concern for any legal regime,[173] and some aspects of this proposal would admittedly be difficult to administer. It bears emphasizing, however, that calculating damages paid by an infringer would involve no variation from current practice. The primary difficulty, of course, would be calculating inducement costs on the part of the patentee. Courts should consider actual out-of-pocket expenses, projected expenses, and risk-adjusted opportunity costs borne by the patentee.[174] While some objections have already been addressed,[175] this section delves into several additional complexities of calculating a prevailing patentee's compensation. While this is a difficult task, calculating damages has always been an imprecise science, and it is not improper to award estimated damages as long as they have an adequate factual basis.[176]

It bears noting at the outset that the current doctrinal framework for calculating damages already involves significant analytical nuance, and recent reforms have further increased its complexity.[177] Under the *Panduit* framework, courts must consider demand for a patented product, the availability of acceptable noninfringing substitutes, manufacturing and marketing capability to exploit demand, and the amount of profit that the patentee would have made (which involves separating fixed from variable costs[178]) to determine the availability and amount of lost profits.[179] These are all highly factually intensive inquiries upon which reasonable minds can differ. Reasonable royalty calculations are also highly complex.[180] The "analytical method" requires a court to apportion the infringer's profit projections

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[172] Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1317 (Fed. Cir. 2011) (rejecting the 25% "rule of thumb" approach to determining a reasonable royalty); *Lucent Techs.*, 580 F.3d at 1305 (rejecting a reasonable royalty award as unsupported by the evidence).

[173] *See* Golden, *supra* note 2, at 563.

[174] By focusing on actual, subjective costs of invention and commercialization, where known, this proposal differs from Abramowicz and Duffy's suggestion for an "inducement" approach to non-obviousness, which would follow an objective standard. Abramowicz & Duffy, *supra* note 11, at 1621. A salutary implication of this proposal is that so-called patent trolls, which amass patent portfolios but do not manufacture patented goods, would recover relatively little given that they do not bear significant commercialization costs.

[175] *See supra* Part II.A.2.

[176] Taylor, *supra* note 14, at 160.

[177] *See* Blair & Cotter, *supra* note 3, at 22 (noting that the adoption of cause-in-fact and proximate causation in damages calculations requires a "greater degree of economic sophistication").

[178] Tate v. Tate, 575 F.2d 1152, 1156 (6th Cir. 1978); *see* Lemley, *supra* note 54, at 659–60.

[179] *Tate*, 575 F.2d at 1156.

[180] *Cf.* Cincinnati Car Co. v. N.Y. Rapid Transit Corp., 66 F.2d 592, 595 (2d Cir. 1933) ("The whole notion of a reasonable royalty is a device in aid of justice, by which that which is really incalculable shall be approximated, rather than the patentee, who has suffered an indubitable wrong, shall be dismissed with empty hands.").

between the patentee and the infringer,[181] and the fifteen-factor *Georgia-Pacific* test is notoriously complicated.[182]

Recent reforms have made reasonable royalty calculations even more difficult, as courts are more closely scrutinizing the evidence and economic rationale underlying such determinations.[183] As noted, in *Uniloc v. Microsoft*, the Federal Circuit rejected the well-established "25 percent" rule of thumb for calculating reasonable royalties,[184] insisting on a tighter fit between a proffered reasonable royalty and the economic dynamics of a potential licensing arrangement.[185] Furthermore, in *Lucent Technologies v. Gateway, Inc.*, the Federal Circuit vacated the jury's $358 million damages award because it was not supported by substantial evidence.[186] The Federal Circuit continued to emphasize analytical rigor in *ResQNet.com, Inc. v. Lansa, Inc.*, stating that "[a]t all times, the damages inquiry must concentrate on compensation for the economic harm caused by infringement of the claimed invention."[187] Other proposed reforms, such as apportioning the economic value of a patent relative to the prior art,[188] would also involve highly technical analyses. Any damages regime (including the present one) predicated on determining the value of a patent will be inherently contingent.[189] Notwithstanding concerns that judges struggle to make economic distinctions,[190] there is little indication that this proposal to calculate patentee compensation is significantly more complex than the current damages regime.

John Golden presciently outlines several difficulties of implementing a cost-plus approach to damages.[191] He notes the challenge of identifying and weighing pertinent technology development costs. Given a multifaceted, longstanding research and development program, it may be difficult to apportion particular R&D costs—including the cost of failed technologies—to particular patented inventions. Additionally, Golden notes the complexity of determining an appropriate rate of

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[181] Opderbeck, *supra* note 17, at 133.

[182] Georgia-Pac. Corp. v. U.S. Plywood Corp., 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970); *see* Durie & Lemley, *supra* note 3; *cf.* Heald, *supra* note 64, at 1194.

[183] Michael J. Kasdan & Joseph Casino, *Federal Courts Closely Scrutinizing and Slashing Patent Damages Awards*, 2010 PATENTLY-O PATENT LAW JOURNAL 24, 28.

[184] Uniloc USA, Inc. v. Microsoft Corp., 632 F.3d 1292, 1317 (Fed. Cir. 2011).

[185] *See* Jonathan A. Muenkel & Amar A. Mehta, *Uniloc v. Microsoft: The Federal Circuit's Continued Efforts at Patent Damage Reform*, 3 LANDSLIDE 10, 10 (2011).

[186] Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1335 (Fed. Cir. 2009); *see* Kasdan & Casino, *supra* note 183, at 29–33.

[187] ResQNet.com, Inc. v. Lansa, Inc., 594 F.3d 860, 869 (Fed. Cir. 2010); *see* Landers, *supra* note 69, at 168.

[188] *See* Patent Reform Act of 2007, H.R. 1908, 110th Cong. § 5 (2007); Opderbeck, *supra* note 17, at 134–35.

[189] Landers, *supra* note 69, at 166–67.

[190] J. Jonas Anderson, *Judicial Lobbying*, 91 WASH. L. REV. 401, 433 (2016); Letter from Paul. R. Michel, Chief Judge, U.S. Court of Appeals for the Fed. Circuit, to Patrick Leahy & Orrin G. Hatch, Senate Comm. on the Judiciary (May 3, 2007), *available at* https://perma.cc/G6VL-UJ5X.

[191] Golden, *supra* note 2, at 537–39.

return for investments in technological development.

While daunting, these challenges are surmountable. Indeed, in the context of the federal government's use of patented inventions, there is precedent for courts to adjust compensation based on the patentee's development cost.[192] Some of these difficulties, such as the need to rely on projections and the endogeneity of determining a "reasonable profit," have been addressed above.[193] Other commentators have also addressed the feasibility of certain aspects of cost-plus approaches, such as accounting for nonpatent incentives to reduce patentee recovery.[194] More generally, in defending an inducement theory of calculating damages, Ted Sichelman argues that "courts can hear evidence on R&D, testing, and commercialization costs (including the cost of failures); technological and market risk; increased profits versus baseline profits; the value of other patented components; the value of noninfringing alternatives; and so forth, in order to determine when injunctions and make-whole damages might lead to grossly excessive awards."[195] Such evidence can help courts determine appropriate invention, commercialization, and risk-adjusted opportunity costs to compensate the patentee. As noted earlier, this proposal would ameliorate some informational difficulties by placing the onus on the patentee to prove the amount of compensation needed to induce invention and commercialization.[196] Similarly, the defendant has the opportunity and incentive to counter that argument with its approximation of inducement costs.[197] This proposal thus puts the primary informational burden on the parties closest to the facts rather than on the courts.[198]

It is true that this proposal would enhance judicial discretion to shape compensation awards, thus increasing uncertainty.[199] Such discretion may raise concerns about separation of powers and democratic legitimacy given that courts would have significant power to determine damages.[200] However, courts have long exercised substantial discretion in determining patent infringement damages,[201] which has been further increased by recent Supreme Court rulings on awarding enhanced damages and attorney fees.[202] Furthermore, it again bears emphasizing that compensation would be capped by make-whole damages. When inducement

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192 *See, e.g.*, Leesona Corp. v. United States, 599 F.2d 958, 978 (Ct. Cl. 1979).

193 *See supra* Part II.B.

194 *See, e.g.*, Sichelman, *supra* note 2, at 311; Ouellette, *supra* note 18, at 204.

195 Sichelman, *supra* note 5, at 565; *see* Sichelman, *supra* note 2, at 309.

196 *See supra* Part I.A.2.

197 *Id.*

198 *See* Golden, *supra* note 2, at 564 ("The principle of devolution . . . emphasizes the value of leaving significant decisions and responsibility to private parties or government actors who operate on a finer scale than a high-level policy maker.").

199 *Cf.* Sichelman, *supra* note 5, at 562.

200 *See* Sichelman, *supra* note 2, at 307; *cf.* Michael S. Moore, *Four Reflections on Law and Morality*, 48 WM. & MARY L. REV. 1523, 1535 (2007).

201 Sichelman, *supra* note 2, at 307; Brennan et al., *supra* note 18, at 326.

202 *See* Halo Elecs. Inc. v. Pulse Elecs., Inc., 136 S. Ct. 1923 (2016); Octane Fitness, LLC v. ICON Health & Fitness, Inc., 134 S. Ct. 1749 (2014).

costs are highly indeterminate or a court cannot resolve conflicts between the patentee's and defendant's estimates, the court can always award full make-whole damages to the patentee as a backstop. Furthermore, the risk of gross inaccuracy in determining appropriate compensation is mitigated by the availability of review upon appeal. Under this proposal, courts would need to resolve significant methodological questions to calculate a patentee's compensation. Because such questions are discretionary in nature, courts would need to explain and justify their decisions and would be subject to review for abuse of discretion on appeal.[203] Among the difficulties of the current system of jury-determined damages, there is little exposition of findings, and such determinations are subject to deferential review for substantial evidence on appeal.[204]

There are, of course, a host of challenges associated with administering the patent surplus to fund technological research and development. This proposal raises the specter of government self-dealing, as it may incentivize courts to decrease the compensation received by a patentee relative to the infringer's damages, thus maximizing the patent surplus. However, several factors mitigate this concern. First, courts would not face a true incentive for self-dealing given that courts themselves would not retain the patent surplus; courts would allocate it to federal funding agencies, which would disburse it to researchers. Second, the prospect of self-dealing is further mitigated by the fact that courts would need to provide economic justification for their compensation and damages awards (more justification than juries currently provide), and their calculations would be subject to more searching review by appellate courts. The actual disbursement of money necessarily entails some administrative expense and overhead. Furthermore, interest-group lobbying may influence the allocation of these funds.[205] But mechanisms already exist for parties to apply for federal grants through competitive, peer-reviewed selection processes;[206] agencies could simply expand these existing practices to allocate the patent surplus.

C. Diminishing Incentives to Invent and Commercialize

A central critique of any proposal that decreases compensation for patentees is that it would diminish incentives to invent and commercialize.[207] Indeed, this

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[203] *See* Lucent Techs., Inc. v. Gateway, Inc., 580 F.3d 1301, 1310 (Fed. Cir. 2009) (subjecting a district court's decisions concerning the methodology of determining damages to review for abuse of discretion).

[204] *See* Durie & Lemley, *supra* note 3, at 632–33; *Lucent Techs.*, 580 F.3d at 1310 (noting that courts characterize a jury's determination of damages as a question of fact and review it for substantial evidence); Golden & Sandrik, *supra* note 8, at 346–47 (noting the dramatic rise in the use of juries in patent cases, which exacerbates concerns over accuracy in damages determinations).

[205] *Cf.* Rebecca Dresser, *Public Advocacy and Allocation of Federal Funds for Biomedical Research*, 77 MILLBANK Q. 257, 259 (1999).

[206] *See, e.g.*, Bhaven N. Sampat, *Mission-oriented Biomedical Research at the NIH*, 41 RES. POL'Y 1729, 1733–34 (2012) (describing NIH's peer-review process).

[207] *See, e.g.*, Brennan et al., *supra* note 18, at 321–22.

proposal will likely reduce such incentives for many patentees, as compensation for infringement may be less than make-whole damages paid by a defendant. Again, however, focusing on the normative aims of the patent system should mitigate this concern, for it is likely that traditional damages overcompensate patentees in many cases, particularly where sales and profits have already covered fixed costs of invention and commercialization as well as provided a substantial profit. After all, if the objective of the patent system were to maximize patentees' profits, it would offer high statutory damages or automatic trebling of damages.[208] Rather, the patent system attempts to strike a balance between inducing technological development and promoting access to technologies, and it seeks to provide just enough compensation to stimulate invention and commercialization and nothing more. Thus, a normatively faithful view of the patent system may indeed decrease incentives for particular patentees.[209]

More importantly, this proposal does not decrease incentives to invent and commercialize as much as shift them between different types of innovative activity. Government funding agencies would allocate the patent surplus to support other forms of research and development, consistent with the aims of the patent system.[210] As noted, these funds can support upstream research that benefits entire industries or targeted areas of technological development that the patent system and the market tend to neglect.[211] Furthermore, under one variant of this proposal, the government would allocate the patent surplus to compensate patentees for whom make-whole damages provide inadequate compensation, for instance for technologies of high social value but relatively low private value. Thus, for a certain class of actors, this proposal would actually *increase* incentives to invent and commercialize new technologies.

D. Discouraging Litigation and Encouraging Market Entry

A related concern is that this proposal would decrease incentives for patentees to sue potential infringers, thus decreasing inducement incentives and encouraging market entry. This proposal, unlike others that simply reduce the infringer's damages to cover a proportional share of the patentee's inducement costs, maintains

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[208] Interestingly, an early patent statute automatically trebled damages for any type of infringement, but the patent system soon abandoned that practice. *See* Act of Apr. 17, 1800, ch. 25, 2 Stat. 37, 38, § 3; Blair & Cotter, *supra* note 3, at 5.

[209] Modifications of this proposal could shore up incentives to invent even for patentees subject to inducement cost compensation. For instance, with total compensation capped at inducement costs, policymakers could more comfortably extend the patent term or expand patent scope, thus maintaining robust incentives to invent and increasing the chances that damages would reimburse all inducement costs. *Cf.* Abramowicz, *supra* note 125, at 160 ("A working cost-plus damages system would make it feasible to grant broad patent scope without granting powerful monopoly rights."); Ayres & Klemperer, *supra* note 13, at 1001–02 (suggesting coupling probabilistic patent enforcement with term extensions).

[210] As explained more fully below, the patent surplus may not arise if the patentee and infringer settle, which is one potential (salutary) outcome of this proposal. *See infra* Part III.E.

[211] *See supra* Part II.B.

fairly robust deterrence incentives by requiring infringers to pay full make-whole damages. However, under this proposal, patentees would still have reduced incentives to bring infringement suits, given that they would only receive inducement costs and not full make-whole damages as compensation. Thus, this proposal threatens to discourage litigation, encourage market entry, and ultimately diminish incentives to invent and commercialize. For a variety of reasons, however, this concern is either misplaced or overstated.

First, at a theoretical level, more market entry is not necessarily problematic as long as it does not unduly hamper incentives to invent and commercialize. The most controversial type of market entry encouraged by this proposal is uncompensated infringement. However, if a patentee is reluctant to sue an infringer because it has already made substantial profits, thus covering inducement costs and encouraging similar investments in the future, then competition to bring down price and increase access during the patent term eliminates some static inefficiency while not overly diminishing dynamic efficiency.[212] While the prospect of actors "getting away" with infringement may offend some moral intuitions, this again reflects a property- or tort-based view of the patent system rather than conceiving of it as a regulatory scheme aimed at promoting technological progress.[213] Notably, courts have emphasized that damages should compensate patentees "without regard to the question whether the defendant has gained or lost by his unlawful acts."[214] The critical aim is to compensate the patentee appropriately, regardless of any windfall the infringer may enjoy.[215]

Beyond uncompensated infringement, this proposal also encourages market entry in the form of licensing—both *ex ante* licensing prior to using a patented technology and *ex post* licensing in the form of a settlement after infringement and the patentee has begun to enforce its rights. The prospect of defendants paying relatively high, make-whole damages while patentees receive relatively low inducement compensation encourages both kinds of licensing. Both types of licensing either avoid or lower litigation costs and promote competitive rent dissipation while still providing some remuneration to the patentee.

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[212] *Cf.* Ayres & Klemperer, *supra* note 13, at 986–87 (arguing that limited amounts of infringement can reduce *ex post* allocative inefficiency without reducing *ex ante* incentives to invent and innovate); Sichelman, *supra* note 5, at 557–58 (characterizing some kinds of infringement as "efficient breach" that diminishes deadweight losses associated with exclusive rights). *But cf.* Blair & Cotter, *supra* note 3, at 66–70 (challenging Ayres and Klemperer's thesis).

[213] *See* Ghosh, *supra* note 31, at 1315–16.

[214] Coupe v. Royer, 155 U.S. 565, 582 (1895); *see also* Georgia-Pac. Corp., v. U.S. Plywood-Champion Papers Inc., 446 F.2d 295, 296–97 (2d Cir. 1971) (reducing damages substantially because the district court did not adequately consider that the defendant would have negotiated for a residual profit in a hypothetical negotiation); Tektronix, Inc. v. United States, 552 F.2d 343, 351 (Ct. Cl. 1977) ("The proper measure [of damages] is what the [patent] owner has lost, not what the taker has gained.").

[215] *Cf.* Lemley, *supra* note 54, at 669 ("But the ultimate aim is not to mimic exclusivity, or to give patentees the full social value of their technology, but instead to set a rate that would have both compensated patentees and allowed users of the technology to make a reasonable profit.").

Notably, this proposal benefits from the self-correcting function of time. Early in the patent term, before a patentee has recouped inducement costs, the patentee has a strong incentive to bring a lawsuit against an infringer, as it can expect to receive the entire measure of make-whole damages as compensation. However, later in the patent term, the patentee's incentive to bring an infringement suit wanes, as the patentee's substantial profits reduce its amount of compensable outstanding inducement costs. This proposal thus dynamically calibrates a patentee's incentive to litigate to decrease as time and overall profits accumulate, and it accords with other suggestions to weaken intellectual property rights over time, even before expiration.[216]

Second, as a practical matter, litigation costs as well as potential enhanced damages and attorney fees may be available to deter infringement even when outstanding inducement costs are relatively low.[217] Although this proposal would calculate compensation to a patentee based on inducement costs, enhanced damages would still be available for egregious conduct on the part of defendants, most notably for willful infringement.[218] In *Halo Electronics v. Pulse Electronics*, the Supreme Court recently liberalized the test for finding willful infringement, emphasizing that district courts have discretion to award enhanced damages based on the "particular circumstances of each case."[219] Given the normative objective of deterring infringement—particularly willful infringement—under this proposal, courts would still have discretion to enhance damages for willfully infringing defendants. Furthermore, courts would have discretion to award some or all of these enhanced damages to the patentee as an inducement to bring suit in the first place, even if "ordinary" compensable inducement costs are relatively low. Similarly, the prospect of awarding attorney fees—which are usually substantial in patent litigation[220]—would both decrease incentives to infringe on the part of willful infringers and increase incentives to bring infringement suits on the part of patentees.

For similar reasons, concerns that patentees would have less incentive to vigorously litigate their theory of damages, whether lost profits or reasonable royalties, are not as acute as they might appear at first glance. Aside from diminished incentives to bring a suit at all, patentees may have diminished incentives to invest in legal services and expert witnesses to prove a high amount of

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216 *See, e.g.*, Justin Hughes, *Fair Use Across Time*, 50 UCLA L. REV. 775 (2003) (arguing that fair use should expand toward the end of a copyright term); Joseph P. Liu, *Copyright and Time: A Proposal*, 101 MICH. L. REV. 409 (2002) (arguing that courts should consider the passage of time in fair use cases).

217 *See* Blair & Cotter, *supra* note 3, at 42 (emphasizing the deterrent effect of litigation costs as well as potential enhanced damages and attorney fees).

218 35 U.S.C. § 284 ("The court may increase damages up to three times the amount found or assessed.").

219 Halo Elecs., Inc. v. Pulse Elecs. Inc., 136 S. Ct. 1923, 1934–35 (2016) (abrogating In re Seagate Tech., LLC, 497 F.3d 1360 (Fed. Cir. 2007)).

220 *See supra* Part II.A.1.

market-based damages by the defendant. After all, a patentee may only expect to receive outstanding inducement costs. However, several factors weigh against such an argument. First, even if a patentee would only expect to receive minimal damages, it may still highly value deterring another party's infringement of its patent, motivating vigorous litigation of its theory of lost profits or reasonable royalties. Second, it is likely that most patentees would also argue that significant fixed costs of invention and commercialization are still outstanding and that they should receive the full measure of make-whole damages from the defendant; as such, they still have incentives to argue forcefully for high damages awards, which they may receive if a court determines that normal profits have not recouped inducement costs.

One could argue that even if potential infringers are deterred from infringing, they would still have an incentive to "lowball" patentees in licensing negotiations. After all, patentees would receive only inducement compensation, thus giving infringers significant leverage in licensing negotiations. Several mechanisms already mentioned, however, mitigate this concern. First, patentees can still threaten to hold defendants liable for full make-whole damages. Furthermore, patentees have the leverage of treble damages and attorney fees in situations where a prospective licensee chooses to infringe instead.

E. Splitting the Patent Surplus

Another potential objection to this proposal is that patentees and infringers would game the system by simply splitting the patent surplus through settlement. For instance, if a patentee and infringer were nearing the end of trial, and it appeared that the infringer would face substantial make-whole damages while the patentee would recover modest outstanding inducement costs, the parties would have an incentive to settle at some figure between these values, thus eliminating the patent surplus. This objection could be addressed in several ways. First, if the settlement occurred after the start of litigation, courts could be required to approve any such settlement before it takes effect. While American jurisprudence typically favors settlement as private ordering that avoids litigation costs, courts must authorize settlements in some instances. For example, courts must approve settlements in class action suits before they are legally binding,[221] ostensibly to ensure the fairness of the outcome to the parties involved.[222] Analogously, this proposal could implement a rule stating that courts must approve settlements, perhaps out of a policy interest in maintaining a patent surplus in some cases.

As a general matter, however, the tendency of decoupling to encourage settlement is a feature rather than a bug. One of the primary strengths of decoupling

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[221] Fed. R. Civ. P. 23(e); *see* Andrew Rosenfield, *An Empirical Test of Class-Action Settlement*, 5 J. LEGAL STUD. 113, 115 (1976).

[222] *See* Fed. R. Civ. P. 23(e)(2) ("If the proposal would bind class members, the court may approve it only after a hearing and on finding that it is fair, reasonable, and adequate.").

regimes in general is that they promote settlement.[223] This benefit is especially valuable in the context of patent litigation, which is unusually expensive and represents a significant drain on judicial and innovative resources. More substantively, splitting the patent surplus also promotes greater market entry relative to the status quo, thus producing competition that tends to decrease prices and increase access to patented technologies. Given the benefits of avoiding litigation and increasing market entry, settling and splitting the patent surplus is a benefit of decoupling damages paid from compensation received.

F. Why Not Just Pay Inducement Damages?

Critics might argue that this proposal undermines its own purpose. After all, one of the aims of compensating patentees for inducement costs (and not providing full make-whole damages) is to promote more competitive entry, thus dissipating rents, reducing prices, and increasing access to technology. However, the prospect of paying full make-whole damages deters potential infringers from entering the market. Critics may contend that this proposal leads to the worst of both worlds: decreased incentives to invent and commercialize with high barriers to entry in the form of make-whole damages. Going further, commentators have argued in favor of "pure cost-plus" reforms to patent damages in which infringers pay to cover inducement costs, thus maintaining incentives to invent and commercialize but reducing (in most contexts) expected damages, thus promoting entry. In other words, infringers should just pay a proportional amount of "inducement damages" rather than make-whole damages.

This Article offers four responses to such criticisms. First, a pure cost-plus system raises the difficulty of apportioning compensation among multiple infringers over time. If, for instance, a patentee has $100 million in outstanding inducement costs, and a defendant commits infringement to the tune of $10 million in make-whole damages, what is the appropriate amount of compensation that that infringer should pay? Certainly, it would be grossly excessive to hold the infringer liable for the entire $100 million, particularly because later infringers should bear some liability for remaining inducement costs. But *ex ante*, there is no way of knowing if there will be later infringers, how many there will be, and what their magnitude of infringement will be. This gives rise to a serious apportionment challenge for such proposals.

Second and relatedly, a pure cost-plus approach may allow an infringer to bear liability for more than the economic harm caused by its patent infringement, particularly if inducement costs are relatively high.[224] Even if the universe of current and future infringers were presently known, thus addressing the apportionment

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[223] Polinsky & Che, *supra* note 24, at 563.

[224] *Cf.* Brennan et al., *supra* note 18, at 283 ("If appropriate evidence is supplied by the patentee, courts would then adjust this compensation award upwards to account for the patentee's risk-adjusted R&D costs and to ensure a reasonable profit.").

issue, dividing outstanding inducement costs among these infringers could yield damages grossly incommensurate to the economic harm of infringement. To return to our example, suppose that a patentee has $100 million in outstanding inducement costs, and there are five current and future infringers, all of whom commit infringement to the tune of $10 million each in make-whole damages. To compensate for outstanding inducement costs, each of the five infringers would have to be liable for $20 million in damages, which is grossly disproportionate to the actual economic value of their infringement. In their pure form, "proportional cost-plus" recovery regimes lack a limiting principle (other than the patentee's outstanding costs) for constraining damages awards. This may lead to grossly unjust damages awards. Furthermore, as others have noted, pure cost-plus regimes create incentives for patentees to inflate (or not economize on) technological development costs.[225] This proposal establishes an intuitive ceiling for a defendant's liability: the market value of its infringement as measured by make-whole damages.

Third, critical to understanding the operation of this proposal is that actors in the patent system engage in probabilistic decision making against a backdrop of sometimes uncertain legal rules. This proposal has assumed the status quo of the availability of injunctions and advocates imposing make-whole damages on defendants. While this would seem to strictly deter infringement, thus eliminating the supposed benefit of competitive market entry, it offers less deterrence than the status quo. Whether a market actor infringes is a complicated calculation based on its awareness of a patent, the actor's assessment of the patent's validity, the probability of detection, the probability of litigation success, and the chances of facing an injunction and/or high damages upon a finding of infringement. To this calculus, this proposal adds the complicating factor that patentees would only receive inducement costs as compensation, thus reducing their incentive to sue. Therefore, even though this proposal maintains the current system's availability of injunctions and make-whole damages for defendants, it encourages an uptick in competitive market entry by infringers relative to the status quo, thus decreasing deadweight loss. In short, this proposal alters the game-theoretic calculus for potential infringers and nudges the expected returns of infringement a bit higher.

Fourth, the subtle benefits of this proposal compared to pure cost-plus regimes lie in recognizing that any cost-recovery calculations will frequently be incorrect.[226] As mentioned, calculating inducement costs will necessarily involve projection, speculation, and discretion.[227] The question then becomes: given that errors will occur, should those errors systematically weigh toward overcompensating or undercompensating patentees? As Michael Abramowicz observes, the potential downside risk of providing insufficient compensation is significant.[228] If the

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[225] *See* Abramowicz, *supra* note 125, at 140–41; Sichelman, *supra* note 2, at 313.

[226] *Cf.* Ouellette, *supra* note 18, at 206–07.

[227] *See supra* Part II.A.2.

[228] Abramowicz, *supra* note 125, at 146 ("The case . . . for a reward system that seeks to reimburse risk-adjusted research-and-development costs in any technological domain, thus depends on

permitted rate of return is too small, "many inventors who might have invented might choose not to invent at all, because they anticipate earning back less than their risk-adjusted returns."[229] While permitting an excessive rate of return is also problematic,[230] Abramowicz's analysis suggests that, within certain parameters, it is better to overcompensate rather than undercompensate patentees. Abramowicz's computer simulations reveal that the optimal damages regime may be a hybrid of make-whole damages and cost-plus recovery.[231] Coincidentally, this "sweet spot" is precisely where licensing negotiations are likely to fall where patentee compensation is limited to inducement costs but infringers face the prospect of paying make-whole damages, as this Article proposes.[232] Put differently, the settlements that patentees and infringers are likely to reach will represent a hybrid of make-whole damages and inducement recovery. Thus, in an indirect fashion, distinguishing damages paid from compensation received utilizes private ordering to nudge the patent system toward an inducement-recovery framework while mitigating the significant downside risk of undercompensating patentees.

V. Conclusion

This Article has proposed separating damages paid by an infringer from compensation received by a patentee. It does so to better serve the multiple, sometimes conflicting normative objectives of the patent system and infringement damages. On the one hand, the patent system seeks to provide enough incentive to induce the invention and commercialization of new technologies—and nothing more. The current regime of make-whole damages, which is based on the market value of technologies rather than the actual and opportunity costs of technological development, likely overcompensates patentees in a significant number of cases. Thus, this proposal tailors compensation for instances of infringement to a patentee's outstanding inducement costs. On the other hand, the patent system also endeavors to deter infringement and shunt would-be infringers into voluntary licensing of patents by imposing make-whole damages. This proposal helps ensure that infringement is not more economically favorable than licensing by maintaining the current regime in which defendants are liable for make-whole damages upon a finding of infringement. Courts and funding agencies would allocate any patent surplus—the difference between damages paid and compensation received—toward research and development, thus advancing the overarching aims of the patent system.

An inducement approach to damages offers many benefits. First, it better

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whether the government can be expected to make its estimates sufficiently accurately that the profit and error margin it allows will be enough not to dissuade even a small percentage of inventions.").

229 *Id.* at 182.

230 *Id.*

231 *Id.* at 178.

232 How the patentee and infringer split the patent surplus, of course, remains to be seen, but the final "equilibrium price" of infringement will fall between these amounts.

aligns the law of damages with the normative aims of the patent system. To the extent that current doctrine provides greater compensation than would be necessary to induce invention and commercialization, it may systematically overcompensate patentees and exacerbate allocative inefficiencies long-associated with exclusive rights. Second, this proposal also deters infringement, promotes the accuracy benefits of voluntary licensing, and mitigates the social costs of litigation. Third, rather than simply reducing incentives to invent, this proposal shifts such incentives to areas of technological development neglected by markets and the patent system.

Of course, the devil is in the details, and this proposal must contend with several objections. While reform to the damages statute may be preferable, there is significant flexibility within that statute to accommodate bifurcating damages paid from compensation received. This proposal mitigates some of the complexity of calculating inducement costs by placing the onus on patentees to show relevant and recoverable expenses. While this proposal may encourage some uncompensated infringement, this is a feature rather than a bug, and remedies such as enhanced damages and attorney fees are available to curb rampant willful infringement. Although patentees and infringers will predictably settle in many cases, thus eliminating the patent surplus, this outcome still produces more competitive entry than the status quo. Finally, this proposal harnesses private ordering to safeguard against undercompensating patentees by encouraging patentees and infringers to settle at some compensation between make-whole damages and full inducement costs. Although a radical proposal, decoupling damages paid from compensation received may provide some valuable insights for an area of law in need of reform.